ESCAP Technical Paper

Green ICT:

A "Cool" Factor in the Wake of Multiple Meltdowns

Turning threats into opportunities:

Promoting green ICT for socio-economic should be the least effecteded and could continue to get worse development in Asia and the Pacific

Green ICT:

A "Cool" Factor in the Wake of Multiple Meltdowns

ESCAP Technical Paper

Information and Communications Technology and
Disaster Risk Reduction Division

Green ICT: A "Cool" Factor in the Wake of Multiple Meltdowns

Prepared by Preminda Fernando and Atsuko Okuda

Authorized for distribution by Xuan Zengpei

December 2009

Abstract

EXECUTIVE SUMMARY

In recent years, Asia and the Pacific has been rocked by a series of crises, ranging from sudden increases in food and fuel prices to the deep Economic Crisis in the context of growing threats of climate change. ESCAP member countries have been grappling with urgent measures, responses and actions to deal with all of them at the same time, while addressing other socio-economic development issues and poverty reduction. In order to address the current global Economic Crisis, a number of countries pledged stimulus packages and increased government spending to sustain economies. Some countries went a step further to announce what is labeled as a "Green Stimulus Package" to ensure that environmental aspects are taken into account in dispensing the packages.

This report is prepared to bring to the attention of decision and policy makers that ICT, in particular green ICT, has an important role to play in stimulating economic activities, advancing social development goals and promoting sustainable development. In this report, "Green and cool ICT" is defined as ICT which, as a result of usage, produce comparatively low levels of carbon emissions while having the potential to exponentially reduce emissions in other areas by catalyzing technological, institutional and behavioral change, while bringing forth socio-economic benefits.

Using the green growth premise of inter-linked social, economic, and environmental systems, this paper evaluates and analyses how "green and cool ICT" initiatives and applications, such as mobile communications, videoconferencing, e-government and dematerialization of content, can play a major role in reducing CO2 emissions, and ensuring sustainable development and green growth in order to meet development goals and improve quality of life in Asia and the Pacific. This report also takes into account requirements for socio-economic development among the Least Developed Countries (LDC), Landlocked Developing Countries (LLDC) and Small Island Developing Countries (SIDS) in the region.

Against this background, this report reviewed some of the findings from existing research on green and cool ICT, such as below, to base the discussion of this report on:

- Approximately 7.8 $GtCO_2e$ (Gigatonnes of CO_2 equivalent) emissions can be reduced by 2020 through proper ICT deployment; this is estimated to be 15% of emissions in 2020 based on BAU (business as usual) estimates which would amount to approximately $946.5 billion in cost savings.

- Using technology to dematerialize the way people work in public and private sectors has the potential to reduce 500 MtCO2e in 2020 which is equal to the total ICT carbon footprint in 2002.

At the same time, the report argues, among others, that

- Many countries in the region may not have taken into consideration environmental impacts – both positive and negative – in designing, implementing and evaluating ICT policies and initiatives in the region.

- Overall benefits of green and cool ICT would be realized with a critical mass of users, economies of scale for producers and service providers, and enabling policy environments.

- The potential cost savings of green and cool ICT applications, such as videoconferencing resulting from local and trans-border travel reductions, cannot be realized without having adequate infrastructure to make a conversation effective enough to make it a viable substitute.

- Taking into consideration the current ICT development and affordability, accessibility and relevance to LDCs, LLDCs and SIDS, the report reviewed mobile communication, e-government and video-conferencing as green and cool ICT which could bring environmental, social and economic gains.

The report then concludes with the following recommendations to accelerate the introduction of green and cool ICT to the mainstream of ICT for development in particular and overall development discourse in general. Conventionally, ICT initiatives have been designed to address socio-economic challenges of our member countries, ranging from providing better public services to under-serviced rural population to creating better business and employment opportunities through e-business and e-commerce. This report recommends that policy and decision makers should also include environmental concerns in designing, implementing and evaluating ICT initiatives, and those initiatives which address all socio-economic-environmental factors should be given a priority, to be included in green stimulus packages and government spending in the coming months and years.

1) Create an enabling ICT policy framework

It was concluded that government has a significant role to play in promoting green and cool ICT, including the following:

- Reflect environmental concerns, such as less use of materials and energy, in the ICT policy, strategy and initiatives

- Assess ICT infrastructure, products and services against socio-economic-environmental criteria when purchasing

- Prioritize mobile communication and applications and videoconferencing as green and cool ICT, wherever possible in government spending and ODA-funded projects

- Establish a Centre of Excellence

- Promote evaluation of ICT policies, strategies and initiatives against environmental concerns, including GHG emissions reduction

- Encourage investments in green and cool ICT infrastructure

- Support pilot projects

2) Support the business case when markets do not produce the desired outcome

Since green and cool ICT is a new concept, the private sector companies might not be aware of a need for taking into consideration environmental concerns. Thus, creating

incentives for the private sector to invest in green and cool ICT might accelerate the development of a market.

- Encourage more research and studies on other green and cool ICT at the national level
- Raise awareness on market potentials for green and cool ICT among the private sector companies
- Create right financial incentives to encourage the development of private sector specialized in green and cool IT products and services
- Encourage green and cool ICT procurement by the public and private sectors

3) Encourage positive behavioral change among end users

This report also highlighted that existing ICT initiatives and equipment could go a long way in reducing energy and material consumption if certain behavioral changes are introduced and conformed to by end users. On the other hand, introducing and expanding green and cool ICT applications, such as e-government, only to print out more forms and documents, would not bring the maximum benefits.

- Government agencies lead by example by setting a target in reducing use of materials and establishing necessary procedures, such as introducing travel substitution and more videoconferencing
- Government, academia and mass media facilitate and coordinate the sharing of information, good practices and lessons learned in ensuring awareness raising on green and cool ICT.

CONTENTS

ANNEXES

List of Tables

List of Figures

ABBREVIATIONS

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
BAU	Business as Usual
CAGR	Compound Annual Growth Rate
CO2	Carbon dioxide
CIF	Climate Investment Funds
COAG	Council of Australian Governments
CTF	Clean Technology Fund
ESCAP	Economic and Social Commission for Asia and the Pacific
FEMA	Federal Emergency Management Agency
GDP	Gross Domestic Product
GHG	Green House Gas
GtCO2e	Gigatonnes of CO2 Equivalent
ICT	Information and Communication Technology
IP	Internet Protocol
IPCC	Intergovernmental Panel on Climate Change
ISDN	Integrated Services Digital Network
IT	Information Technology
ITU	International Telecommunication Union
Kbps	Kilobit Per Second
Kg	Kilogram
LAN	Local Area Networks
LCD	Liquid Crystal Display
LDCs	Least Developed Countries
LLDCs	Landlocked Least Developing Countries
MtCO2e	Megatonnes of CO2 Equivalent
MDB	Multilateral Development Bank
NGN	Next-Generation Network
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
PC	Personal Computer

PDA	Personal Digital Assistant
ROI	Return on Investment
SCF	Strategic Climate Fund
SFDCC	Strategic Framework on Development and Climate Change
SIDS	Small Islands Developing States
SMS	Short Message Service
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
W	Watts
WBG	World Bank Group
WMO	World Meteorological Organization
WSIS	World Summit on the Information Society
WWF	World Wildlife Fund

A. Background

It has been nine years since the turn of the millennium and these are times that will go down as milestones in human evolution. Characterized by the convergence of the worst economic crisis since the Great Depression, continuing food and fuel price fluctuations, and the effects of climate change, the repercussions of these "triple threats" are becoming more apparent and demand immediate and effective long-term solutions[1].

On the other hand, these threats are an opportunity to alter perspectives on development and the role of government and make some drastic and long lasting changes in the use of this global interlinked eco-system. Adding to this, rapid technological advancements in the past few decades are opening up avenues to improve quality of life and that of future generations. These opportunities should be recognized and leveraged to survive the rough seas ahead.

1. Climate change

It is hard to argue that the global eco-system is not under pressure due to climate change-related effects which are linked to greenhouse gas (GHG) emissions. Scientists have been debating how much GHG the world could emit in total and have warned that the world is on course for disaster. Even the most drastic emissions cuts currently being discussed stand little chance of limiting global warming to safe levels; two recent studies published in *Nature* by scientists in England and Germany have found prompting calls for radical rethinking on how to tackle climate change. These studies predict that if present emissions and trends continue, an estimated trillion tones of carbon dioxide will be emitted by the year 2050 which is enough to push the planet into a danger zone which could lead to catastrophic consequences[2].

The key to understanding climate change and developing mitigation methods is to realize that what matters most is the cumulative total of CO_2 emissions because it is the concentration of CO_2 and other GHGs that influence climate change[3]. Energy efficiency is at the heart of the climate change problem. The energy efficiency measures that are implemented will have to balance out the rapid economic growth that is predicted in the coming decade especially in the Asia-Pacific region. New energy infrastructure investments are urgently required to move towards cleaner energy

---

[1] ESCAP (2009), Economic and Social Survey of Asia and the Pacific 2009, http://www.unescap.org/survey2009/

[2] Nature (2009), Time to act, Vol. 458, Issue no. 7242, 30 April 2009, http://www.nature.com/nature/journal/v458/n7242/pdf/4581077a.pdf. The Nature journal is an international weekly journal.

[3] Intellect (2008), High Tech: Low Carbon – The Role of Technology in Tackling Climate Change. Intellect is the trade association for the UK Technology industry; see web link: www.intellectuk.org/hightechlowcarbon

production, but there is also much that can be done in reducing energy consumption, in changing agricultural practices and through land-use change to reduce carbon[4].

Carbon emissions can be considered as a result of market failure since the price does not include external effects of industrial production. In order to internalize these external effects, government intervention would be necessary. In this regards, inter-governmental discussions on climate change are currently rife, intended to pave the way for a deal on an international treaty on global warming to be agreed on in Copenhagen in December 2009 to replace the 1997 Kyoto protocol, which expires in 2012. To put it in economic terms, according to the Stern review[5], 1% of global gross domestic product (GDP) per annum should be invested in order to avoid the worst effects of climate change. Failure to do so might result in a 20% reduction in global GDP[6].

The impressively high economic growth rates over the past 20 years, resulting in the doubling of Asia Pacific regional GDP[7], was unfortunately driven by production processes which have generated high emissions and high levels of energy consumption. Though the over all poverty level in the region has reduced over the recent years[8], the characteristically high levels of poverty in the region makes it more vulnerable to climate change effects; the potential is there to break this vicious cycle through sustainable growth strategies that are based on good practices from other parts of the world[9].

Future growth rates and vulnerability levels in these less developed countries will depend not only on climate change but also on the type of development path that is pursued[10]. As the region begins to tackle the threats related to prevailing economic

---

[4] ITU (2007), ICTs and Climate Change ITU-T Technology Watch Report#3 December 2007, pp. 5

[5] The **Stern Review on the Economics of Climate Change** is a 700-page report released on October 30, 2006 by economist Lord Stern of Brentford for the British government, which discusses the effect of climate change and global warming on the world economy. Although not the first economic report on climate change, it is the largest and most widely known and discussed report of its kind.
http://en.wikipedia.org/wiki/Stern_Review#cite_note-0

[6] Climate Change Basics-24 Lessons Revealing the Fundamentals (2008), McGraw Hill Professional Education

[7] ESCAP (2008), Statistical Yearbook for Asia and the Pacific 2008, pp. xvii

[8] ESCAP (2008), Statistical Yearbook for Asia and the Pacific 2008, pp. xviii

[9] European Commission (2009), ICT and energy efficiency – The case for manufacturing,
http://ec.europa.eu/information_society/events/ict4ee/2009/docs/files/ec/ec/infso/g2/SmartManufacturing.pdf

[10] UNFCCC (2007), Climate change: Impact, vulnerability and adaptation in developing countries, pp.10
http://unfccc.int/files/essential_background/background_publications_htmlpdf/applicat

crisis and climate change and develops strategies to confront the combined pressures of increased demand for food, water, shelter, energy and other basic needs, it is increasingly clear that sustainable green growth is the way forward.

2. Green Growth

One of ESCAP's responses to the challenge of climate change and ensuring sustainable development is the Green Growth framework. By and large, green growth could be the answer to the prophesized impending climate change and global warming, as it promotes sustainable economic and social development[11].

According to the ESCAP studies, sustainable development is widely accepted as resting on the three interconnected areas: 1) economic growth, 2) social development, and 3) environmental sustainability. Understanding sustainable development also helps to develop a holistic and concrete vision of how to integrate the three areas of development into a coherent decision-making, planning and implementation processes at all levels of governance.

Growth is usually determined by market forces which for the most part do not take into account environmental costs. Climate change is the most glaring example of such market failure. As depicted below (Figure 1) the pillars of green growth are directly related to economic growth stimulators.

Figure 1: Pillars of green growth [12]

ion/txt/pub_07_impacts.pdf

[11] The concept of sustainable development first received global attention as a result of the work of the World Commission on Environment and Development and its report, also known as the Brundtland Report titled "Our Common Future" published in 1987. The World Summit on Sustainable Development held in Johannesburg in 2002 urged the global community to complete the formulation and elaboration of national strategies for sustainable development and begin implementation by 2005, as mapped out in the Johannesburg Plan of Implementation.

[12] ESCAP (2008), Green growing in Asia and the Pacific, http://www.greengrowth.org/download/2009/GG-28-05-09-2%5B1%5D.pdf

3. The Economic Crisis

Another crisis the region has been tackling is the economic crisis which started in 2008, sparked by rising defaults in subprime mortgages in the United States of America and triggered a global crisis. National economies in Europe, Africa, Asia and the Pacific alike have been suffering from various effects ranging from declining exports to closure of factories and increasing unemployment. Though the worst may be over and signs of recovery are gradually emerging, there is still mounting concern as to how deep and how long the repercussions will be felt.

Governments are responding to the economic crisis by lowering interest rates dramatically, in some cases down to almost zero, and billions of dollars in liquidity support and fresh capital is being injected into the banking systems around the world. Some argue that the London G20 summit (April 2009), which resulted in a substantial pledge of $ 5 trillion to counter the economic crisis, did not come with a concrete set of strategies as to how and when the money will be injected into the global economy[13].

B. Climate Change, Economic Crisis and ICT

In the face of these challenges and crises, ICT can play a major role in reducing the emissions of carbon dioxide and other GHGs, directly and indirectly through reduction in energy consumption and material inputs, while accelerating socio-economic development which is required by ESCAP member countries more than ever. The direct impacts of ICT on climate change – both negative and positive - are increasingly being recognized. ICT can increase efficiency in various socio-economic activities, which will be detailed later in the paper, while efforts to make ICT more energy efficient are also underway.

The ICT industry is undoubtedly feeling the effects of the Economic Crisis as are all other sectors of the global economy. The Organisation for Economic Co-operation and Development (OECD) Information Technology Outlook 2008 laments that the IT industry was likely to have only grown by 4% at most in 2008 compared to the high growth rates of previous years[14]. With the global economy worsening and business and consumer confidence plummeting, growth in this sector is expected to remain flat or probably decline during 2009. Well known IT research provider Gartner, forecasts IT and telecom spending will fall 6% this year due to the weak economic conditions. Gartner believes that total spending on telecom and IT hardware, software and services will fall to $3.2 trillion, down from $3.4 trillion last year. Earlier this year Gartner had projected a 3.8% decline in spending, but since the full impact of the

---

[13] The Economist (2009), "Banking on the fund-The G20 and IMF" published in, April 11, 2009. Vol. 391, Issue 8626; pg. 12;
http://proquest.umi.com/pqdweb?did=1676776271&sid=1&Fmt=3&clientId=22984&RQT=309&VName=PQD

[14] OECD (2009), OECD Information Technology Outlook 2008,
http://www.oecd.org/document/20/0,3343,en_2649_33757_41892820_1_1_1_1,00.html

global recession on the IT services and telecommunications sectors is still emerging, the forecast has been revised and could continue to worsen, or show improvements along the general improvement of economic conditions.

The computing hardware segment could be the hardest hit, with spending projected to shrink 16.3% while the software segment should be the least affected, with spending to drop only 1.6%[15]. However, Gartner released survey findings in April 2009, which indicate that the global economic crisis has not dampened green ICT as a priority issue for most organizations. More than a third of the total 620 survey respondents, who were selected due to their important role in their respective organization's green ICT programs, indicated that they had expected to spend more than 15% of their ICT budgets on green ICT projects. Accordingly, Gartner predicts that there will be a "continued focus on projects that improve energy efficiency and save money"[16].

Similarly, according to International Telecommunication Union (ITU) reports, there are good indications that some segments of the ICT sector will endure the tempest better than others. As with the Gartner forecast, ITU analysts believe that spending on software and IT services, including outsourcing, by governments and businesses is likely to continue as these are deemed as areas of critical importance for productivity improvement. Internet-related sales and investments in infrastructure, driven by demand for high-speed Internet from consumers and businesses, are also expected to be solid although some infrastructure investments may be delayed due to the prevailing credit crunch[17].

This ITU analysis presented in a report entitled "Confronting the Crisis" emphasizes ICT initiatives as vital services and suggests that the fixed line to mobile substitution may gain momentum in developed markets during a prolonged recession. The report also notes that long project lead times for the satellite industry means that it has been less affected in the short term; this segment has been characterized by strong recent growth in demand from developing countries[18].

The ITU report goes on to say that, as the established order is overturned due to the Economic Crisis, convergence in the ICT industry will accelerate, with the emergence of new players with new business models. Country's ability to navigate the economic calamity will depend on its ability to invest for the future and explore new opportunities to benefit from the eventual upturn. As an industry founded on

---

[15] Telecomasia.net (2009),
http://www.telecomasia.net/article.php?id_article=14104&id_cat1=5&utm_source=lyris&utm_medium=newsletter&utm_campaign=telecomasia

[16] CeBIT Australia (2009), GFC no dampener for Green IT,
http://www.gocebit.com.au/?q=news/gfc-no-dampener-green-it

[17] International Telecommunication Union (ITU) (2009), Confronting the Crisis: Its Impact on the ICT Industry, published in February 2009;
http://www.itu.int/osg/csd/emerging_trends/crisis/index.html

[18] International Telecommunication Union (ITU) (2009), Confronting the Crisis: Its Impact on the ICT Industry, published in February 2009;
http://www.itu.int/osg/csd/emerging_trends/crisis/index.html

innovation, the current turmoil will create prospects for emerging ICT companies supported by governments with clear vision and holistic policies, especially in such an area of green and cool ICT[19].

C. Objectives and Methodology

In this context, this study is intended to be a basis for policy makers to develop justifiable arguments as to why green and cool ICT should be recognized as a vital part of the massive stimulus spending that will take place in the region which will inevitably shape socio-economic growth for the next decade. In particular, this paper aims to raise awareness among ICT policy and decision makers on environmental impacts of ICT policies and initiatives, in addition to the need for consideration of socio-economic dimensions in the planning and implementation process.

At the same time, it should be noted that literature pertaining to ICT and their relationship to harmful emissions is still scarce; it is hoped that this paper will stimulate further discussions and research on the topic and dialogue between the environment and ICT communities on promoting green and cool ICT starts in earnest.

As such, this study first details what is defined as green and cool ICT, followed by why it is important now and which technologies, services and initiatives could be categorized as green and cool ICT. At the end of the paper, a list of recommendations is provided, based on the findings of the research.

A review of studies and research on the role of ICTs in reducing carbon emissions and promoting energy efficiency was also conducted for setting the context for this paper, while addressing socio-economic development challenges among ESCAP's developing countries. The literary review involved research on the web, text books, periodicals, and magazines.

It should also be noted that this paper does not take into account all environmental concerns of ICT services and initiatives. It is noted that e-waste and some production processes of ICT products might have adverse effects on the environment, but these issues are not discussed in this paper.

D. What is Green and Cool ICT?

"Green and cool ICT" is defined in this paper as ICT which, as a result of usage, produce comparatively low levels of carbon emissions while having the potential to exponentially reduce emissions in other areas by catalyzing technological, institutional and behavioral change.

It is important to mention that technological advancement is expected to play a major part in the amount of carbon emitted from hardware; as technology develops it is believed that emissions will reduce through energy efficiency gains and other means.

---

[19] International Telecommunication Union (ITU) (2009), Confronting the Crisis: Its Impact on the ICT Industry, published in February 2009; http://www.itu.int/osg/csd/emerging_trends/crisis/index.html

The word "green" is based on the green growth framework which is used to define sustainable development and the word cool stands for the potential of initiatives to reduce carbon emissions through harnessing the catalytic power of ICT.

Green ICT and Green IT are also common terms used in various publications and literature. These terms refer to more generic types of ICT and IT which are eco-friendly. The term Green ICT is also used in this paper when referring to generic eco-friendly ICT products and applications. However, when referring to products and applications which have the potential to exponentially reduce CO_2 emissions, the term green and cool ICT is used.

The green growth framework of inter-linked social, economic and environmental systems is used in this paper to evaluate and analyze how "green and cool ICT" products and applications can play a major role in stimulating economies, improving social conditions, and reducing CO_2 emissions in order to meet development goals and improve quality of life.

To define the "coolness" of ICT and to analyze the impact of ICT on emissions reduction, it is important to understand their direct and indirect effects such as 1) impact of a specific product itself 2) impact on the surroundings as a result of usage of that particular product, and 3) socio-economic and structural changes that its usage could result in.

There are two basic results that a particular ICT initiative, service or product can have in terms of carbon emissions. Some deployments can, even though they may reduce carbon emissions in the short-term, result in higher emissions over time. This type of utilization initiates new deployments, institutional structures (the way an office operates and work flow) and behavior that lead to increasing CO_2 emissions. The other more desirable scenario is when a particular deployment of green and cool ICT not only reduces consumption of materials and inputs but also consistently supports accelerated reduction of CO_2 emissions. These types of transformative solutions catalyze new deployments, institutional structures, and behavior that is conducive to decreasing CO_2 emissions (see Figure 2).

Figure 2: Definition of Green and cool ICT
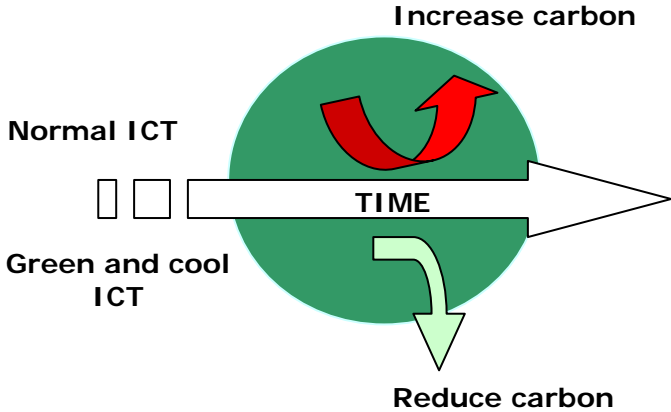
From the ICT perspective, green and cool elements could be assessed in various processes of:

- manufacturing, delivery, installation, use and recycling of ICT products
- development and delivery of ICT services, applications and content
- use of materials, such as paper, and energy consumption in the above processes

An area not discussed in this report in detail is e-waste. It is an important area of discussion and an avenue for opportunity as well as concern. This rapidly growing waste problem, more specifically toxic elements of ICTs such as lead, beryllium, mercury, cadmium, and flame retardants, pose both an occupational and environmental health threat. While consumption of ICT products are mostly in developed countries, the wastes are in some cases shipped to developing nations. According to a report, some 40,000 tons of used electronic equipment enter India every month and are routed to illegal electronic dump grounds. There are some positive aspects of the international trade in e-waste as they provide economic benefits to some of the handlers and importers in the developing countries. However, the risks associated with the trade are asymmetrical, requiring adequate regulations that enable monitoring and enforcement of standards and penalties in case of violations [20]. Improved manufacturing processes and material usage is also paramount in reducing e-waste while some would argue that the selling price of ICT products should reflect their actual costs including the environmental and social costs. For the sake of focus, this report will not analyze the e-waste related issues of the discussed green and cool ICT.

1. Criteria for Identifying Green and Cool ICT Initiatives

Against the above background, this paper aims to identify examples of green and cool ICT. Conventionally, ICT policies and initiatives are designed mainly from social and economic perspectives. This paper highlights the importance of addition of an environmental feature into the design of ICT policies and initiatives as summarized in Figure 3. This diagram can be used to conceptually prioritize ICT initiatives which could address concerns covered in the three aspects (environmental, social, and economical) depicted and promote investments in such technologies and initiatives as part of green stimulus packages and government spending.

Figure 3: Areas of benefit of ICT initiatives from a "Green Growth" perspective

Environmental benefits

[20] Digital review of Asia Pacific 2007/2008, at http://www.digital-review.org

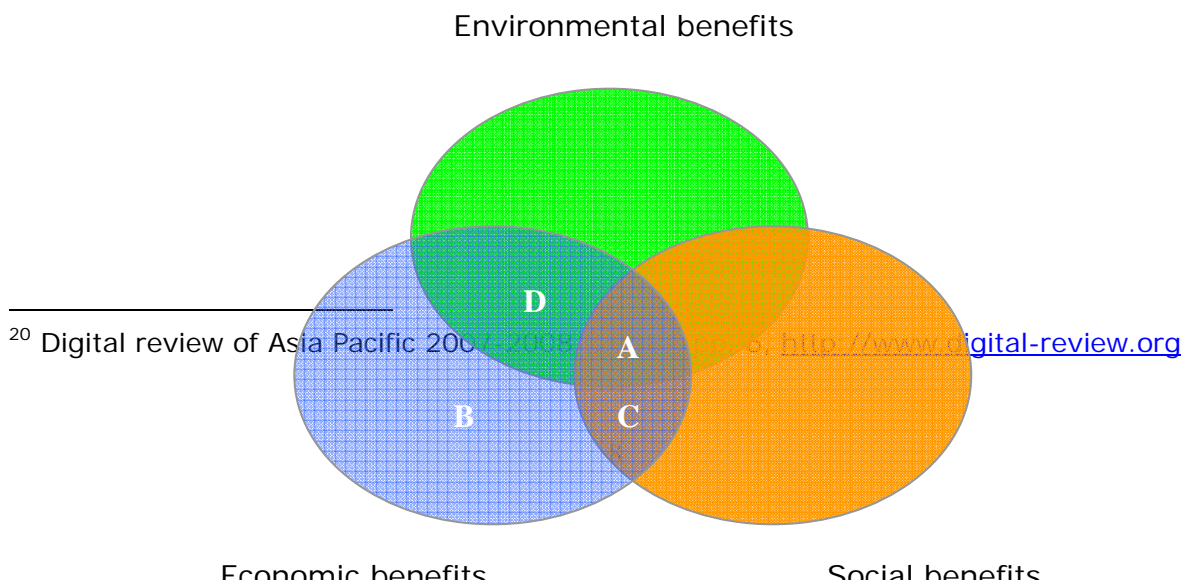Economic benefits   Social benefits

Figure 3 demonstrates that most ICT initiatives and deployments would fall in region B where economic benefits and financial returns are the main drivers. Some governments and companies may boldly venture to invest in deployments that either have economic and social benefits as in region C or economic and environmental benefits as depicted in region D. However, rarely does one find initiatives that fall in region A, the ideal region, where economic, social and environmental benefits converge.

The initiatives and products discussed in this paper fall in the A region. Though there are always negative implications to all actions, finding products and applications that have minimum negative impacts and capitalizing on their positive aspects will produce sound and tangible results which can truly be sustainable and drivers of growth and welfare.

A rigorous criterion was used to evaluate the ICT products and applications discussed in this paper. They were selected according to their ability and potential for:

1) Reduction of carbon dioxide emissions and promoting energy efficiency and dematerialization
2) Meeting development challenges of the region, such as rural development
3) Addressing financial and budgetary concerns without aggravating balance of payments or deepening debts
4) Enhancing long-term economic competitiveness
5) Enhancing development of the ICT industry which could support sustainable economic and social development

E. Why Green and Cool ICT Now?

This study argues that green and cool ICT is a timely topic in Asia and the Pacific due not only to climate change and associated debates on GHG emissions reduction but also to the Economic Crisis and urgent need to disburse the stimulus packages.

A serious by-product of the Economic Crisis is that many countries may opt for solutions which could be potentially harmful to the environment due to their limited consideration for environmental concerns or lack of adequate holistic planning. Instead of investing on integrating solutions based on green and cool technologies into Economic Crisis counter-measures, many countries might resort to a quick fix and get left behind as other more visionary states go for more long term solutions. This type of situation can be viewed as the "sum of all fears" where one crisis (economic) may catalyze another crisis (climate change) which in-turn will cause a downward spiraling effect whereby the end result is a worst case scenario.

Green spending is a reality and must be tapped into. It's already happening in some parts of the Asia-Pacific region and other parts of the world. Various responses to the Economic Crisis and need to promote green growth are converging in the form of green stimulus packages announced by various ESCAP member countries. The countries that are leading the push towards green growth and the respective green allocations are given in Figure 4. The measures being implemented in the Asian and Pacific countries, such as the Republic of Korea, China and Japan, are focused on energy efficiency, green jobs, energy efficient transport and buildings.

Figure 4: Green Measures as a Percentage of Total Stimulus spending in selected countries

Country	Green Measures as a Percentage of Total Stimulus	In billions	
		Amount Spent on Green Measures	Amount Spent on Fiscal Stimulus
Republic of Korea	81%	$ 30.70	$ 38.10
European Union	59%	$ 22.90	$ 38.80
China	38%	$ 221.30	$ 586.10
United States of America	12%	$ 112.30	$ 972.00
Australia	9%	$ 2.50	$ 26.70
United Kingdom	7%	$ 2.10	$ 30.40
Japan	3%	$ 12.40	$ 145.90

Source: Financial Times[21]

In addition to these green stimulus packages, ESCAP's developing member countries pledged increased government spending to sustain their economies and substitute declined exports and demand. In the process of planning the disbursement of the funds, policy and decision makers must consider whether current responses are going to create a post-recession economy that is sustainable and competitive in the medium to longer term. Would anyone disagree that it is efficient and wise to invest now to build future sustainability, whilst stimulating the economy for growth, jobs and tackling poverty?

In addition to the need to balance immediate economic concerns and long-term sustainable development gains in disbursing green stimulus packages, the region should also address concerns related to underlying socio-economic challenges, such as need to further develop infrastructure. While the Asia and Pacific region powers the world economy out of recession, pressures on the environment are being felt increasingly as consumption revives. Therefore, greening of businesses and sustainable consumption remain the core prerequisites for meeting both human welfare and

---

[21] The Financial Times (2009), *"Which country has the greenest bail-out?" (March 2009) see web link:* http://www.ft.com/cms/s/0/cc207678-0738-11de-9294-000077b07658.html. FT.com is the online portal for The Financial Times, one of the world's leading business news organizations.

environmental protection needs and it is high time to take a holistic approach and decisive actions. Green ICT is the way forward in this regard because their potential to increase efficiency, while enabling social benefits, and offer economic competitiveness are the crux of their positive contribution to sustainable development.

In countries where green investments are low or even non-existent, it maybe time to reconsider priorities and to embark on more ambitious and forward thinking spending strategies. Funding mechanisms which are targeted at efficiency improvement must be tapped in order to improve ICT infrastructure, applications and content development and most importantly show-case ICT as being part of the solution to overcome the crisis and ensure sustainable development.

The UN Secretary General, Ban Ki-moon, outlined several priority areas needing attention to deal with the current global situation, including the inter-linkage between economic growth and climate change[22]. The United Nations issued a Global Green New Deal Policy Brief prior to the G20 meeting of world leaders in London in early April 2009. The brief asserts, echoing the renowned Stern review, that investing one per cent of global GDP, or around $750 billion, into the below five key sectors could be the answer to a Global Green New Deal[23]:

1. Improving the energy efficiency of old and new buildings
2. Increasing the viability of renewable energy including wind, solar, geothermal, and biomass
3. Development of sustainable transport including hybrid vehicles as well as high speed rail and bus rapid transit systems
4. Preserving the planet's ecology including freshwater sources, forests, soils and coral reefs
5. Developing sustainable agriculture including organic production

Green and cool ICT leveraged to augment progress in these five areas could play an important role in reviving the global economy and boosting employment while accelerating the fight against climate change, environmental degradation and poverty.

During the Great Depression seventy-five years ago, US President Franklin D. Roosevelt (who coincidentally was the creator of the name "United Nations" [24])

---

[22] UNEP (2009), http://www.unep.org/greeneconomy/index3.asp

[23] The Green Economy Post (2009), The UN's Five Sectors Key to Sustainable Recovery and The Global Green New Deal, March 2009; see web link: http://greeneconomypost.com/united-nations-ustainable-recovery-global-green-new-deal-policy-brief-1078.htm

The UN Secretary General also launched a new group consisting of business leaders and experts who will advise him on energy and climate change challenges, particularly in identifying key issues in the run-up to the major UN conference to be held in Copenhagen in December 2009 intended to result in a new global pact and action plan for combating climate change (UN News Centre).
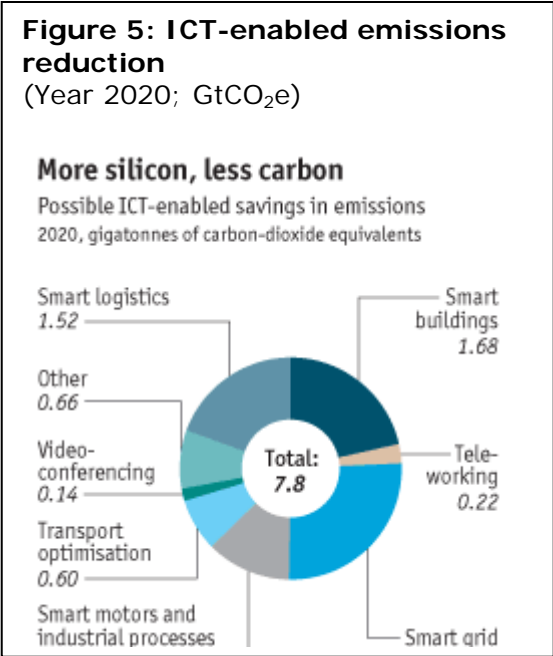
[24] UNDESA (2007), A Guide to a Career with the United Nations, pp.8

launched an ambitious effort called the "New Deal" intended to increase employment, provide social security, reform tax policies and business practices, and stimulate the economy through the construction of homes, hospitals, schools, and other public buildings, roads, dams, and electrical grids. Though Roosevelt's plan created millions of jobs, it was not just about fiscal spending and employment generation but also about a policy framework of governance that modernized US infrastructure which lasted for the rest of the twentieth century[25]. Similarly, this could be the time to seize the opportunity to bring about tomorrow's sustainable growth by investing wisely today.

1. ICT's Role in Reducing Carbon Emissions

This section examines various aspects of green and cool ICT in more detail. Whether good or bad, over the last decade ICT has transformed the way of life and is becoming a part of the daily routine. An independent prediction put the ICT sector as a strong growth sector for years to come[26]. A number of publications and research have attempted to pin-point the long-term benefits of ICT on sustainable development, and linked ICT use and productivity as well as economic growth[27].

Equally, there is a transformation that is happening in all areas of the ICT industry where the role of ICT in combating climate change is receiving sustained attention. People are discussing green ICT in different political and business fora and conferences. The industry press chatter is complaining that the attention and discussion continues to focus more on problems rather than potential solutions. Push strategies for ICT sales increases during economic downward times are very apparent. However, the potential for socio-economic development and carbon reduction by the effective use of ICT must not be overlooked by distaste for the hype.

This swelling discourse about the importance of analyzing the impact of ICT on global warming is sparking new and encouraging studies. Based on expected growth in the sector, several studies have boldly attempted to quantify emissions associated with ICT products and services. Though the figures

Figure 5: ICT-enabled emissions reduction
(Year 2020; GtCO$_2$e)

More silicon, less carbon
Possible ICT-enabled savings in emissions
2020, gigatonnes of carbon-dioxide equivalents

Smart logistics 1.52
Other 0.66
Video-conferencing 0.14
Transport optimisation 0.60
Smart motors and industrial processes
Smart buildings 1.68
Tele-working 0.22
Smart grid
Total: 7.8

http://www.unep.org/pdf/A_Global_Green_New_Deal_Policy_Brief.pdf

[26] Articlesbase (2009), Opportunities Abound For ICT Sector Despite Slowdown, http://www.articlesbase.com/business-articles/opportunities-abound-for-ict-sector-despite-slowdown-785914.html

[27] InfoDev (2007), ICT, innovation, and economic growth in transition economies, http://www.infodev.org/en/Publication.553.html

stated in these reports may be estimates, it is a good starting point to analyze the impact of ICT on emissions and to start looking at the bigger picture of where ICT plays a significant role in reducing emissions of other sectors.

According to the Smart 2020 report, aside from emissions caused by deforestation, power generation and fuel used for transportation are the largest contributors to man-made GHG emissions. Therefore, it is very clear that one of the vital roles of ICT is in helping to improve energy efficiency in power transmission and distribution (Smart grids), in factories and buildings (Smart buildings) that require power to operate, and in transportation (Smart logistics) related use (see **Error! Reference source not found.**). These strategic CO_2 reduction areas could include smart city planning, improved appliance and motor system performance, smart industry and efficient and intuitive grids, smart work in energy efficient buildings, dematerialization of services and reduced travel[28]. By using simulations and optimizing envelope measures, improved ventilation and passive solar heating techniques, buildings can be more energy efficient[29]. Leading ICT manufacturers have developed specialized algorithms to calculate the actual ventilation and heating requirements of buildings such as government offices, banks, hospitals, industrial sites and schools where by many thousands of CO_2 emissions are saved over a given period[30].

The Smart 2020 study estimates that approximately 7.8 $GtCO_2e$ emissions can be reduced by 2020 through proper ICT deployment; this is estimated to be 15% of emissions in 2020 (estimated at 51.9 $GtCO_2e$) based on BAU (business as usual) estimates which would amount to approximately $946.5 billion in cost savings due to saved electricity and fuel consumption (smart grids etc.)[31]. The amount of reductions and saving discussed in the Smart 2020 report, if realized, could have a massive impact.

Overall green ICT advantages, according to the Smart 2020 study, are that they:

- Provide information in standard forms on energy consumption and emissions, across sectors while incorporating monitoring information into the design and control of energy use;

[28] The word "Smart", which is used extensively in the Smart 2020 report referenced in this paper, is used to indicate the use of ICT in various areas to further improve efficiency resulting in reduced emissions.

[29] WWF (2008), Identifying and assessing the opportunities to reduce the first billion tonnes of CO_2 - The potential global CO_2 reductions from ICT use, pp. 26 http://assets.panda.org/downloads/identifying_the_1st_billion_tonnes_ict_academic_report_wwf_ecofys.pdf

[30] Intellect (2008), High Tech: Low Carbon – The Role of Technology in Tackling Climate Change, pp. 11 Intellect is the trade association for the UK Technology industry, pp.47, www.intellectuk.org/hightechlowcarbon

[31] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp. 9, http://www.smart2020.org/. The exact figures for the estimated $946.5 billion costs savings stated in the report were calculated based on $872.3 billion in energy and fuel saved and an additional $143.5 billion in carbon saved, assuming a cost of carbon of $ 33/tonne, for a total of $1,015 billion in savings.

- Improve accountability of energy consumption and carbon emissions;

- Offer innovations that capture energy efficiency opportunities across buildings/homes, transport, power, manufacturing and other infrastructure and provide alternatives to current ways of operating, learning, living, working and traveling;

- Offer smart and integrated approaches to energy management of systems and processes, including benefits from both automation and behavioral change and are alternatives to high carbon activities, across all sectors of the economy (see Figure 6 for a simple depiction of an ICT enabled energy system).

Figure 6: ICT and energy systems [32]
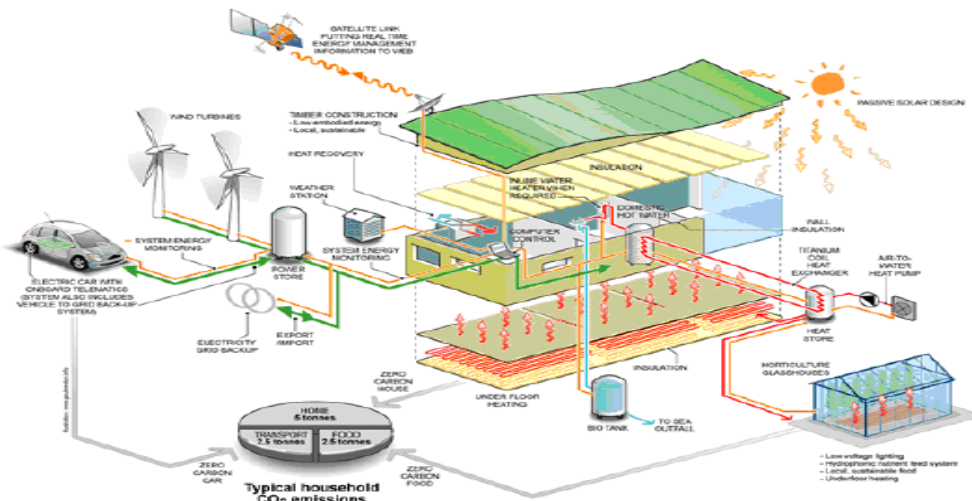
As discussion on the need for green ICT intensifies, an increasing number of countries have started to show exponential growth in demand for green ICT services. Figure 7 shows that the estimated growth rates of green ICT services are impressive and require some attention. Though only some of the more developed countries in the region seem to be capitalizing on this new market area, the very high compound annual growth rates (CAGR) in all countries may be a clear indication of a strong future for green ICT.

Figure 7: Growth in demand for Green ICT services (2007 to 2011) geographic forecast [33]

---

[32] WWF (2008), Identifying and assessing the opportunities to reduce the first billion tonnes of CO_2 - The potential global CO_2 reductions from ICT use, pp. 18, http://assets.panda.org/downloads/identifying_the_1st_billion_tonnes_ict_academic_report_wwf_ecofys.pdf

Market	2007	2008	2009	2010	2011	CAGR % (07-11)
ANZ	90	166	283	446	652	64.16
ASEAN	45	84	148	245	375	69.62
Greater China	52	97	166	283	447	70.98
India	23	46	86	152	230	77.65
Korea	36	66	114	184	293	68.76
ROAP	2	4	6	11	17	71.02
Total	249	462	805	1,320	2,014	68.71

Source: Springboard Research, 2008
All Values are US$M

ICT, Carbon Emissions and Economic Growth

There are also studies which aim to link ICT, carbon emissions and economic growth in the region. To try to understand the impacts of ICT on CO_2 emissions in areas with high levels of economic growth, it is notable to look at how the low growth rate of transport in South Asia as a whole is affecting emissions levels. The region's economies grew at an impressive aggregate rate of 5.3 percent per year between 2000 and 2005; this level of growth is second only to that of China which was 7.5 percent per year. However, while China's rate of CO_2 emissions from transport kept pace with the economic development rate by growing at 7.3 percent per year, South Asia's emissions increased only by a paltry annual rate of 1.3 percent. The World Bank estimates that it was due to the nature of the respective economic engines fueling the growth in South Asia particular in places like India, which represents nearly 83 percent of the region's economy (GDP), where economic growth is powered by non-transport-intensive sectors such as information technology, biotechnology, and research and development, while China's is driven largely by manufacturing and production of goods for export[34].

However, while the transport related emissions has played a relatively small part in South Asia's CO_2 emissions, the rapid pace of urbanization and likely acceleration of motorization trends present a threat to emissions mitigation efforts in the future. The mobility demands of the new urban populations thriving in the expanding information economy in rapidly transforming cities such as Bangalore, Hyderabad, and Mumbai is indicative of the challenge and at the same time opportunities for future emissions mitigation[35]. As recommended in the Smart 2020 study, efficient motors (in vehicles,

---

[33] ZDNet Asia (2008), Asia's green IT services to hit US$2B in 2011,
http://www.zdnetasia.com/news/business/0,39044229,62048138,00.htm

[34] The World Bank (2009), South Asia Climate change strategy, pp.134
http://siteresources.worldbank.org/SOUTHASIAEXT/Resources/Publications/448813-1231439344179/5726136-1232505590830/1SARCCSJanuary192009.pdf

[35] The World Bank (2009), South Asia Climate change strategy, pp.139
http://siteresources.worldbank.org/SOUTHASIAEXT/Resources/Publications/448813-1231439344179/5726136-1232505590830/1SARCCSJanuary192009.pdf

industrial machinery, etc.) and ICT enabled grids, as well as videoconferencing and telecommuting could play a vital part in the city planning and business operation models. Best practices from other countries should make their way into the hands of policy makers and private sector to ensure emissions levels are kept in check through innovate and visionary forward thinking initiatives, without compromising socio-economic development.

The conventional thinking is to deal with environmental issues only as a last step once all the other factors are in place. Core strategies and plans of governments and private companies do not included green components for the most part. However, to develop a low carbon economy and achieve green growth, ICT providers and users have to re-think the notion of sustainable ICT solutions. The WSIS plan of action line C7 calls on all stakeholders to encourage ICT use for environmental protection. ICT for development initiatives of the 21st century should not only be eco-friendly and just cost cutting activities but they should also be potential avenues for creating future markets.

Geneva Plan of Action (2003) from the World Summit on the Information Society (WSIS) Action Line C7: E-environment

a. Governments, in cooperation with other stakeholders are encouraged to use and promote ICTs as an instrument for environmental protection and the sustainable use of natural resources.
b. Government, civil society and the private sector are encouraged to initiate actions and implement projects and programmes for sustainable production and consumption and the environmentally safe disposal and recycling of discarded hardware and components used in ICTs.
c. Establish monitoring systems, using ICTs, to forecast and monitor the impact of natural and man-made disasters, particularly in developing countries, LDCs and small economies.

Emissions from the ICT Industry

At the same time, one should be mindful of the fact that ICT is also an industry which contributes to carbon emissions. Analysts from Gartner estimated that the ICT sector was responsible for 2 % of total global carbon emissions[36]. This estimate includes the emissions during the "in-use" phase of PCs, servers, cooling of these devices, fixed and mobile telephony, local area networks (LAN), office telecommunications, and printers. According to another study, in 2007, the total carbon footprint of the combined emissions of personal computers and peripherals, telecom networks and devices, and data centers was calculated as 830 MtCO$_2$e, which is 2% of human activity related emissions released that year and the study goes on to predict that even with

---

[36] Gartner (2007), http://www.gartner.com/it/page.jsp?id=503867. The Gartner estimate includes an estimate of the embodied energy that's used in design, manufacture and distribution, in large-volume devices, namely PCs and cell phones as well as all commercial and governmental IT and telecommunications infrastructure worldwide, but not consumer electronics other than cell phones and PCs.

technological advancements resulting in improved energy efficiency of ICT's, a 6% growth rate is expected every year till 2020[37]. According to the same study, the sector's emissions today has risen to 0.5 $GtCO_2e$, and will increase to 1.4 $GtCO_2e$ in 2020 under BAU growth.

However, it is also sensible to assume that much of the discussion about ICT contribution to emissions maybe bias in some form or the other. According to one article, Internet search giant Google has refuted a recent report which claimed that a single Internet search requires half the energy as boiling a pot of water[38]. Some information may also be misinterpreted. A survey done by Global Action Plan states that ICT sector emissions levels in the UK are equal to that of the aviation industry[39]. While, Gartner VP, Simon Mingay, is also quoted as saying that use of IT accounts for 2% of global carbon dioxide emissions which is equivalent to the airline industry[40] – presumably at the global level. Mingay's statement is repeated by Information Society Commissioner Viviane Reding of the European Union in yet another write-up[41]. Further studies would be needed to understand the true global picture and possible implications, although it is clear that ICT products and services do contribute to carbon dioxide emissions, and more efforts towards improving energy efficiency and effectiveness of ICT use should be encouraged in the coming years.

(a) Selected Green and Cool ICT

Out of the plethora of available green ICT options and actions mentioned in the previous section, this section aims to identify ICT services and solutions which would help in reducing carbon dioxide emissions, are affordable and readily available in developing countries in Asia and the Pacific, while advancing socio-economic benefits. Based on the findings, this analysis basically reinforces the notion that dematerialization or substitution (replacing paper use and meetings with online applications and virtual meetings) can produce significant results without a need for massive ICT investment.

Using technology to dematerialize the way people work in public and private sectors has the potential to reduce 500 $MtCO_2e$ in 2020 which is equal to what was the total

---

[37] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.17, http://www.smart2020.org/

[38] Redorbit (2009), http://www.redorbit.com/news/technology/1623958/co2_emissions_from_it_sector_a_growing_concern/

[39] Global Action Plan (2007), http://www.globalactionplan.org.uk/news_detail.aspx?nid=62992fb1-c745-4738-bf96-f4acfd08088a

[40] Gartner (2008), http://blog.gartner.com/blog/sym_emea.php?blogid=32&startpos=42

[41] Renewable Energy Information (2008), http://renewenergy.wordpress.com/2008/04/10/ict-sector-to-monitor-its-own-co2-emissions/

ICT carbon footprint in 2002[42]. Subtracted from the IPCC worst case scenario $MtCO_2$ emissions in 2050 (see Table 1), this would be a 9 % reduction and this significant amount of CO_2 could be removed from the atmosphere 30 years in advance. However, predicted growth rates in personal computer (PC) use (laptops are predicted to replace desktops) will emit 643 $MtCO_2$ in 2020 due to power consumption and embodied carbon[43], off-setting the travel related savings of the dematerialization estimates mentioned above. An area of concern is that if the dematerialized service is heavily PC dependant, this estimated emissions might increase further. According to estimates, laptops will dominate the ICT CO_2 emissions footprint in 2020 with a 22% share, while desktops with LCD monitors will represent 20%, mobile phone handsets with their incredibly high level of penetration will only be 1% of the total ICT-related carbon emissions while their related networks will make up a whopping 13%. To put it in another way, 4 billion PCs are expected to hold a 42% share of the total carbon emissions from the ICT use while 4.8 billion mobile phone accounts will be responsible for a much lower combined total of 14% of the total ICT footprint[44]. Based on this, mobile phone driven dematerialization of e-government services which can provide public services and information without a need for physical travel could help achieve sustainable socio-economic development in the future.

In addition to promoting mobile technologies, a few studies have highlighted possible effects of carbon emissions reduction through a decrease in physical travel. According to a WWF study, a significant reduction could be expected by reducing car commuting and increasing the use of videoconferencing[45].

Table 1: 2% less carbon through travel reduction

5,587 $MtCO_2$	IPCC worst case scenario 2050 for travel related carbon emissions[46] (see annex 5)

---

[42] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.10, http://www.smart2020.org/

[43] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.20, http://www.smart2020.org/

Embodied Carbon is quoted as "carbon dioxide emitted at all stages of a good's manufacturing process, from the mining of raw materials through the distribution process, to the final product provided to the consumer" in IISD "Embodied Carbon in Traded Goods" at http://www.iisd.org/pdf/2008/cph_trade_climate_carbon.pdf

[44] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.20-22, http://www.smart2020.org/

[45] More research on the impacts of travel substitution and use of videoconferencing among developing countries would be encouraged.

[46] http://www.ipcc.ch/ipccreports/sres/emission/118.htm#533

5,487 MtCO$_2$	Minus the WWF predicted reductions if 5% car commuters become telecommuters and 15% airplane business trips are substituted by virtual meetings[47]
100 MtCO$_2$	Total (IPCC worst case scenrio minus WWF predicted reduction)
2%	less carbon dioxide to worry about

(MtCO$_2$: Million tons CO$_2$)

So given the overall travel related emissions reduction potentials, what may be the first steps to realize this potential? This analysis used the previously discussed green growth framework, to deduce that one specific ICT product and two interrelated ICT applications could be further examined:

- Mobile communication
- Videoconferencing
- E-government

Undoubtedly, there would be more of such applicable infrastructure, services and applications. These three were initially selected for affordability, availability as well as relevance in the context of developing countries with focus on the previously discussed three partially overlapping social, economic and environmental factors. In addition to the environmental considerations and need for green growth, this report takes into account vital roles of ICT services and applications in promoting socio-economic development among developing countries in the region.

A number of ICT initiatives and projects have been implemented and planned among ESCAP member countries. Although these are important investments in developing an inclusive information society, this report aims to highlight some as strategic initiatives and urge further discussions among governments and donor agencies for possible inclusion in the green stimulus package and any future government spending.

Mobile phones

---

[47] WWF (2008), Outline for the first global IT strategy for CO$_2$ reductions,
http://assets.panda.org/downloads/global_strategy_for_the_1st__billion_tonnes_with_ict__by_wwf.pdf

Taking into account the above socio-economic-environmental considerations, mobile phones and communication are selected as green and cool ICT for a variety of reasons. Mobile phone connections have surpassed fixed line connections in an increasing number of countries and are recognized as an ideal tool for connecting the unconnected and accelerating rural development. In some of ESCAP member countries where ICT infrastructure development is still a daunting challenge, mobile phones offer an affordable and practical means of bridging the digital divide, delivering vital services to the huge portion of unconnected and under-serviced population in remote and rural areas.

> **Box 1: Mobile phones and rural development**
>
> Nobel Laureate Muhammed Yunus, well known for being the founder of the famous Grameen Bank in Bangladesh, transformed his belief that ICT can change the lives of poor people into reality by creating the Grameen Telecom of Bangladesh. Grameen Bank provides loans to the poor women of rural Bangladesh to buy their own mobile phones and to sell mobile phones to fellow villagers. Due to the rapid growth in the mobile industry in over the recent years, there are almost 300,000 women engaged in the mobile phone business serving 10 million subscribers to Grameen Telecom in Bangladesh[1].
>
> Source: ESCAP Survey

According to a report, China's mobile phone use growth is a good example and maybe a foreshadowing of what is to come[48]. Launched in 2006, China Mobile's Agricultural Information Service provides advice on how to cultivate crops and take care of cattle, as well as weather, news, and information on market prices for various products. The information can be accessed using phones or the Internet. During that year, subscribers were paying 2 renminbi (less than 30 cents US in today's terms) per month for each category of information they received. At the end of June 2007, the Agricultural Information Service had 24.8 million subscribers, up 40 percent from the total at the end of 2006[49].

This phenomenon of rapidly expanding access to mobile services has been observed not only in a handful of industrialized countries but also LDCs, LLDCs and SIDS. Mobile phones have become a significant part of communication and even among the poor in the region.

In terms of its energy efficiency, since the early models of the 1980's, mobile phone has improved beyond expectations. Ten years ago a single call used tens of Watts of power; today the same call consumes around 1 Watt[50]. Other factors such as the weight of the phones have also come down drastically over the decades, translating directly to improvements in their eco-efficiency due to the use of less material.

---

[48] About.com (2009), China Mobile's growth increasingly reliant on rural areas, http://pcworld.about.com/od/markettrends/China-Mobile-s-growth-increasi.htm
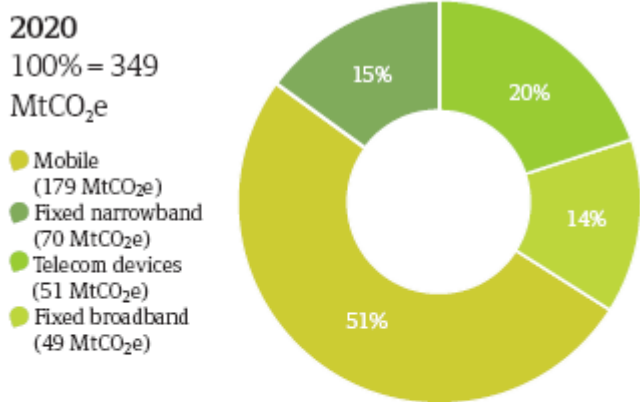
[49] Infoworld (2007), China Mobile's growth increasingly reliant on rural areas, http://www.infoworld.com/d/networking/china-mobiles-growth-increasingly-reliant-rural-areas-746

[50] Intellect (2008), High Tech: Low Carbon – The Role of Technology in Tackling Climate Change, pp. 11 Intellect is the trade association for the UK Technology industry, www.intellectuk.org/hightechlowcarbon

However, there are other concerns to take into account than energy consumption of mobile phone handset itself as listed below.

As discussed earlier, mobile phone handsets will represent only 1 % of total ICT carbon footprint in 2020, though mobile networks or the infrastructure that provides the mobile phone connection will represent 13% thereby dominating the overall estimated telecoms footprint (see Figure 8)[51]. This could be considered as a side effect of introducing more mobile phones to connect the unconnected in developing countries. At the same time, the number of fixed telephone line subscribers in an increasing number of ESCAP countries demonstrated a decline, while broadband subscribers are virtually non-existent in most of developing countries in the region. Thus, social and economic benefits of connecting people via mobiles phones would outweigh the relatively high level of emissions caused by the necessary network infrastructure, while newer more advanced network hardware and architecture may offer more promising solutions for energy efficiency.

Figure 8: Global Telecom (devices and infrastructure) carbon footprint[52]

2020
100% = 349 MtCO$_2$e

- Mobile (179 MtCO$_2$e)
- Fixed narrowband (70 MtCO$_2$e)
- Telecom devices (51 MtCO$_2$e)
- Fixed broadband (49 MtCO$_2$e)

Mobile phones will represent 1% of the total ICT footprint (6% of 25%)

Mobile networks will represent 13% of the total ICT footprint (51% of 25%)

Fixed broadband will represent 4% of the total ICT footprint (14% of 25%)

Major mobile network providers have started focusing their attention on increasing energy efficiency of their base stations, which consume the majority of power in a standard mobile network. Base stations are the link between mobile devices and the main network infrastructure. The energy consumption of some of these base stations

---

[51] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.23, http://www.smart2020.org/

[52] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.22, http://www.smart2020.org/

have dropped from 2000W in 2001 to around 600W in 2006 and this trend is expected to continue due to rapid technological developments[53].

Videoconferencing

Another potential ICT technology identified in this study is video-conferencing. As the previous chapter highlighted, transportation was one of the main causes for GHG emissions. Thus, reduction of physical travel and introducing ICT to meet the need for travel could bring about positive environmental effects, while saving time and costs especially in remote and rural areas.

As mentioned earlier, the IPCC scenario modeling techniques have predicted a travel related emissions range between 3,823 - 5,587 $MtCO_2$ by 2050 compared with 1,310 $MtCO_2$ of emissions in 1990 (see Appendix 5 for more details). According to the WWF, 100 $MtCO_2$ emissions are reduced if 5% car commuters become telecommuters and 15% airplane business trips are substituted by virtual meetings[54]. Subtracting the WWF estimated travel related carbon reduction as a result of virtual meetings from the highest IPCC predicted amount means in real terms approximately 2% less carbon to worry about (see Table 1). Though modest, this figure puts into perspective the realistic reduction goals that are required to make effective change.

Figure 9: Growth in the number of commercial vehicles

Sources: UNESCAP, State of the Environment, 2006
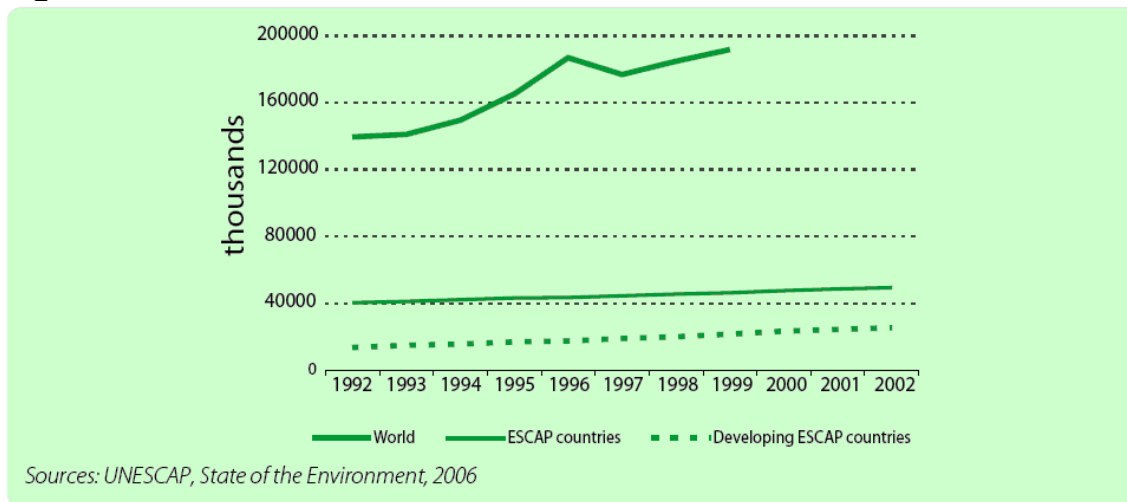
It is estimated that a ton of carbon is released when one travels 5,000 miles in an airplane or drive 2,500 miles in a medium-sized car according to one source[55].   While

---

[53] Intellect (2008), High Tech: Low Carbon – The Role of Technology in Tackling Climate Change, pp. 11 Intellect is the trade association for the UK Technology industry, www.intellectuk.org/hightechlowcarbon

[54] WWF (2008), Outline for the first global IT strategy for CO_2 reductions, http://assets.panda.org/downloads/global_strategy_for_the_1st__billion_tonnes_with_ict__by_wwf.pdf

[55] The Nature Conservancy (2009), http://www.nature.org/initiatives/climatechange/activities/art19630.html

another more aggressive estimate puts 7,000 miles of travel with 2.5 tons of carbon release.

As shown in the worst case scenario, telecommuting and virtual meetings, even with a low level of adoption, has the potential to reduce 68 MtCO$_2$ by 2030, which is a sizeable reduction. The upward growth rate of commercial vehicles in all parts of the world is a point of concern (See Figure 11) as it directly relates to increased emissions[56]. Therefore, travel reduction through videoconferencing and telecommuting could be promoted as an alternative for such increases in demand.

Figure 10: Travel to business meeting – Kg of CO$_2$ output per trip
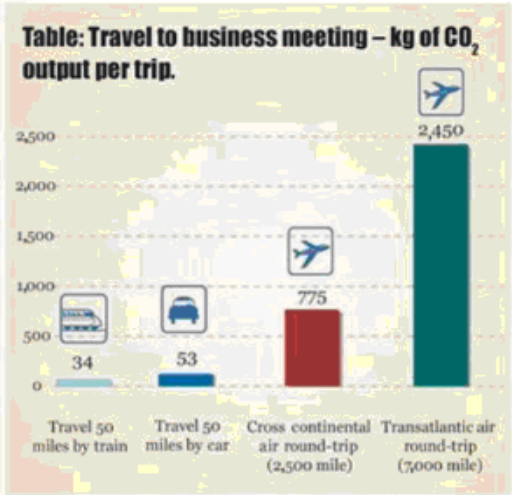
Source: ClimateAction (2007)[57]

Figure 11: Estimated incremental potential for GHG emissions reductions enabled through ICT by 2030 (MtCO$_2$)

---

[56] UNESCAP (2006), Green growth at a glance, pp.5,
http://www.unescap.org/esd/water/publications/sd/GGBrochure.pdf
[57] ClimateAction (2007),pp.207 http://www.climateactionprogramme.org/books/2007/

	Estimated Incremental Potential for GHG Emissions Reductions Enabled by ICT by 2030 MtC0$_2$		
	low	medium	High
Smart buildings – ICT in legacy buildings	121	545	969
Smart buildings – ICT for planning and operating new buildings	46	439	832
Transport mode switching enabled by smart urban planning	38	190	380
Telecommuting and virtual meetings (smart work)	68	159	404
In vehicle ICT and intelligent transport infrastructures (smart vehicles and intelligent transport)	581	1,486	2,646
E-commerce and dematerialization	198	927	1,822
ICT for energy efficiency in Industry (improving day by day operations: smart industry and plant and process design: I-optimization)	100	815	1,530
ICT in Energy supply systems (Removal of network constraints – 2020)	17	59	128
Estimated total potential for CO$_2$ emission reductions	1,168	4,620	8,711

Source: WWF (2008), Identifying and assessing the opportunities to reduce the first billion tonnes of CO$_2$ - The potential global CO$_2$ reductions from ICT use [58]

There are already signs of increased videoconferencing in the public sector mostly driven by cost cutting or economic motives. Viet Nam's Government Office plans to promote dematerialization by having the Chairmen of provincial-level people's committees attend official discussions via videoconferencing. The use of video-conferencing for government workers promises significant savings for state coffers, according to a report[59].

Some other forward thinking on green ICT includes the government of Australia's plan in 2009, to deploy videoconferencing systems across 20 government sites in order to reduce travel costs. Robust security measures would be employed to ensure sensitive government meetings are not breached. This project is expected to cost $13 million and will use an existing IP network of a leading telecom provider. The potential cost saving is the main driver in this case as well and is perceived as the primary return on investment (ROI). The system is intended for use in inter-jurisdictional meetings, including Council of Australian Governments (COAG) and ministerial Council meetings[60]. Medicare Australia, an Australian government agency which plays an integral role in the Australian health sector[61], has already implemented a videoconferencing system across its state and territory offices as part of measures to curb air travel budgets.

---

[58] WWF (2008), Identifying and assessing the opportunities to reduce the first billion tonnes of CO$_2$ - The potential global CO$_2$ reductions from ICT use, pp. 88, http://assets.panda.org/downloads/identifying_the_1st_billion_tonnes_ict_academic_report_wwf_ecofys.pdf

[59] dgCommunities (2009), Vietnam makes cost savings via video-conferencing http://egovernment.developmentgateway.org/News.10971+M5f8f01d16e3.0.html

[60] Australian IT (2009), http://www.australianit.news.com.au/story/0,24897,25114178-15306,00.html

[61] http://www.medicareaustralia.gov.au/about/index.jsp

Video-conferencing requires a certain level of bandwidth between users. Increasing availability of broadband networks would enable more users to apply this technology. Although broadband subscriber levels in Asia and the Pacific are not equitably spread between countries or sub-regions, the overall growth patterns are obvious according to the ESCAP Statistical Yearbook for Asia and the Pacific 2008.

**Figure 12: Number of fixed broadband internet subscribers (per 100 people)**
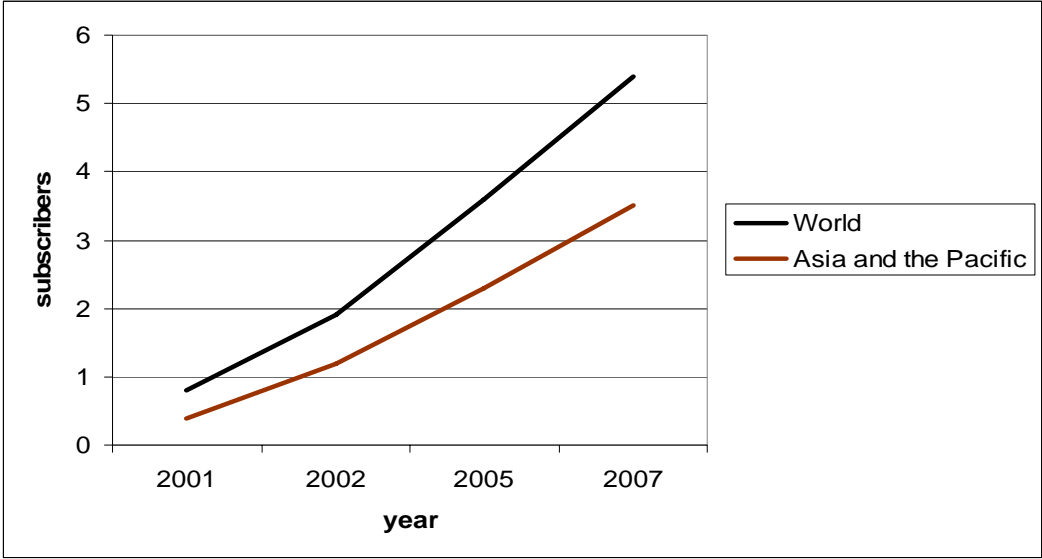
Source: ESCAP Statically Yearbook for Asia and the Pacific 2008[62]

A recent study tried to identify and rank the main factors that lead certain organizations to choose videoconferencing over physical travel.

Figure 13: Effects of videoconferencing on meetings

---

[62] ESCAP (2008), Statistical Yearbook for Asia and the Pacific 2008
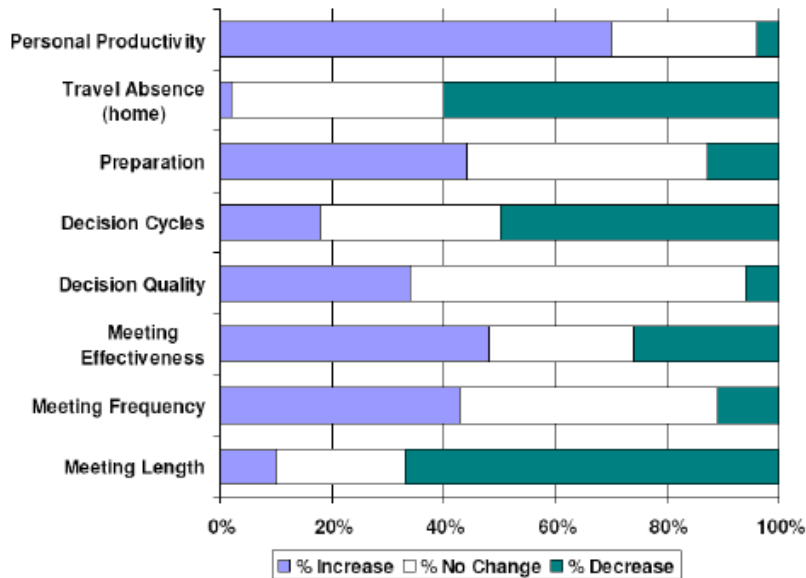
Source: WWF (2009), "From workplace to anyplace assessing the opportunities
to reduce greenhouse gas emissions with virtual meetings and telecommuting"[63]

Interestingly, these studies highlight that current environmental considerations do not
rank high as a driver for the adoption of videoconferencing solutions[64]. According to
the study, videoconferencing results in substantial reduction of travel costs and related
time savings. While, through videoconferencing, more frequent meetings with more
participants who would have otherwise not have made the journey, can take place at a
considerably lower cost. This means that more people with different backgrounds and
perspectives can be brought to the "virtual table," enriching the discussion and leading,
eventually, to a more informed decision[65]. Research has also been undertaken on the
types of benefits and where videoconferencing could be most effectively utilized[66].

---

[63] WWF (2009), "From workplace to anyplace assessing the opportunities
to reduce greenhouse gas emissions with virtual meetings and telecommuting"

[64] WWF (2009), "From workplace to anyplace assessing the opportunities
to reduce greenhouse gas emissions with virtual meetings and telecommuting"

[65] WWF (2009), "From workplace to anyplace assessing the opportunities
to reduce greenhouse gas emissions with virtual meetings and telecommuting"

[66] Armstrong (2007), "Business air travel demand in the light of conferencing
alternatives and pressure for responsible practice"

Some researchers were unable to find evidence of strong contribution by the non-
verbal communications when videoconferencing is chosen over a phone call. Tasks
needing social cues such as speaker attention did benefit from video while participants
in virtual meetings are more task-oriented, less likely to engage in as much small talk,
less argumentative but no actual difference was found in the ability to problem-solve.
The impact of using technology affects more the process than the actual out-come
according to the studies. An improvement in the process of meeting could be that
virtual meetings can be recorded; giving participants the possibility to summarize and
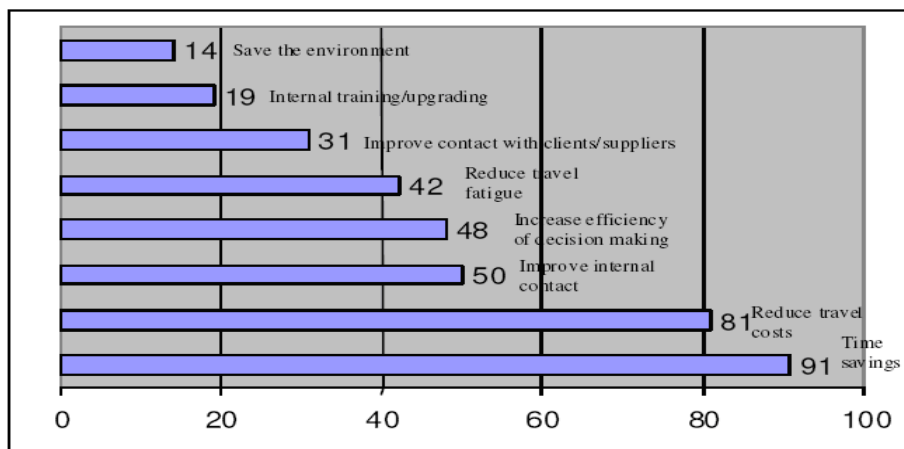
Figure 14: Reasons for adopting videoconferencing

Source: WWF (2009), "From workplace to anyplace assessing the opportunities to reduce greenhouse gas emissions with virtual meetings and telecommuting"[67]

As mentioned earlier, virtual meetings are very affordable since much of the required tools can be installed on a basic computer. Popular applications, such as Skype and GoogleChat, don't require more than a webcam and sufficient bandwidth for Internet access. Based on current technology, if individuals want to make a difference by looking at it from an actual cost benefit perspective, hardware costs for stand alone videoconferencing equipment range from $70 - $ 10,000[68]. Some have a maximum transfer rate of 512 Kbps; the minimum band width for useful social and business related dealings would have to be around 300-400 Kbps for simultaneous voice and video transmission and reception.

Placed in the socio-economic context of developing countries, these applications and services could have significant impacts. One of the main hindrances in further spreading the Internet in remote and rural areas has been a certain level of literacy and education required for understanding most of the online content. Such applications and videoconferencing infrastructure would alleviate needs to travel from remote and rural areas to cities, saving time and costs, while contributing to emissions reduction, in addition to lowering the entry point for farmers and rural population.

---

analyze the discussion afterwards. However, any meeting can be recorded using a simple microphone. This leads to the question whether personal meetings aren't the backbone of human interaction and must not be compromised. The goal is to maintain a balance and make an informed choice when to substitute travel with green and cool ICT.

[67] WWF (2009), "From workplace to anyplace assessing the opportunities
to reduce greenhouse gas emissions with virtual meetings and telecommuting"

[68] CNET (2009), http://shopper.cnet.com/4566-3503_9-0.html

The main issue is that many people have a bias against virtual meetings; the general assumption is still that virtual meetings are less effective than in-person meetings, which is tipped to change as people experience more advanced solutions which give clear communications capabilities at affordable prices[69].

Emerging Trends and Challenges

Videoconferencing can substitute unnecessary travel only when a critical mass of users and service providers[70] start to blossom. As mentioned before, 4 billion PCs are expected to make up 42% of the total ICT footprint while 4.8 billion mobile phone accounts will make up only 14% of the total ICT footprint[71]. Based on this and increased opportunities for rural people to communicate without a need for literacy, the combination of mobile phones and videoconferencing must be given some serious thought.

Before the emergence of 3G technologies, videoconferencing through mobile phones was impossible. Video is a heavy consumer of bandwidth and 3G provides sufficiently high bandwidth to transport the very large quantities of video data needed for real time videoconferencing. The standards committees that specified 3G protocols ensured that all 3G service providers would enable anyone to talk to anyone else, anywhere, over 3G. That is, "anyone" who has a 3G mobile telephone.

Solutions that enable anyone using a 3G video mobile phone to talk to anyone else using IP or ISDN videoconferencing equipment exist[72]. This type of solution is blazing paths as exciting applications that make video connections between mobile and fixed line phones. In order for the required mobile-to-fixed line videoconferencing to succeed, a 3G network, a wire line network, and equipment would be necessary.

Looking at the total telecom infrastructure related emissions (Figure 8), the number of broadband accounts which are vital for videoconferencing provided by both telecom companies and cable operators will be more than double between 2007 and 2020 and mobile accounts will almost double during the same period. In 2002, there were 1.1 billion mobile active accounts and is set to increase to 4.8 billion in 2020 and is the largest source of global telecom footprint emissions. Increased access to broadband will also have an impact – the number of routers will grow from 67 million in 2002 to 898 million in 2020[73].

---

[69] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age United States report Addendum, pp.43, http://www.smart2020.org/

[70] Exact figures for achieving critical mass depends on each country, subregion, and region, and the dynamics of such markets
[71] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.20-22, http://www.smart2020.org/

[72] For an example, among others, of a mobile videoconferencing solution see: http://www.radvision.com/Visual-Communications/Interactive-and-Converged-Applications/Mobile-Video-Conferencing/default.htm

[73] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.23, http://www.smart2020.org/

Figure 15: Global Telecom devices carbon footprint (MtCO$_2$e)[74]

A Increased number of mobiles 1.1 billion to 4.8 billion, routers from 67 million to 898 million and IPTV boxes from 0 to 385 million

B Power consumption decreases due to smart chargers and 1 W standby
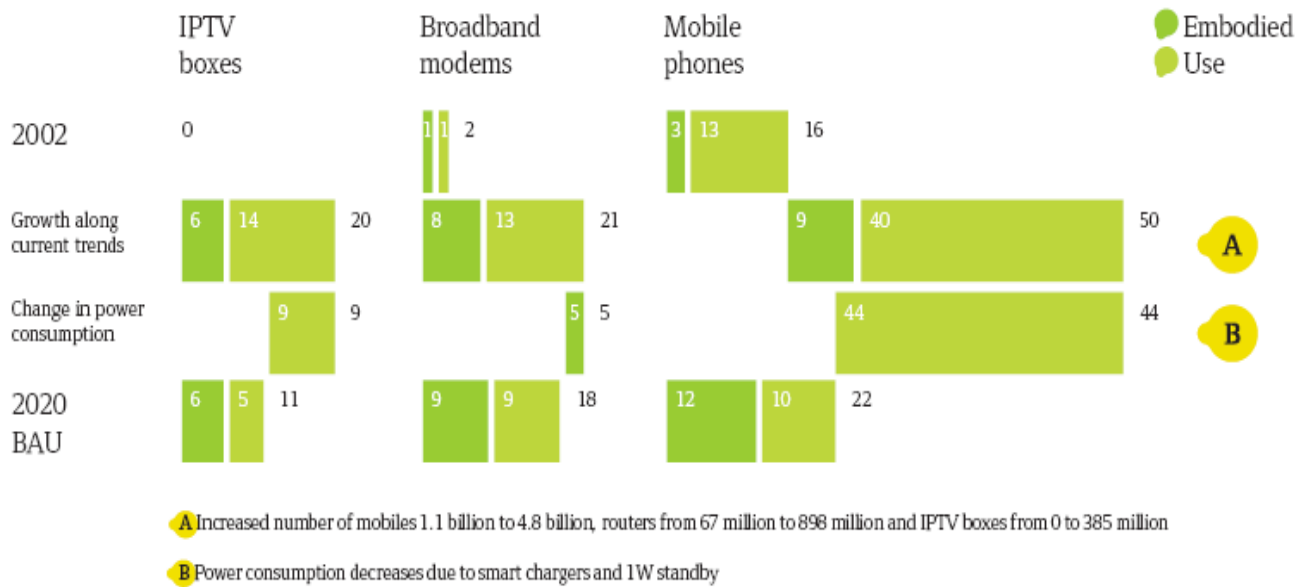
To counter this predicted possible negative impacts, the telecommunications industry is currently edging towards a major revolution as it migrates from today's separate networks (for voice, mobile, data etc) to a single, unified IP-based next-generation network (NGN). There is a significant decrease in the number of switching centres required for these networks. For instance, British Teelcom's 21st Century Network (21CN) will require only 100-120 metropolitan nodes compared with its current 3,000 locations. NGN switching locations have more tolerant climatic range specifications, which improved from the 35 to 50 degree temperature range. As a result, the switching sites can be fresh-air cooled in most countries rather than requiring special air conditioning. NGNs make use of more recent standards, such as VDSL2 (ITU-T G.993.2), which specifies three power modes (full, low-power and sleep), whereas the old standard VDSL has only a single power mode (full power)[75].

Technological, institutional and behavioral change is vital to mainstreaming of carbon reducing green and cool ICT. Proponents have to push for better and favorable environments to ensure a realistic growth for this type of green and cool ICT use. Governments have to respond quickly and with a strategic overall picture in mind. One of the good examples could be the Green ICT strategies of the Republic of Korea.

Telecommuting

One concrete application of videoconferencing and mobile phones, which has steadily been spreading across the region is telecommuting. Telecommuting is getting a great

---

[74] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.24, http://www.smart2020.org/

[75] ITU (2007), ICTs and Climate Change ITU-T Technology Watch Report#3 December 2007, pp. 6

deal of international attention in recent years due to the need for travel reduction, energy efficiency, air quality improvement, work/life balancing, reduction in health-care costs by reducing stress and sick leave use, expanding the opportunities of mobility-limited sectors of society (including the disabled, elderly and homemakers); competitive recruitment and retention of the best workers, improved productivity and customer care due to extended hours of customer representative availability, support for regional economic development due to improved linkages to underdeveloped regions.

According to one report, flexibility in use of time and location has opened up opportunities for women in India, where web-based medical transcription services are provided to doctors and hospitals in the U.S over the Internet. Involving many women working from home, higher salaries and the flexibility of telecommuting are a critical allure in this case[76]. At the same time, it is estimated that the global tele-worker population will increase from 758.6 million in 2006 to over 1.0 billion in 2011, which is over 30% of the worldwide workforce due to the increasing role of mobility as a key enabler in improving a company's productivity[77], supported by robust and ubiquitous ICT infrastructure.

Another study highlights that the volume of GHG emission reductions potentially delivered by teleworking is larger than the volume potentially delivered by virtual meetings. Teleworking is not the same as "home work (or work from home)"; increasingly people work in various locations outside the workplace[78]. The study also emphasizes that maximum benefits can be achieved where both policy makers and private-sector companies produce and use IT; 1) work together to leverage teleworking and virtual meeting solutions as tools to deliver GHG emissions reductions while 2) implementing strategies that reduce the risks of negative rebound effects (see below) and increase the opportunities to reduce carbon emissions[79].

Although work at the office is not likely to disappear, new forms of telecommunication such as voice and picture communication are likely to make telecommuting more social in the future. Some tools for mobile working are cell phones, mobile computing platforms, social media websites, web conferencing, and Wiki's, which are becoming more affordable, available and accessible in developing countries.

It is important to note that the rate of penetration of teleworking and teleconferencing into the work setting is not uniform across countries, due to different economic, technological, and policy contexts. According to a recent study, in 2005 there were around 26.1 million teleworkers (defined as those teleworking at least once a month)

---

[76] The World Bank (2006), ICT & Gender Equality, Gender and Development Group, http://siteresources.worldbank.org/INTGENDER/Resources/GenderICTBriefingNoteOct06.pdf

[77] IDC (2007), Worldwide Mobile Worker Population 2007–2011 Forecast, http://www.idc.com/about/about.jsp. IDC is a global provider of market intelligence for the information technology, telecommunications, and consumer technology markets.

[78] WWF (2009), "From workplace to anyplace assessing the opportunities to reduce greenhouse gas emissions with virtual meetings and telecommuting"

[79] WWF (2009), "From workplace to anyplace assessing the opportunities to reduce greenhouse gas emissions with virtual meetings and telecommuting"

in the US, corresponding to 17.5 percent of the total workforce. Among these, 16.2 million were classified as "contract teleworkers," while 12.4 million were "employee teleworkers." Out of the total 26.1 million, 22.2 million workers were teleworking at least once per week, with 12.2 million teleworking almost every day (full time)[80].

In the EU, the percentage of teleworkers (teleworking at least once a month) was around 8 percent of the total workforce, while only 2 percent telework every day (full time), with the highest proportion of teleworking in the Scandinavian countries and the Netherlands and the lowest in southern European countries. In Japan teleworkers accounted for 6.6 percent of the workforce in 2000[81].

Following the 1994 Northridge Earthquake in greater Los Angeles, the US Federal Emergency Management Agency (FEMA) took the initiative in promoting office decentralization by setting up federally sponsored disaster-response telework centers in the area[82]. This type of public – private initiative serves as a great example of fast acting and effective disaster management.

It should also be pointed out that this will result in increased usage of data processing equipment which in turn consumes more electricity. Estimates say that data centers will constitute 9% of the total ICT carbon footprint while data center cooling systems will emit 4% of the total ICT related carbon in 2020 which is a total of 259 $MtCO_2$ [83] while the total predicted savings from telecommuting and videoconferencing is only 68 $MtCO_2$. Keep in mind that the emissions depicted here don't relate only to data centers used for telecommuting, since big companies use them for their daily operations, Internet search giants such as Google use them, watching YouTube videos requires there use, and the internet itself is a massive data center network. However, the argument should also be based on the savings and gains of less physical travel and associated emissions reduction.

As described earlier, in a private or public sector setting, eco-friendly ICTs are used primarily for energy cost saving reasons as opposed to environmental reasons. In these cases, telecommuting is low on the priority list because the money saved through less travel is only beneficial to the employee who usually pays for these costs anyway. So, the overall strategic plan of an organization plays a big role in whether this type of environmentally friendly initiative is considered important.

---

[80] WWF (2009), "From workplace to anyplace assessing the opportunities
to reduce greenhouse gas emissions with virtual meetings and telecommuting"

[81] WWF (2009), "From workplace to anyplace assessing the opportunities
to reduce greenhouse gas emissions with virtual meetings and telecommuting"

[82] Jackson and van der Wielen (eds) (1998);
http://books.google.co.th/books?id=Og8SNMbUEBUC&pg=PA300&lpg=PA300&dq=e-agriculture+and+teleworking&source=bl&ots=kc4GPEjRHG&sig=OCzkeyjG8DSdi0WnVi9_QRoDis0&hl=th&ei=vSovSsDTDYKPkAXWgcGYCg&sa=X&oi=book_result&ct=result&resnum=6#PPP1,M1

[83] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age
pp.21, http://www.smart2020.org/

E-government

In addition to mobile communication and videoconferencing/telework, this report highlights the importance of organizing data and information for better public services which would compliment communication aspects of ICT initiatives. Among various applications, this report selected e-government, as information and data provided through various e-government systems, ranging from agricultural information to health and education services, are vital to socio-economic development and poverty reduction in developing countries. Systematic and consistent introduction of such an application would also reduce duplication of information entry and services, which would lead to reduction in papers, energy consumption and time and efforts on the part of end users. The value would be augmented when mobile penetration and such communication means as videoconferencing are widely available even among remote and rural areas.

E-government is defined as "utilizing the Internet and the World-Wide-Web for delivering government information and services to citizens." Technically speaking, this may include using the Internet coupled with different IT applications such as databases, networking, discussion forums, multimedia, office automation, tracking and tracing of documents, permits and applications, and personal identification technologies[84]. In real terms, e-government dematerializes a portion of paper and travel requirements associated with government public services.

The UN's five-stage e-government model[85] breaks down the process of digitizing government process into the following:

1. emerging
2. enhanced
3. interactive
4. transactional
5. networked

In the *emerging* stage, a country is committed to establishing e-government, and sets up an official site with a limited domain to provide users with access to political and organizational information. These types of basic sites usually consist of contact information, organization structure and other basic descriptive information.

In the *enhanced* stage, there is an increase in the number of official web sites with more up-to-date information on policies and searchable databases containing laws and regulations. These sites are inter-connected to other sites in order to provide citizens with easier access to information they need.

---

[84] ScienceDirect (2008),
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6WGP-4T0X2T6-1&_user=1916156&_coverDate=09%2F30%2F2008&_rdoc=1&_fmt=full&_orig=search&_cdi=6828&_sort=d&_docanchor=&view=c&_acct=C000055299&_version=1&_urlVersion=0&_userid=1916156&md5=e297f584b4626c27bcd86d1fecb71499#bib19

[85] UN Global E-government Survey. UN Department of Economic and Social Affairs (UNDESA) and the Civic Resource Group (CRG), 2003

In the *interactive* stage, a country's net presence is further enhanced in order to have many organizations and services online. In this advanced stage, extensive interaction takes place between the citizens and public service providers; data search possibilities are enhanced as well as accessibility to various forms.

In the *transactional* stage, services such as application for visas, obtaining and renewal of passports and driving licenses, and the payment of taxes, which demand two-way communication via the Internet, are predominant. This stage enables various transactions through electronic signatures and other enhanced and regulated security functions.

Finally, in the *networked* stage, users have access to all public services at any time via the internet and the physical barriers between offices, sectors, and departments are completely removed[86].

Figure 17 below illustrates estimated savings by introducing various dematerialization methods in 2020. In addition to the above described videoconferencing and telecommuting, e-paper, e-commerce and online media have identified as effective means to reduce carbon emissions. In the above mentioned report, 500 MtCO$_2$e in 2020[87] is the goal and innovate solutions could come through e-government which can be an effective way to reduce emissions.

Figure 16: Impact of dematerialization (GtCO$_2$e)[88]
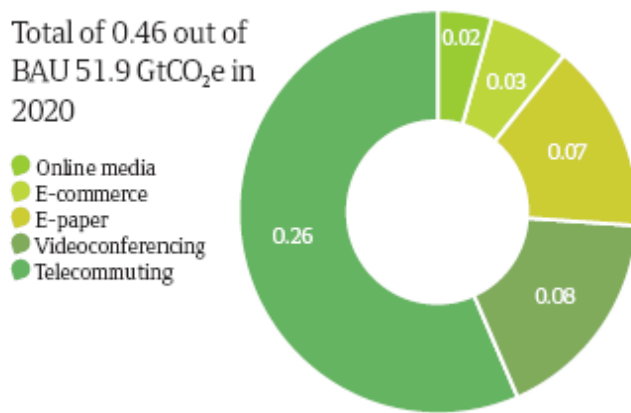
[86] ScienceDirect (2008), http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6WGP-4T0X2T6-1&_user=1916156&_coverDate=09%2F30%2F2008&_rdoc=1&_fmt=full&_orig=search&_cdi=6828&_sort=d&_docanchor=&view=c&_acct=C000055299&_version=1&_urlVersion=0&_userid=1916156&md5=e297f584b4626c27bcd86d1fecb71499#bib19

[87] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.10, http://www.smart2020.org/

[88] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.30, http://www.smart2020.org/

Source: GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age

One of possible positive impacts of dematerialization through e-government could be reduction in the use of materials, such as paper. A meager 13% global reduction in paper use is estimated to result in a reduction of 100 MtCO$_2$ of emissions[89]. This is equal to one fifth of the total global ICT carbon footprint in 2002[90]. If most of the world's government public services focused on dematerializing paper forms, a significant reduction in paper use could be achieved. It is not very costly or difficult to set up a secure website to offer online forms where transactions can take place.

For example in Thailand tax returns are filed online and taxes can be paid electronically, eliminating a great deal of paper and travel. A number of governments in developing countries have started introducing online transactions to facilitate and streamline government service provisions. However, it is up to the citizen to choose an online option and the regular method of going to a revenue department office to file taxes is still happening. M-government is a subset of e-government where ICTs, limited to mobile and/or wireless devices, like mobile phones, laptops, and PDAs (personal digital assistants) connected to wireless networks are used to help make public information and government services available "anytime, anywhere" to citizens and officials. In most cases where infrastructure availability in rural areas is limited, a simple first step would be to provide mobile services and create simple m-government applications or to set up electronic data entry points in local administrative offices where a government officer can assist people to enter a form electronically, or such services could be provided by Internet Café operators for a nominal fee.

On the other hand, if the dematerialized service is not as good as the regular paper based method or users face barriers, a higher-carbon release will result as people use both the dematerialized service and the paper version – a good example of this is when people print emails due to a variety of reasons including fear of system crashes and ease of reading and for extra prudent record keeping. Thus, despite rapid technological advances across the world, some of the predicted trends such as the "paperless" office have not happened in its true sense and adoption of videoconferencing and tele-working has not been as wide as expected[91].

Based on the relatively lesser impact of mobile phones on emissions than other more material- intensive means and rapidly expanding access to mobile networks in remote and rural areas in developing countries in the region, social, economic and environmental benefits can be realized through m-government solutions. In Malaysia,

---

[89] WWF (2008), Outline for the first global IT strategy for CO$_2$ reductions.

[90] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.10, http://www.smart2020.org/

[91] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age pp.29, http://www.smart2020.org/

for example, citizens can verify their voting information, such as the parliamentary and state constituencies where they are to vote, using SMS (short message service)[92].

E-Agriculture: linking economic, social and environmental benefits

Among various e-government applications, it should be noted that some applications have higher impacts on socio-economic development in the development context; e-agriculture being one of them. Agriculture is a major source of income for a majority of the poor in many developing countries in the Asia-Pacific region. At the same time, a majority of farmers live in remote areas with limited access to agricultural as well as other types of information. As such, better access to agricultural information via e-agriculture applications has been promoted as a means to improve agricultural productivity and natural resource management and increase income in rural areas. Although there are many different online and offline information channels for farmers, few of them are sufficiently customized and have materialized full potentials of ICT, yet.

Among various functions, e-agriculture can play a vital part in improving agricultural extension processes and reducing travel and opportunity costs as exemplified by e-Choupal in India where ICT plays only a 20% part but results in large increases in income of farmers. This example was also mentioned in the Regional Action Plan which was adopted by the ESCAP organized Asia-Pacific Regional Conference on WSIS, held in Tehran in 2005. This green ICT application also ties into not only food security issues but also increasing farmers' income; one study founds that in mid-2003 11,000 villages with 1 million farmers benefited from a $6 increase in earning per ton of produce sold through the e-Chopal initiative[93]. Such applications of ICT in agriculture could be further explored in other countries to test whether it is replicable and scalable. A mobile phone driven model might be even more promising since they represent less carbon emissions and wider user base in rural areas, although the introduction of such a model has just began in more ICT advanced countries.

Other functions of e-agriculture could include the strengthening of existing agricultural extension services and other community information dissemination methods through ICT enabled information kiosks, linkages to institutions of agricultural expertise, and community agro-climatic atlases to provide farmers with improved access to real-time climate information and to quickly get solutions to crop related problems[94].

In summary, these are just a few examples of a number of e-government applications and initiatives which have been implemented in Asia and the Pacific. Previously, mainly

---

[92] eGovernmernt for Development (2008), mGovernment: Mobile/Wireless Applications in Government, http://www.egov4dev.org/mgovernment/

[93] University of Michigan (2003), ITC'S E-Choupal and profitable rural transformation, Web-based information and procurement tools for Indian farmers

[94] The World Bank (2009), South Asia Climate change strategy, pp.84-85 http://siteresources.worldbank.org/SOUTHASIAEXT/Resources/Publications/448813-1231439344179/5726136-1232505590830/1SARCCSJanuary192009.pdf

socio-economic impacts were taken into consideration in designing and implementing such ICT initiatives. However, when equation includes environmental factors, the case of why e-govenrment applications are important become even more compelling.

(b) The Rebound Effect

Although the case is compelling, it is also important to understand and address the rebound effect because only proper implementation of ICT initiatives can make them green and cool. In fact, green and cool ICT might not need new investment or infrastructure. As briefly mentioned in the previous chapter, the introduction of ICT, for instance, might not bring about desired environmental impacts, if e-mail and other information are printed on paper. Furthermore, a research paper points to some uncertainty in the net impacts of increased efficiency through ICT. In theory, greater efficiency should result in less energy and material use and fewer emissions. However, there are concerns that these gains may lead to rebound effects, whereby overall consumption continues to increase as a result of increased efficiency resulting in more overall emissions. For example, using technology that saves time (e.g. telecommuting which reduces the commute to work, for example) may mean more time is available for other, potentially higher-carbon emitting activities.

Though ICT has the potential to improve efficiency leading to reduced emissions and use of materials, prevention of the rebound effect requires an emissions-containing framework (i.e. emissions caps linked to a global carbon price structure) to facilitate the transition into a low carbon economy. Without such a framework there is no guarantee that efficiency gains from green and cool ICT would not be off set by increased emissions.

2. Tapping into Stimulus Packages: some stimulus spending is already taking place

One of the repeated questions on how then to introduce green and cool ICT often boils down to availability of sufficient funds. In the previous chapter on *Why Green and Cool ICT Now*, it was explained that green stimulus packages have been formulated by some countries, which should include strategic investments in green and cool ICT. However, beyond these green stimulus packages, there are also other avenues to enable such funding within a larger picture.

As quantified in the previous chapters, mobile phones, videoconferencing and e-government could be some of the most affordable, available and accessible green and cool ICT for developing countries in Asia and the Pacific. Most countries have started introducing and implementing a comprehensive e-government programme to reap such socio-economic-environmental benefits, while mobile services are available in all of ESCAP member countries.

However, the further expansion of mobile services and e-government initiatives as well as introduction of videoconferencing could be delayed or altered significantly, due to the current economic crisis and decreased government budget and ODA availability. Thus, this report so far explored a way to link the need for strategic ICT interventions for sustainable and socio-economic development with green stimulus packages.

Furthermore, a recently published UN Environment Program (UNEP) report emphasizes the important role of environmental investments in stimulating the global and national economies back to sustainable development. This UNEP report recommended that one third of the estimated $2.5 trillion of planned stimulus packages should be invested on 'greening' the world economy. This would aid in re-energizing the global economy out of recession and onto a 21st century green growth guided path"[95]. This would further open up funding avenues for green and cool ICT initiatives.

In order to establish relevance, while attempting to discuss ICT initiatives and activities which are realistically feasible within the budgetary constraints of most countries of the Asia Pacific region, the presumption is that relatively adequate funding will be available from external sources such as World Bank Group (WBG) and through expanded spending of the LDC, LLDC and SIDS in the region to sustain and stimulate the economies. Funding should also be available as a result of G20 and other commitments as well as south-south funding mechanisms to put towards green and cool ICTs.

The WBG is part of the UN Secretary General's Climate Change Team and is a partner of the UN family within the framework of "Acting on Climate Change: The UN Delivering as One." Collaborative efforts with the multilateral development banks (MDBs) in regard to climate action have been further strengthened through joint implementation of initiatives such as the Climate Investment Funds (CIF), which were approved by the World Bank Group's Board of Directors in July 2008. The funds, encompassing the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF), are built on the principle of utilizing the skills and capabilities of the MDBs to raise and deliver new and additional resources at significant scale[96]. The five MDBs are:

1. African Development Bank
2. Asian Development Bank
3. European Bank for Reconstruction and Development
4. Inter-American Development Bank
5. World Bank Group

In October 2008, the WBG adopted the Strategic Framework on Development and Climate Change (SFDCC)[97]. The framework contains six action areas that are aligned with the Bali Action Plan and aim to:

1. Support climate action in country-led development processes
2. Mobilize additional concessional and innovative finance
3. Facilitate the development of market-based financing mechanisms
4. Leverage private sector resources
5. Support accelerated development and deployment of new technologies
6. Step up policy research, knowledge and capacity building

---

[95] The World Bank (2009),
http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,date:2009-02-17~menuPK:34461~pagePK:34392~piPK:64256810~theSitePK:4607,00.html#Story1

[96] The World Bank (2009),pp. 2-5,
http://siteresources.worldbank.org/EXTCC/Resources/WBGatWork.pdf

[97] The World Bank (2009), This document as well as the technical background document can be accessed at: www.worldbank.org/climatechange

Among others, there are WBG Climate Investment Funds, consisting of two trust funds, which is said to be worth US$6 billion.

The Asian Development Bank (ADB) is going to double its clean energy investments in the region to $2 billion yearly to help cut GHG emissions. Private entities, such as JP Morgan, plans to launch a $1 billion fund to invest in green and eco-friendly industries in the Republic of Korea.

F. Policy Options and Possible Actions

Based on the above findings, there are a number of policy options and possible actions by the governments to further deepen the introduction and implementation of green and cool ICT. This report highlights the importance of government intervention and lays down some technical, economic and behavioral challenges that need to be overcome to accelerate this process.

It is important to put into perspective the development problems that practitioners of sustainable development are facing in the Asia Pacific region. Poor people perceive poverty in a much complex manner and they employ a range of strategies, not only to maximize income, but also to minimise risk and to protect or increase other items that they value[98].   Therefore, these differentiating values must be taken into account depending on the socio-economic landscape of a targeted green and cool ICT deployment location.

Figure 17: Barriers and required actions to mainstream smart work through green and cool ICT

---
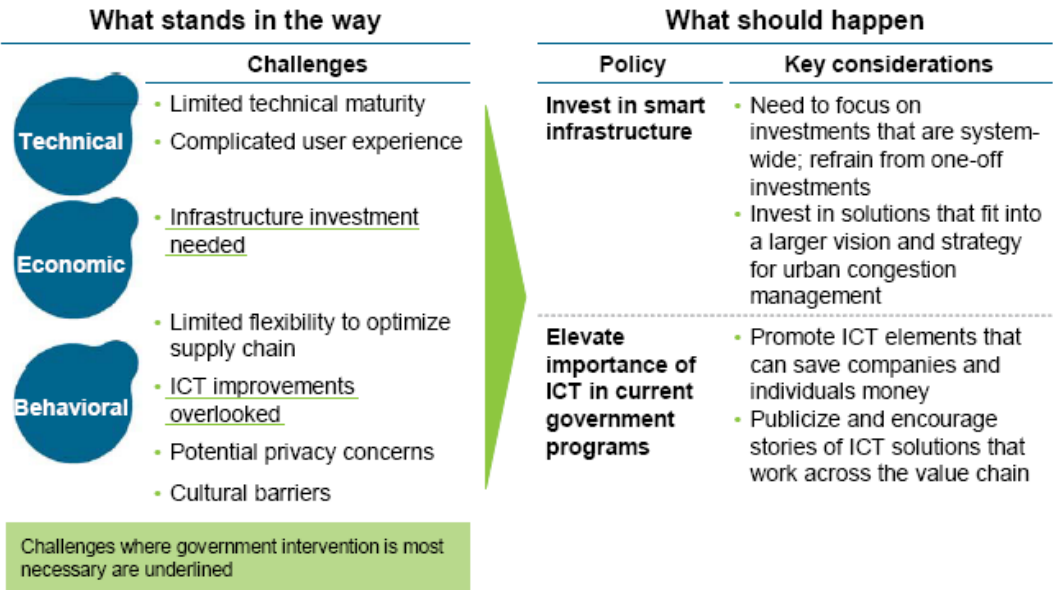
[98] Sarah Parkinson, Ricardo Ramírez (20060, "Using a sustainable livelihoods approach to assessing the impact of ICTs in development"

Source: Smart 2020" Enabling the low carbon economy in the information age[99]

An examination of the different outcomes of green and cool ICT policies and strategies are represented in Table 2. The ideal scenario depicted as the "Smart world" can only be achieved through joint efforts of policy makers, ICT providers and users so that transformative solutions, such as virtual meetings and more efficient information dissemination and exchange, are allowed to reach their potential of fueling growth as well as improving quality of life.

Table 2: Overview of different levels of mainstreaming of green and cool ICT[100]

Possible scenarios of our future		IT industry and end user behavior	
		IT industry and end users/people do not address climate change and green growth issues specifically	IT industry and users/people aggressively pursue and offer climate friendly solutions
Policy arena	Effective climate change related policy, including support for green and cool solutions	Policy heavy world	Smart world
	Weak climate change related policy, not considering the role of green and cool ICT	High carbon world (maybe even end of the world)	Tech heavy world

Source: WWF (2009), "From workplace to anyplace assessing the opportunities to reduce greenhouse gas emissions with virtual meetings and telecommuting"

Meeting development challenges, addressing economic and financial concerns without deepening debts, enhancing long-term economic competitiveness as well as enhancing sustainable provision of public services accelerated by ICT are key elements to consider when discussing ICT policy options and strategies.

Better procurement practices and disseminating information on best-practice cases are among the simple and quick solutions that can be implemented in a relatively short time frame in order to begin the process of mainstreaming green and cool ICT. These and other similar activities are most effective when there is active participation of both the public and private sectors, as highlighted in the Table 3[101].

Table 3: A framework of policies and strategies for effectively implementing green and cool ICT and responsibilities of the key actors

---

[99] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age United States report Addendum, pp.26-28, http://www.smart2020.org/

[100] WWF (2009), "From workplace to anyplace assessing the opportunities to reduce greenhouse gas emissions with virtual meetings and telecommuting"

[101] WWF (2009), "From workplace to anyplace assessing the opportunities to reduce greenhouse gas emissions with virtual meetings and telecommuting"

	Public sector	**ICT industry**	**Users**
Ensure broadband infrastructure	Regulatory framework and incentives *	Direct investment ***	
Build knowledge and capacity on green and cool ICT use for GHG emissions reduction	Core function of the public sector ***	Most knowledgeable on technology and its uses ***	Direct experience and practical insight ***
Remove regulatory barriers	Assess and revise regulation ***	Identify barriers and propose solutions **	Identify barriers and propose solutions **
Leverage procurement to promote more green and cool ICT use	***	**	**
Articulate methodologies and data collection and analysis	Dissemination and standardization*	Work with customers and act as facilitator***	Direct application and standard development ***
Systematically assess the emissions impact of ICT solutions	Macro-level analyses***	Systematically assess the impact of products and services ***	Gain direct experience and practical insight ***
Set up data collection systems	Marco-level and standard creation ***	Embed data collection and communication capabilities in IT ***	Implement company and supply-chain-wide systems ***
Disseminate best practices	Country level ***	Customers and policy makers ***	With peers, suppliers, and policy makers ***
Introduce policies that channel resources towards creating low-carbon emissions	Assess and develop appropriate policies ***	Provide advice and explore solutions **	Provide advice and explore solutions **
Technology development and tailoring for developing countries	Provide support and knowledge ***	Develop technology ***	Help articulate requirements ***
Capacity building and information dissemination in developing countries	Support with tools and funding instruments***	Work with local and international suppliers and customers ***	Work with local suppliers and customers ***

* Limited role
** Moderately important role
*** Important role

A vital action to direct actionable policies and funding could be the setting up of centers of excellence to analyze effective and practical digital substitutions for socio-economic development. They can be central to monetizing carbon and other emissions related to green and cool ICT and to monitoring and evaluating the balance between emissions output and reduction.

Furthermore, a host of green and cool ICT, such as mobile applications, can be experimented at the centers for exemplifying their catalytic nature. Such centers can

also explore ways to set up an independent operation of actual redeemable carbon points for using e-government applications through mobile phones. The rebate or redeemable amount could come from collaboration among mobile operators, banks and government in the form of operational cost reduction initiatives. Mobile phones could be used to get community level feedback on carbon emissions related initiatives.

Based on these recommendations from existing studies, and taking into account the state of ICT development among ESCAP's member countries, in particular LDCs, LLDCs and SIDS, some steps to reach the smart world and overcome challenges include the following:

1) Create an enabling ICT policy framework

It was concluded that government has a significant role to play in promoting green and cool ICT, including the following:

- Reflect environmental concerns, such as less use of materials and energy, in the ICT policy, strategy and initiatives
- Assess ICT infrastructure, products and services against socio-economic-environmental criteria when purchasing
- Prioritize mobile communication and applications and videoconferencing as green and cool ICT, wherever possible in government spending and ODA-funded projects
- Establish a Centre of Excellence (as described above)
- Promote evaluation of ICT policies, strategies and initiatives against environmental concerns, including GHG emissions reduction
- Encourage investments in green and cool ICT infrastructure
- Support pilot projects

2) Support the business case when markets do not produce the desired outcome

Since green and cool ICT is a new concept, the private sector companies might not be aware of a need for taking into consideration environmental concerns. Thus, creating incentives for the private sector to invest in green and cool ICT might accelerate the development of a market.

- Encourage more research and studies on other green and cool ICT at the national level by governments and private sector alike
- Raise awareness on market potentials for green and cool ICT among the private sector companies
- Create right financial incentives to encourage the development of private sector in developing green and cool IT products and services
- Encourage green and cool ICT procurement by the public and private sectors

3) Encourage positive behavior change among end users

This report also highlighted that existing ICT initiatives and equipment could go a long way in reducing energy and material consumption if certain behavioral and attitudinal changes are introduced and conformed to by end users. On the other hand, introducing and expanding green and cool ICT applications, such as e-government, only to print out more forms and documents, would not bring the maximum benefits.

- Government agencies lead by example by setting a target in reducing use of materials and establishing necessary procedures, such as introducing travel substitution and more videoconferencing
- Government, academia and mass media facilitate and coordinate the sharing of information, good practices and lessons learned in ensuring awareness raising on green and cool ICT

ESCAP could play a vital role in assisting member countries to raise awareness on environmental concerns of ICT initiatives for socio-economic development and deepen an understanding of other possible green and cool ICT which could be introduced to our developing member countries.

ESCAP will also continue the work in assisting member countries to expand ICT access to un-connected remote and rural areas as part of the implementation of the WSIS outcomes, which would further expand opportunities to tap into green and cool ICT.

At the same time, ESCAP, being a multi-disciplinary regional organization, has an advantage of linking green and cool ICT to various other sectors, such as macroeconomics, environment and energy, while assisting member countries to ensure social concerns of vulnerable groups are reflected in the designing, implementation and evaluation of green and cool ICT.

G. Conclusions

In recent years, Asia and the Pacific has been rocked by a series of crises, ranging from sudden increases in food and fuel prices to the deep Economic Crisis in the context of growing threats of climate change. ESCAP member countries have been grappling with urgent measures, responses and actions to deal with all of them at the same time, while addressing other socio-economic development issues and poverty reduction. In order to address the current global Economic Crisis, a number of countries pledged stimulus packages and increased government spending to sustain economies. Some countries went a step further to announce what is labeled as a "Green Stimulus Package" to ensure that environmental aspects are taken into account in dispensing the packages.

This report is prepared to bring to the attention of decision and policy makers that ICT, in particular green ICT, has an important role to play in stimulating economic activities, advancing social development goals and promoting sustainable development. In this report, "Green and cool ICT" is defined as ICT which, as a result of usage, produce comparatively low levels of carbon emissions while having the potential to exponentially reduce emissions in other areas by catalyzing technological, institutional and behavioral change, while bringing forth socio-economic benefits.

This report identified mobile communication, videoconferencing and e-government as affordable, accessible and available green and cool ICT for ESCAP's developing member countries. In order to mainstream green and cool ICT further, a number of recommendations are made in the previous section. Some of the recommendations do not need extensive investments; rather, a change in the way people work, such as using more e-government applications and services, is expected to make a significant impact, if implemented collectively. Other recommendations, such as building adequate green and cool ICT-centred infrastructure and development of private sector, may require a longer time frame.

Conventionally, ICT initiatives have been designed to address socio-economic challenges of our member countries, ranging from providing better public services to under-serviced rural population to creating better business and employment opportunities through e-business and e-commerce. This report recommends that policy and decision makers should also include environmental concerns in designing, implementing and evaluating ICT initiatives, and those initiatives which address all socio-economic-environmental factors should be given a priority, to be included in green stimulus packages and government spending in the coming months and years.

Although GHG emissions, reductions and energy savings are calculated for each application and product type, a future discussion would require a holistic view. The report highlighted the need for reliable and robust ICT infrastructure which can bring about socio-economic gains, with a reduced level of carbon emissions. However, the same infrastructure will be used to materialize gains and savings for other identified green and cool ICT products and services; thus the total gains in introducing green and cool ICT would be greater.

ANNEXES

Annex 1: Glossary

CO₂e: Equivalent CO_2 (CO_2e) is the concentration of CO_2 that would cause the same level of radiative forcing as a given type and concentration of greenhouse gas. Examples of such greenhouse gases are methane, perfluorocarbons and nitrous oxide. CO_2e is expressed as parts per million by volume, ppmv.
(http://en.wikipedia.org/wiki/Carbon_dioxide_equivalent)

IDA: International Development Association

IBRD: International Bank for Reconstruction and Development

Mt: Million tons

Gt: Gigatonne (One billion tones)

Radiative forcing: In climate science, **radiative forcing** is (loosely) defined as the change in net irradance at the tropopause. "Net irradiance" is the difference between the incoming radiation energy and the outgoing radiation energy in a given climate system and is thus measured in Watts per square meter. The change is computed based on "unperturbed" values, as defined by the Intergovernmental Panel on Climate Change (IPCC) as the measured difference relative to a base period. For radiative forcings for the industrial era, it is customary to take the year 1750 as the defined starting point. A positive forcing (more incoming energy) tends to warm the system, while a negative forcing (more outgoing energy) tends to cool it. Possible sources of radiative forcing are changes in insolation (incident solar radiation), or the effects of variations in the amount of radiatively active gases and aerosols present. Because the IPCC regularly assesses the radiative forcing, it also has a more specific technical definition - see "IPCC usage" section.
 http://en.wikipedia.org/wiki/Radiative_forcing

Annex 2: Case studies and statements

Case study: Smart parking network to ease San Franciscans' parking woes

As of fall 2008, 6,000 of San Francisco's 24,000 parking spots will be connected to a wireless network that alerts drivers to free spaces nearby. Using their mobile phones, parkers can search a city map for free spots, receive parking alerts and potentially even feed a meter remotely.

Embedded sensors glued onto the street monitor the speed of traffic and wirelessly relay parking availability and congestion information to a central management office. This information is tracked by the city's transportation officials and posted on websites that smart phones can access.

The data will allow officials to track congestion in real-time and adjust parking durations and pricing to reflect "market" conditions. The city also plans to expand the use of the sensor network to better serve the public by monitoring air quality conditions and detecting possible safety threats.

Officials estimate that a full 30% of all traffic in downtown areas is caused by drivers searching for curb-side parking. They hope that these initiatives may reduce the city's environmental footprint in addition to improving San Franciscans' lifestyle.[102]

Case study: Integrated ICT-based commuting program at Microsoft abates CO2 emissions by 3,077 tons annually

The "commute" website on the Microsoft intranet forms the heart of a fully integrated ICT-based commuting program. On the website, employees can consult the corporate "Connector" bus' real-time schedule information and make reservations, obtain local road congestion data to make the best decision about an upcoming commute, or schedule a carpool home through Microsoft's RideShare software. The RideShare program matches employees by their departure address, destination address and desired commute hours and provides the user with a map of carpools and vanpools that match his or her needs.

For those who choose to drive, Microsoft's "SmartPhlow" software can predict traffic patterns throughout Seattle from just hours to several days in advance and alert users via their phones when something out of the ordinary is going to happen. This allows commuters to plan their transit smartly and avoid congestion and stress, while also reducing their carbon footprint.[103]

"Asia-Pacific countries need to work together to develop a low-carbon economy. There is a lot of room for cooperation on economic development and climate change and energy issues"

-Noeleen Heyzer, Executive Secretary of ESCAP

Source: Xinhua/UNIS (Monday, 22 June 2009)

---

[102] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age United States report Addendum, pp. 29, http://www.smart2020.org/

[103] GeSI (2008), Smart 2020: Enabling the low carbon economy in the information age United States report Addendum, pp. 29, http://www.smart2020.org/

"Despite difficult times, there are reasons to be optimistic. Having contributed consistently as a high-growth sector in its own right, ICTs can now power economic recovery across all sectors. Along with stimulus packages put together by governments, the ICT industry must continue to invest in infrastructure and the roll out of cost-effective services, such as next-generation networks"

- Hamadoun Tour, ITU secretary-general

"ADB has made climate change a top priority. Last year, we provided nearly $1.7 billion for projects with clean energy components, far exceeding our $1 billion target. Among others, our initiatives include wind power projects in the People's Republic of China and India, power transmission enhancement in Azerbaijan, green power development in Bhutan, and energy-efficient lighting for low-income households in the Philippines. With transport a major area of concern, we are supporting the improvement of energy-efficient mass transit systems in several Asian cities. And we support several initiatives that integrate forest protection and sustainable land use while capturing benefits from carbon sequestration. Several of our developing member countries have adopted national action plans on climate change, and we look forward to seeing more."

- Haruhiko Kuroda,
President, Asian Development Bank (ADB)
May 2009
Bali, Indonesia

THREE years ago Pip Coburn left his job as an analyst at UBS, a global bank, in order to start his own investment consultancy, Coburn Ventures. At his first staff meeting, in a Manhattan café, he and his five colleagues drew up their to-do list. The most urgent item, everybody agreed, was to get BlackBerries. Then they needed to start contacting clients. And at some point they should probably find some office space, ideally in the chic area around New York's Union Square.

Within three days they had their BlackBerries and were pitching their offerings to fund managers. That went well and kept everybody busy. All six were roaming around the city and country, working from wherever they pleased and meeting clients either virtually—via e-mail, phone or instant messaging—or physically wherever the clients preferred. "No client ever even asked me whether we had an office," says Mr Coburn, "so the office space never rose to the top of the agenda."

Source: The Economist [104]

"There are 370 TelePresence units in operation globally now. Cisco has reduced over $200 million in travel globally … and we have measured $70 million in productivity improvement from this,"

---

[104] The Economist (2008),
http://www.economist.com/specialreports/displaystory.cfm?story_id=10950378

-Les Williamson, Managing Director, Cisco Australia

Source: Australian IT[105]

"As MPs, we are constantly having meetings with constituents, colleagues and other stakeholders. Many of these face-to-face meetings are necessary, but many are not. If all MPs took advantage of online meeting technology it would be a significant step in reducing thousands of travel miles and the associated carbon emissions."

-Nick Hurd, Member of Parliament, UK

"I already use the train to travel to and from Westminster, but hope to further reduce my carbon footprint by stopping needless travel to Cardif for across London for meetings. This also means that I'm reducing my travel expenses - so taxpayers' money can be put to better use. Another key reason for using web conferencing technology is that I want to be as accessible as possible to my constituents. Nothing can replace my traditional surgery, but this means that even when I have to be in London, I can have meetings with my constituents who are over 230 miles away."

- Mark Williams, Member of Parliament, UK

"We used to spend around ten days per month on the road often holding no more than two meetings per day," explains Bowman. "Bringing meetings online means we've made huge savings whilst reducing carbon emissions. In fact, for our latest web event, we are due to have over 300 attendees from as far away as the US, Australia and the United Arab Emirates and nobody needs to leave their desks."

-Martin Bowman, Sales Director of a Scottish software company

Source: PublicTechnology.net[106]

"There are not a lot of things that do better in a challenging economic environment but Skype is one of them. We continue to see consumer take-up of Skype accelerating globally and across Asia Pacific because people feel they can get value and quality without making a huge trade off. There are new opportunities in the business market where some 30% of the Skype user-base comes from. Many small and mid-sized businesses are using Skype and finding that Skype saves on telco costs, increases employee productivity, enables them to communicate better with customers and work more closely with colleagues"

-Dan Neary, vice president & general manager, Skype (Singapore)

Source: Marketing-interactive.com[107]

---

[105] Australian IT (2009),
http://www.australianit.news.com.au/story/0,24897,25114178-15306,00.html

[106] PublicTechnology.net (2007), MPs are holding meetings online to combat climate change,
http://kmportal/display/ictblog/MPs+are+holding+meetings+online+to+combat+climate+change

Annex 3: World Bank Group funding for 2007

World Bank Group (WBG) lending & investment by sector (Fiscal Year 2007) [108]

IBRD Lending
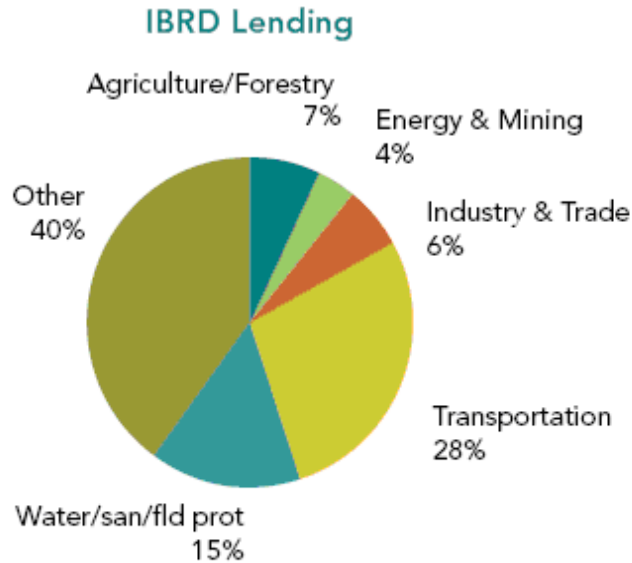
Source: IBRD (Business Warehouse of 1/27/08). 'Other' includes Public Administration and Law (21.3%), Education (3.3%), Finance and PSD (8.9%),Health and Social Services (6.9%), Information and Communication (0.01%).

---

[107] Marketing-interactive.com (2009), http://marketing-interactive.com/news/10579

[108] The World Bank (2008), Development and climate change: A Strategic Framework for the World Bank Group, pp. 20-22, http://siteresources.worldbank.org/EXTCC/Resources/407863-1219339233881/DCCSFTechnicalReport.pdf

IDA Lending

Agriculture/Forestry
7%

Energy & Mining
10%

Industry & Trade
4%

Transportation
12%

Water/san/ fld prot, 10%

Other
57%

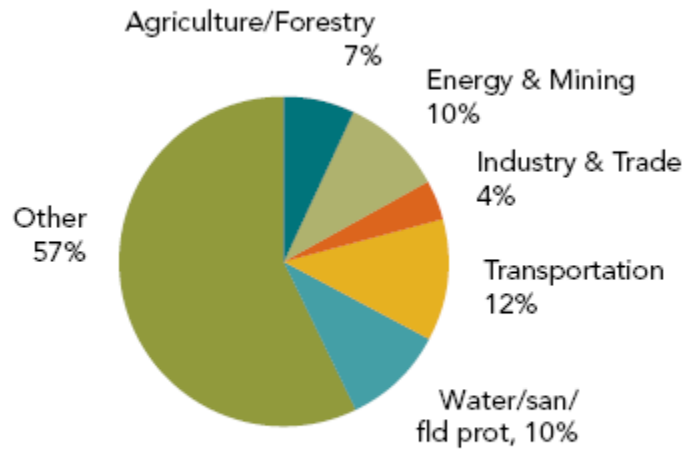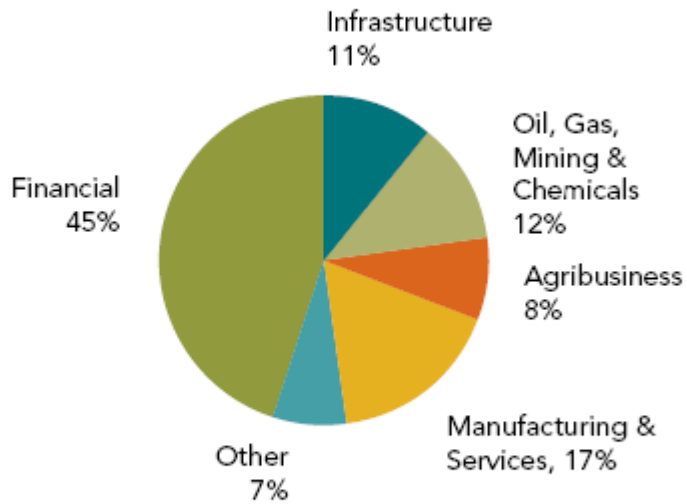*Source:* IDA (Business Warehouse of 1/27/08); 'Other' includes Public Administration and Law (23%), Education (14%), Finance (4%), Health and Social Services (16%), Information and Communication (1%).

IFC Investment

Infrastructure
11%

Oil, Gas, Mining & Chemicals
12%

Agribusiness
8%

Manufacturing & Services, 17%

Other
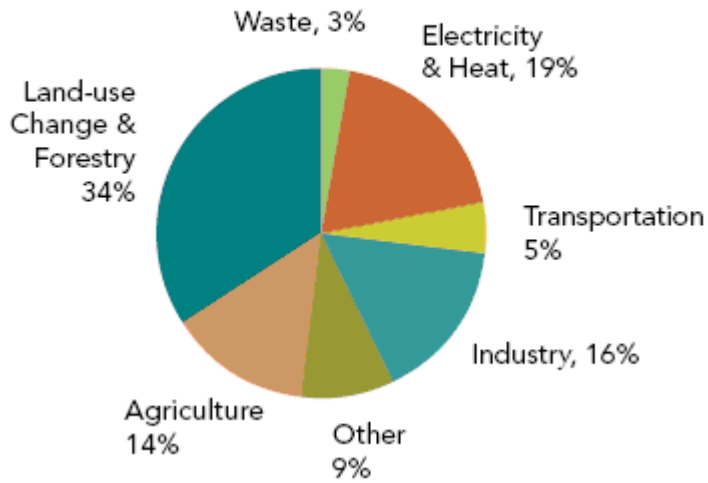7%

Financial
45%

Source: IFC Annual Report 07. 'Financial' includes global financial markets, subnational finance, and private equity and investment funds. 'Other' includes information and communication technologies, and health and education.

Emissions sources and WBG lending profile for Asia and the Pacific[109]

---

[109] The World Bank (2008), Development and climate change:

GHGs by Sector
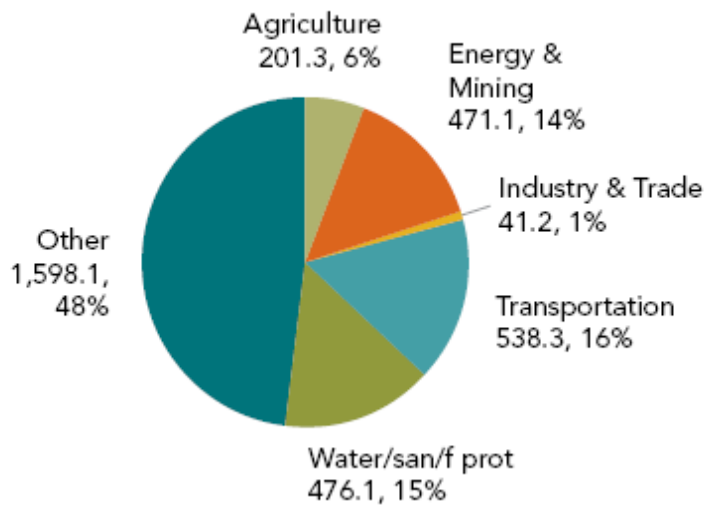
- Waste, 3%
- Electricity & Heat, 19%
- Land-use Change & Forestry 34%
- Transportation 5%
- Agriculture 14%
- Other 9%
- Industry, 16%

IDA Lending by Sectors ($M, %), FY05–07

- Agriculture 201.3, 6%
- Energy & Mining 471.1, 14%
- Industry & Trade 41.2, 1%
- Other 1,598.1, 48%
- Transportation 538.3, 16%
- Water/san/f prot 476.1, 15%

A Strategic Framework for the World Bank Group, pp. 20-22,
http://siteresources.worldbank.org/EXTCC/Resources/407863-1219339233881/DCCSFTechnicalReport.pdf

IBRD Lending by Sectors ($M, %), FY05–07

Agriculture
648.54, 8%

Energy &
Mining, 389.66, 9%

Industry & Trade
249.15, 3%

Other
3,527.61
42%

Transportation
1,975.32, 24%

Water/san/f prot
1,488.47, 18%
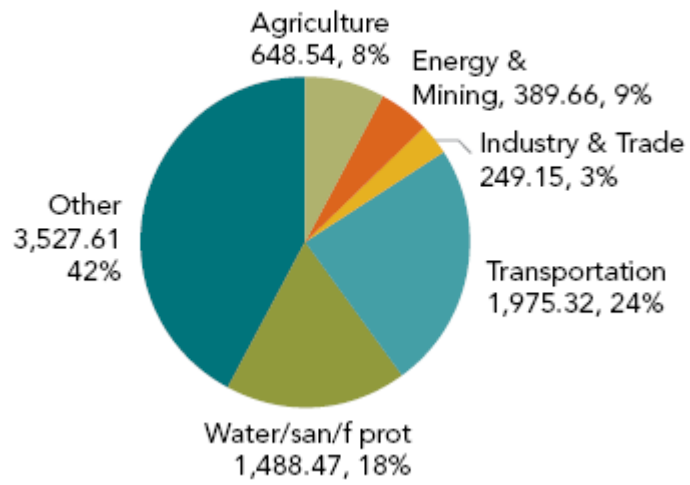
Annex 4: Integrated approach to sustainable development[110]

---

[110] ESCAP (2006), Green growth at a glance,
http://www.unescap.org/esd/water/publications/sd/GGBrochure.pdf
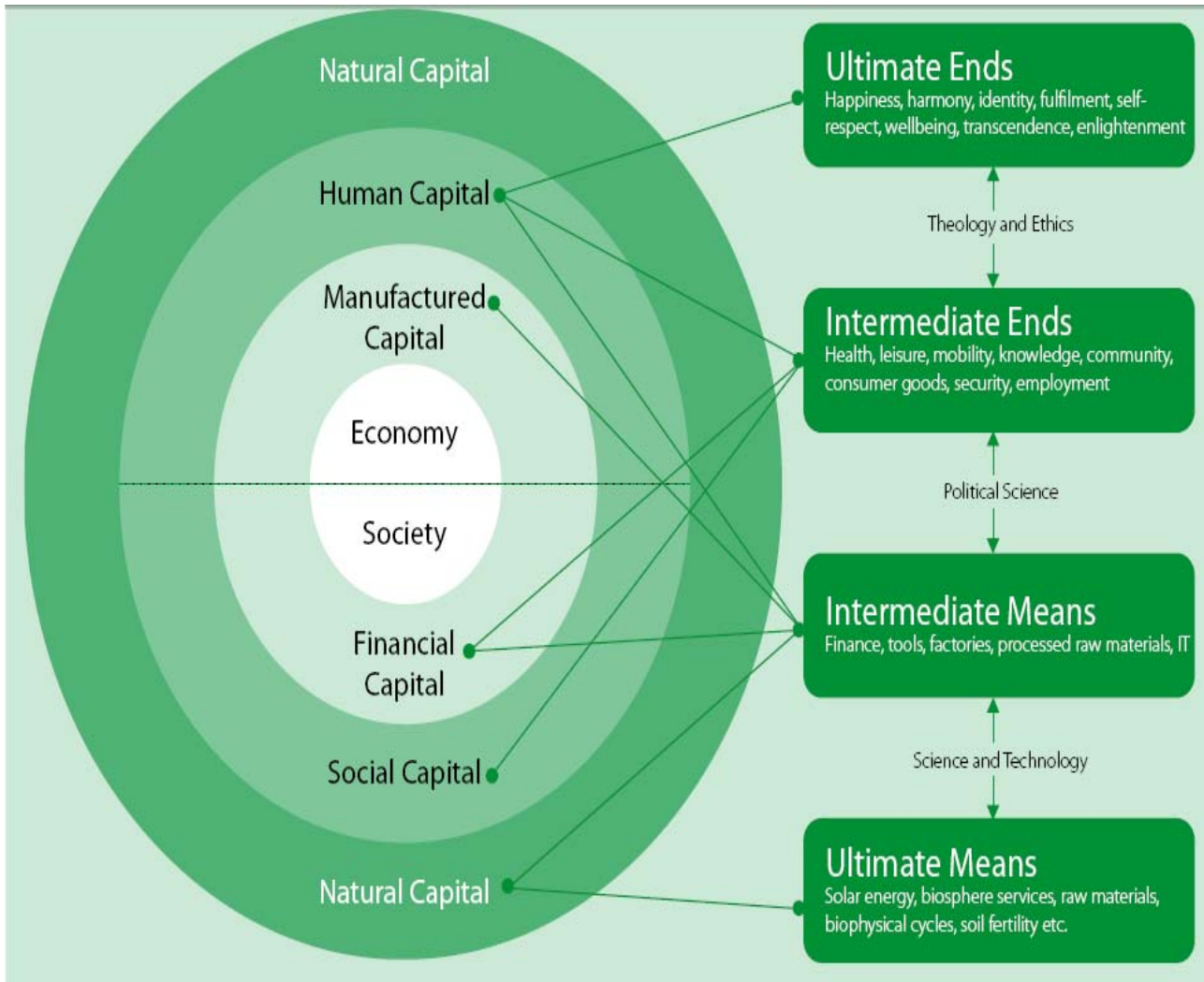
Annex 5: IPCC Overview of sectored Carbon Dioxide Emissions

http://www.ipcc.ch/ipccreports/sres/emission/118.htm#533

The UN defines development as the furthering of human choices. Such choices are neither finite nor static. Yet, regardless of the level of development, the three essential choices are to have access to the resources needed for a decent standard of living, to lead a long and healthy life, and to acquire knowledge (UNDP, 1997). Other valued choices range from political, economic, and social freedom to opportunities for being creative and productive, and to enjoy human rights (UNDP, 1997).

As a result of different model specifications and detail, it is not possible to draw up consistent comparisons between sector emissions across different models. An overview of sectored CO_2 emissions by sector and source category is summarized in Box 5-2 on the basis of the results of the MESSAGE (for energy and industrial sources) and AIM (for land-use change sources) models.

Box 5-2: CO$_2$ Emissions by Sector and Source for MESSAGE Scenarios

Table 5-4 gives an overview of CO_2 emissions by sector and source category according to the IPCC reporting format given in Watson et al. (1996b). The differences in sector detail across models mean a consistent comparison and sector CO_2 emission balances are only possible within one particular modeling framework. Table 5-4 presents the scenario results as calculated with the MESSAGE model for 1990, 2050, and 2100 and for the four scenario families and their scenario groups. Emissions related to land-use change were derived from consistent model runs with the AIM model.

As in Watson et al. (1996b), emissions are presented by sector, and emissions categories adopt both supply and demand perspectives for energy-related CO_2 emissions. The supply side CO_2 balance accounts emissions at the point of energy combustion, that is at a coal-fired power plant (electric generation) or by burning coal in industrial boilers (direct fuel use by industry). Conversely, the demand side CO_2 balance accounts emissions per end-use category, irrespective of whether emissions originate directly at the point of end-use or upstream in the energy conversion sector. For example, for residential and commercial energy uses, CO_2 emissions include those from direct fuel combustion as well as those emissions that originate from the generation of electricity consumed by the residential and commercial sectors. Finally, an emissions balance by source category is given, in which emissions are accounted for at the level of primary energy (solids, liquids, and gases), again after Watson et al. (1996b). Non-energy emissions are included in a separate "others" category. Combined, these different emission balances can serve as data input for subsequent mitigation analyses at the sectored level or at that of the entire economy.

Table 5-4: Global CO$_2$ (Million tonnes of Carbon Dioxide- MtC) emissions by sector and source category for seven scenarios calculated with the MESSAGE model for 1990, 2050, and 2100. In the SPM, A1C and A1G scenarios are merged into one fossil-intensive A1FI scenario group (see also footnote 2).

	1990	2050							2100						
		A1B	A2	B1	B2	A1T	A1G	A1C	A1B	A2	B1	B2	A1T	A1G	A1C
Supply Side															
Energy Supply/Transformation															
Electric generation	1773	4783	4875	763	2844	2192	6519	5924	7541	9283	207	5323	293	8854	11166
Synfuels production	0	1162	1613	2207	929	1278	2294	3958	170	7245	2071	2848	441	3619	9788
Other conversion*	680	2277	1312	999	1170	1506	3012	719	2901	2393	735	1394	807	7682	622

Direct Use of Fuels by Sector

Residential/commercial	880	2782	1618	1361	1494	2362	3606	2458	1402	925	367	973	656	3085	1255
Industry	1289	1540	1515	843	1401	845	987	1165	273	1601	176	1166	503	984	631
Transportation	1310	3823	2952	2669	2587	3445	4513	5587	1881	4524	1135	1845	1577	5924	8640
Feedstocks	303	912	1311	490	891	972	766	768	91	1963	66	398	448	535	422

Non-Energy Emissions

Cement prod./gas flaring	68	172	192	65	104	141	206	249	136	479	36	187	64	224	462
Land- use change	1010	-139	-104	-902	-436	-139	-139	-139	2	81	-646	-501	2	2	2
TOTAL	7312	16789	15044	8367	10983	12601	21802	21086	14397	28493	4147	13634	4789	30909	32988

Demand Side

Residential/commercial	1995	7212	4631	3126	4059	4846	10290	7032	9407	7827	1698	5830	1209	14971	10939
Industry **	2784	3916	5734	1975	4042	2996	4388	4434	1471	9165	601	4909	1244	4341	3493
Transportation	1523	5800	4783	4168	3318	4897	7262	9759	3516	11421	2494	3396	2334	11596	18554
Land-use change	1010	-139	-104	-902	-436	-139	-139	-139	2	81	-646	-501	2	2	2
TOTAL	7312	16789	15044	8367	10983	12601	21802	21086	14397	27493	4147	13634	4789	30909	32988

By Source

Solids	2346	5356	7106	841	2230	2643	7553	12471	6166	22586	565	7765	188	3904	29596
Liquids	2787	5618	4100	3832	4542	5007	7310	4185	2751	933	910	1039	1542	7813	1118
Gases	1102	5782	3750	4532	4544	4949	6872	4320	5342	4415	3283	5144	2993	18967	1810
Others***	1078	33	88	-837	-332	3	67	110	138	559	-611	314	66	226	464
TOTAL	7312	16789	15044	8367	10983	12601	21802	21086	14397	28493	4147	43634	4789	30909	32988

* Includes emissions from district- heat production, energy transmission/ distribution, oil refining, fuel extraction, and other conversion losses.
** Includes emissions from feedstocks, cement production, and gas flaring.
*** Emissions from land- use change, cement production, and gas flaring.

source: IPCC [111]

---

[111] IPCC special report on emission scenarios,
http://www.ipcc.ch/ipccreports/sres/emission/118.htm#533

Recommended reading:

Anderson, A. H., McEwan, R., Bal, J. and Carletta, J., 2007, "Virtual team meetings: An analysis of communication and context", *Computers in Human Behavior,* vol. 23, no. 5, pp. 2558-2580.

Denstadli, J.M., 2004. "Impacts of videoconferencing on business travel: the Norwegian experience." Journal of Air Transport Management 10: 371–376.

Duarte, D.L., N.T. Snyder, 2001. Mastering Virtual Teams. Jossey-Bass, Inc.: San Francisco.

Egido, C., 1988, "Videoconferencing as a Technology to Support Group Work: A Review of its Failure", *Association for Computing Machinery,* vol. 88, pp. 13.

Jackson, Paul J. (eds), van der Wielen, Jos M. (eds), 1998. "Teleworking: International Perspectives-From telecommuting to the virtual organization". Routledge: London

Roy, J., Filiatrault, P., 1998. "The impact of new business practices and information technologies on business air-travel demand." Journal of Air Transport Management 4: 77-86.

Sellen, A.J., 1995, *Remote Conversations: The Effects of Mediating Talk With Technology*.

Whittaker, S., 1995, "Rethinking video as a technology for interpersonal communications: theory and design implications", *International Journal of Human-Computer Studies,* vol. 42, no. 5, pp. 501-529.