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UNEP

PREVIEW

Green Growth, Resources and Resilience

Environmental sustainability in Asia and the Pacific, 2010

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PREVIEW

Green Growth, Resources and Resilience

Environmental sustainability in Asia and the Pacific, 2010

This preview of the forthcoming ***Green Growth, Resources and Resilience*** report highlights the shifts that have taken place in the outlook for the Asian and Pacific region since 2005. While the region's countries are driving the global "green growth" agenda, the report shows that the challenge of eco-efficient economic growth and inclusive resource use is critical and still growing. Fundamental, rather than incremental changes are needed—governments must therefore take the lead in re-orienting both the "visible" and the "invisible" economic infrastructure. This preview report is intended to assist policymakers involved in the 2010 Ministerial Conference on Environment and Development in Asia and the Pacific and other stakeholders.

Preview
Green Growth, Resources and Resilience
Environmental sustainability in Asia and the Pacific, 2010

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This publication follows the United Nations practice in references to countries. Where there are space constraints, some country names have been abbreviated. In the Asian Development Bank, China is referred to as the People's Republic of China; Fiji as the Fiji Islands; and Kyrgyzstan, as the Kyrgyz Republic. The co-publishing organizations do not guarantee the accuracy of the data included in this publication and accept no responsibility for any consequence of their use. This publication has been issued without formal editing.

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Preface

The Asia-Pacific region faces a new economic reality—a reality characterized by growing resource constraints. Unsustainable patterns of natural resource use and climate change have brought economic and environmental challenges together, with dramatic impacts on millions of people.

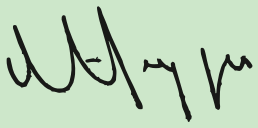
At the time this report was prepared, monsoon floods, the worst in living memory, had covered one fifth of Pakistan's area and displaced over 20 million people. Almost simultaneously, the Russian Federation experienced the hottest weather on record. Drought and the resulting crop-destroying fires eliminated one quarter of its total wheat output. The current economic growth patterns that overexploit natural capital are not economically, socially or environmentally sustainable.

These storm clouds come with a tantalizing silver lining. Awareness, attitudes, markets and technologies are being transformed to make the "greening" of economic growth more economically and politically feasible than ever before. Visionary leadership, the engagement of stakeholders and re-orientation of the economic "infrastructure" are both needed and possible. At the same time, the greening of economic growth is uncharted territory: no country can be expected to achieve it alone. Global and regional cooperation has to be the basis for creating a better future.

The demand for information and analysis has expanded in the five years since ESCAP received a mandate to promote green growth as a strategy to achieve sustainable development, at the 2005 Ministerial Conference on Environment and Development (MCED) in Seoul. We are pleased to join forces with colleagues at the Asian Development Bank (ADB) and the United Nations Environment Programme (UNEP) to publish a preview of the ***Green Growth, Resources and Resilience*** report. The report is the sixth in a series of reports produced every five years by ESCAP, and the third in the ADB's ***Asian Environment Outlook*** series. It is also in line with UNEP's mandate to keep the global environment under review. The 2010 MCED, to be held in Astana, Kazakhstan, will discuss its preliminary findings and recommendations.

The work done by authors, experts, policymakers, consultants, staff members of ESCAP, ADB and UNEP, government focal points, and others who participated in a series of authors' meetings, provided texts, reviewed drafts, stimulated ideas, provided leads to information or who otherwise contributed to the report are acknowledged with appreciation.

We would especially like to acknowledge the contributions of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia in relation to the ground-breaking work done on material consumption and resource efficiency (in partnership with UNEP), and the International Labour Organization Regional Office for Asia and the Pacific on the subject of green jobs.



Noeleen Heyzer

Under-Secretary-General of the
United Nations and
Executive Secretary of ESCAP

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Abbreviations and Acronyms

3Rs	reduce, reuse and recycle
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
ESCAP	Economic and Social Commission for Asia and the Pacific
GDP	gross domestic product
GHG	greenhouse gas
HDI	Human Development Index
ICT	information and communication technology
MCED	Ministerial Conference on Environment and Development in Asia and the Pacific
REDD	reducing emissions from deforestation and forest degradation
tCO_2e	tonnes of carbon dioxide equivalent
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Notes

The symbol "$" stands for the United States dollar unless otherwise indicated.

The Asian and Pacific region, unless otherwise specified, refers to the group of ESCAP members and associate members which are considered to lie within the Asian and Pacific geographic region. ESCAP, ADB and UNEP have differing regional compositions.

Subregions used in this report are as defined by ESCAP, and their countries are, unless otherwise specified:

East and North-East Asia: China, Democratic People's Republic of Korea, Japan, Mongolia and the Republic of Korea.

North and Central Asia: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Russian Federation, Turkmenistan and Uzbekistan.

South-East Asia: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste and Viet Nam.

South and South-West Asia: Afghanistan, Bangladesh, Bhutan, India, Islamic Republic of Iran, Maldives, Nepal, Pakistan, Sri Lanka and Turkey.

The Pacific: Australia, Fiji, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

EXECUTIVE SUMMARY

In 2005, economic growth rates in the Asian and Pacific region were among the highest in the world, and the socio-economic outlook was positive. The crisis of late 2008 and the responses of governments signaled the emergence of a new economic reality, one in which natural resource constraints are largely defining the future outlook.

A new reality means an evolving policy landscape. Policy opportunities have arisen as markets, attitudes and technologies develop, and as effective partnerships between civil society, the private sector and governments are established. Policymakers are now challenged to better deal with uncertainty, to build the capacity of stakeholders to adapt to a changing environment, and to grasp new opportunities. New governance challenges are presented as the numbers of institutions and stakeholders involved in managing environmental assets and threats multiply, as constraints on resources become more evident, and as regional economies and societies enter the global mainstream.

Action for sustainable development is now more economically and politically feasible than ever before, and governments and stakeholders in the region are searching for ways to rise to the challenges. "Green shoots" in the form of policies, initiatives and commitments to "green" economic growth are evident across the region. Many economies are lining up to start the "green race"—the transformation of markets and the acceleration of investments in green technologies and jobs.

The demand for resources and climate change are factors underlying the convergence of economic, resource and environmental challenges. Millions of people continue to live in poverty, and lack access to basic services such as water, energy, transport and housing. As resource constraints are revealed and as populations and economies continue to grow, sustainable development is increasingly about using resources more efficiently. In Asia and the Pacific, the use of key materials (metal ores, industrial and construction minerals, fossil fuels, and biomass) has accelerated since 2000 and the efficiency with which they are used has been declining.

Sustainable development also is increasingly about using resources more effectively as a basis for socio-economic progress. Countries vary widely in how well they use resources. Some countries have used resources relatively well to improve their peoples' well-being. But in other countries, the use of agricultural land, water, and energy is not having the expected impacts on meeting basic needs and boosting socio-economic progress.

Resources are used inefficiently and ineffectively, despite their limited availability; rising costs; supply risks; and the millions of people without sufficient food, water and energy. The capacity to use water effectively is of special concern. The use of these resources has impacts on the health and productivity of ecosystems and on natural landscapes. The resulting reductions in the flows of ecosystem services impact vulnerable and poor people the most heavily. Deepening social divides and vulnerability in the most affected countries are likely to result.

That a new economic paradigm is needed is shown by the increasingly evident limitations of conventional economic growth strategies to deliver long-term prosperity and stability to the majority of people. Economic models based on low-cost labour and inefficient resource use are not economically, socially or environmentally sustainable. Because the challenge presented by the needed change is enormous, fundamental, rather than incremental changes to economic "infrastructure" are needed to effect the systemic changes that will result in a green economy—one characterized by substantially increased investments in economic activities that enhance the earth's natural capital and reduce ecological scarcities and environmental risks (activities such as renewable energy, low-carbon transport; energy and water-efficient buildings; and sustainable agriculture, forest management and fisheries).

New ways of thinking about economic growth and the productive use of natural and human capital are needed. Exploitation of natural capital needs to be replaced with efficient and sustainable use. At the same time, economic growth patterns must focus on employment creation that minimizes or reverses negative impacts on the environment.

Key steps to greener growth include first, establishing a vision and tracking progress based on eco-efficiency and other indicators; second, establishing an integrated policy framework based on policy tools deployed in mutually reinforcing ways; and third, re-orienting governance approaches. A policy framework for promoting environmentally sustainable economic growth is essential, and must be underpinned by specific attention to promoting systemic changes. Systemic change can only be achieved by strategic attention to the both the "invisible" and the "visible" infrastructure of the economy.

The "invisible infrastructure" includes the prices, policies, regulations, technology and institutions that influence access to, use of, and investments in different kinds of capital. Invisible infrastructure also refers to the human capital—peoples' skills, knowledge and competencies—that are the basis for creating green jobs and supporting a shift to green growth. The key to achieving a green economy is fuelling the green growth "engine"—enabling the right price signals, facilitating financial innovations that correctly value resources used and shift investment patterns accordingly, and engaging stakeholders in taking action.

While stimulus investments and cash injections to support specific "green" sectors are important, any momentum gained towards greening of the economy will be lost unless the invisible economic infrastructure creates a virtuous cycle so that investments which promote resource efficiency and sustainable consumption and production patterns are broadened and accelerated, rather than reversed by increasing incomes.

Systemic changes also require attention to the built environment because the physical form of human settlements results in specific patterns of resource use that persist for decades to come. Rapid urbanization rates, significant unmet basic needs, and ongoing and future investments means that this "visible infrastructure" of the economy must be re-oriented towards maximizing eco-efficiency and equitable access to water, energy, transport and other services.

As an equally important aspect of the visible infrastructure of the economy, "natural infrastructure" provides valuable (but under-valued) economic inputs. Natural and agricultural landscapes, biodiversity and freshwater and marine environments support economies and societies in many ways. They ensure that water and food and raw materials can be provided, wastes absorbed, rural livelihoods supported, floods mitigated, and cultures and traditions are maintained, among other functions. Investments in natural infrastructure can help to save resources and money, and to revive and reshape local economies through nature-based tourism and other ecosystem-based economic options.

The priorities for action will take on different forms in different countries depending on their resource endowments, socio-economic challenges and capacities, and vulnerability to change. Some of the key constraints for which solutions exist include the "time gap" between short-term costs and long-term benefits, the need to ensure that the poor are not harmed by pricing policy changes, the fear of entering uncharted policy waters, and the lack of a clear vision.

The Asian and Pacific region has made encouraging first steps towards green growth as one path to sustainable development. With further commitment, deepening insight into policy solutions, and the right investments, the region could lead the globe on the road to a brighter future. No country can expect to achieve this vision alone, but it can be achieved through regional and global cooperation.

PART I: THE CHANGING POLICY LANDSCAPE

A changing regional outlook—converging challenges

In 2005, the growth rates of Asian and Pacific economies were among the highest in the world. This economic expansion raised expectations that many developing countries of the region would be able to achieve Millennium Development Goal 1—halving the number of people in poverty by 2015. Between 1990 and 2005, the region's population living in extreme poverty—on less than $1.25 per day—fell from 1.5 billion to 979 million.[1]

At the same time, the regional assessment for the fifth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED) warned that this socio-economic progress had been achieved at great environmental cost due to unsustainable, and often inequitable, economic growth patterns.[2]

The ongoing shift of a large part of the world's industrial activity to the Asian and Pacific region, coupled with rapid urbanization and industrialization involving intensive use of resources, had exerted considerable environmental pressure.

Some aspects of the region's environmental performance had improved (e.g. better urban air quality in some cities and slowed rates of forest loss); however, the unsustainable economic growth trends, increasingly frequent natural disasters, and the region's contribution to climate change threatened the prospects for continued growth and an acceptable quality of life.[3]

Five years later, in 2010, environmental conditions and trends have not changed significantly, but the socio-economic outlook is far less positive than it was. The region is facing a series of increasingly convergent challenges—insecurity about food, water and energy supplies; persistent economic uncertainty; and climate change impacts. As a result, hard-won gains in reducing poverty and improving people's lives are in danger of being reversed in some countries.

The triple food, fuel and financial crisis that came to a head in late 2008 resulted in a global recession, unemployment, hunger and social conflict. As a result, as many as 21 million people in Asia and the Pacific could have moved below the poverty line during 2009–2010.[4]

By July 2010, China, India, and other countries in the region had resumed their rapid economic growth trajectories.[5] However, the return to rapid growth does not mean that the 2008 crisis will soon become a distant memory. The convergence of the economic, resource and environmental challenges was decades in the making and the underlying forces have not yet been addressed (Box 1.1).

The gaps between the demand for natural resources and supplies of these resources, plus climate change have been instrumental in bringing these challenges together in a way that has increased socio-economic and environmental risk and uncertainty. High food prices, energy and commodity price volatility, persistent inequalities and economic uncertainty continue to cloud the regional outlook.

Climate and environmental change are important aspects of this changing outlook. The extent to which natural resources are used and the resulting impacts on natural systems indicates the approach of "tipping points" (at which an object or process is displaced from one state of stable equilibrium into a new state) in natural systems. Rapid and possibly irreversible environmental change can be expected.

One study examines nine global environmental processes—climate change, rates of biodiversity loss, interference with the nitrogen and phosphorus cycles, stratospheric ozone depletion,

Box 1.1: The 2008 crisis—a precursor

The 2008 triple food, fuel and financial crisis indicates what the future may hold. Gaps between the demand for and supply of key commodities, together with climate change, speculative investments and other factors, dramatically increased prices until 2008, resulting in critical impacts on global economies and people.

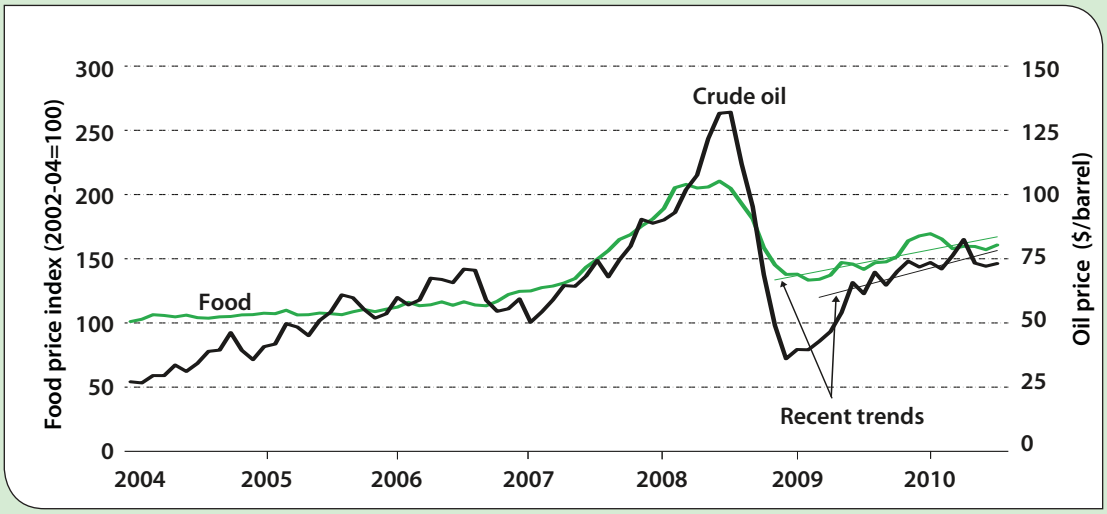
Higher food prices in Asia and the Pacific had already increased the number of undernourished people from 542 million in 2003–2005 to 583 million in 2007,[6] but energy prices proved a critical pressure point. Oil prices hit an all-time high of $145 per barrel in July 2008 and the prices of food, metals, minerals, and other commodities rose together. As the prices of industrial inputs, construction materials, and food increased (and other factors in the financial world weighed in), the global economy contracted dramatically and suddenly, and jobs and livelihoods were lost.

While the global recession interrupted a worrying trend of rising commodity prices, it is likely to provide only temporary relief. Food and energy prices have recovered and have continued to rise in tandem in 2010 (Figure).

The underlying reasons for the energy and commodity price "spikes" are still present. The demand for commodities and energy continues to grow. The perceptions of future resource scarcity have played a role in bringing economic, resource and environmental challenges together. Investments in closely integrated food, fuel and financial markets have increased the volatility of energy and commodity prices. As in the past, episodes of soaring prices will push up domestic inflation, hurt the poor, and expand budget deficits.[7]

As climate-related extreme events become more frequent and severe, so will the impacts of these events on people and economies. In early August 2010, the Russian Federation experienced the highest temperatures on record, and extensive wildfires, with massive impacts on grain production. At the same time, Pakistan experienced the worst floods in living memory, affecting more than 20 million people. The resulting shortfalls in grain production had an almost immediate impact on food prices.

Food and Agriculture Organization food price index and Brent crude oil price, January 2004 to February 2010



Sources: Economic and Social Commission for Asia and the Pacific (ESCAP) based on data from the Food and Agriculture Organization (FAO), World Food Situation, http://www.fao.org/worldfoodsituation/FoodPrices/Index/en and United States Energy Information Administration, available from http://tonto.eia.doe.gov/dnav/pet/hist/rbrteM.htm.

ocean acidification, global freshwater use, change in land use, chemical pollution and atmospheric aerosol loading—and finds that tipping points have already been passed in the case of climate change, rate of biodiversity loss, and interference with the nitrogen cycle.[8]

Environmental change has economic consequences. In four countries covered by an Asian Development Bank (ADB) study (Indonesia, the Philippines, Thailand, and Viet Nam), the costs associated with climate change could be equivalent to a loss of 6.7% of their combined gross domestic product (GDP) by 2100—more than twice the world average.[9]

Economic growth both hinders and aids action to deal with the risks the region faces. Enhanced incomes facilitate investments in much-needed technological change, infrastructure and job creation; however, current economic growth patterns increase the stress on limited resources and competition for access to them among myriad users.

A new economic reality

The increasingly evident constraints in the supply of natural resources, the implications of climate change, and the impacts of both on the global outlook mean that economic growth strategies based on (a) an unlimited supply of cheap (or free) natural resources, (b) resource-intensive mass consumption, and (c) energy sources which are high in carbon content, are not economically, socially, or environmentally sustainable.

The success of poverty reduction efforts, rapid urbanization rates and the growing population of the "consuming class" continue to create an ever-increasing demand for food, water, energy, consumer goods and housing. In India, the number of households that can afford discretionary spending will grow from the present 8 million to an estimated 94 million by 2025; and in China, the middle class that comprised an estimated 87 million consumers in 2005 is expected to rise to 317 million by 2015.[10] The future demand for resources will also be determined by the scale of the unmet needs. By 2008, the number of people living in poverty in the Asian and Pacific region was about 947 million.[11]

Economies of the region are becoming factories to the world. The region's low per capita supply of resources indicates that many countries will increasingly import much of the resources they need. As growing resource demands encounter growing resource constraints, the prices of key commodities will inevitably increase. Economies which are resource intensive—i.e. using high amounts of natural resources per unit of economic activity—will be susceptible to inflationary impacts as commodity prices increase.

Due to the demands on natural resources, economic strategies are needed for using resources more efficiently as well as meeting the needs of people more equitably. Where previously, natural resources have been exploited because of their low (or no) prices and ample supplies, economies of the region, for example, China, Japan and the Russian Federation, are identifying the efficient utilization of energy and other resources as important goals. The European Commission notes that the critical dependence of the European Union on certain raw materials underlines that a shift towards a more resource-efficient economy and sustainable development is becoming even more pressing.[12]

Energy security. The Asian and Pacific region is facing a major energy challenge. As the region urbanizes rapidly and poverty is progressively tackled, energy demands are increasing commensurately. Energy demand in the region is projected to increase by about 34% between 2007 and 2020.[13] Increasing energy demands pose major challenges for countries that import their energy supplies, as demand has lagged supply in recent years.[14] After decades of debate about how long the age of petroleum abundance might last, the globe now appears to be approaching the so-called "peak oil"—when the maximum rate of petroleum extraction will be reached. One source projects this will occur by or in 2020.[15]

The declining availability of petroleum will follow (and then that of gas). Insecurity of energy supplies is linked to far more than just higher oil prices. Petroleum is an input to many other commodities and basic materials. Meanwhile, the rush to meet energy demand from domestic resources is creating additional environmental and social challenges, such as the relocation of communities for hydropower projects and increasing stress on agricultural land and food security related to biofuel production.

Minerals, metals and other materials. Concerns about the limits of supplies of key materials mirror the concerns about peak oil. For metals such as gold, silver and copper, the stock of processed and manufactured metals is now estimated to be equivalent to or larger than the stock yet to be mined. Underground reserves of other metals, such as iron, cobalt, platinum and palladium, are projected to be close to exhaustion by 2050.[16] Signals that supplies of rare earth metals used in low-carbon technologies—in particular wind turbines, hybrid vehicles and all kinds of information and communication technologies (ICTs)—will soon be constrained, caught the attention of technology producers in July 2010 when export restrictions on these metals were tightened.[17] Developments in the supply chain of critical minerals may dampen the currently optimistic outlook for the role of technology in achieving low-carbon growth. Concerns about the scarcity of all types of materials have already motivated important policy and strategic developments to support more resource-efficient economic growth in countries of the region.

Water demand. The Asian and Pacific region has the world's largest share of renewable freshwater resources, but, on a per capita basis, has the lowest availability of water. In water-stressed countries, the demand for water from urban and industrial centres as well as agricultural activity is competing with the need for water to sustain ecosystems and their services on which peoples' livelihoods depend. Although water is a basic requirement for any economic activity, development plans focus on the availability and allocation of land, but not on the availability of land within a specific water basin. The resulting inter-basin water transfers are environmentally, socially and financially burdensome and a reason for water disputes. Lack of the water needed to secure food supplies may lead some countries into an era of food and water scarcity. Under a business-as-usual scenario, the supply of water for irrigation in developing countries (already plagued in many places by old and poorly maintained systems) will be increasingly constrained by 2025, causing annual global losses of 350 million tonnes of food.[18]

Food, land and agricultural inputs. The demand for food in Asia is projected to increase by 40% from 2000 to 2050, but on a limited resource base. Almost all of the region's land that is suitable for agriculture is already being farmed, while competition for arable land from growers of non-food crops increases. The ability to produce enough food will also be affected by more frequent and severe extreme weather events and unstable prices of important agricultural inputs such as oil and fertilizers. The Intergovernmental Panel on Climate Change (IPCC) has concluded that in the worst scenario rice yields are likely to decline by 50% on average by 2100 from the 1990 level.[19] Every 1-degree Celsius increase in nighttime temperature is projected to lead to a 10% reduction in rice yield, according to the International Rice Research Institute.[20]

Ecosystems and biodiversity. Resource use is driving changes in regional ecosystems and impacting the "supply" of the ecosystem services on which lives and livelihoods depend (Box 1.2). Although ecosystem services are in increasing demand as economies and populations grow, many ecosystem services in the region continue to decline, including fresh water; capture fisheries; air and water purification; and the regulation of regional and local climate, natural hazards, and pests.[21]

Biodiversity is an important indicator of the health of ecosystems and provides critical ecosystem services. The region's biodiversity and abundant natural resources provide sustenance and livelihoods for millions of people—from seafood and agricultural products to livestock fodder, fuelwood, timber and medicine. The Asian and Pacific region is one of the globe's richest regions

in terms of biodiversity—it contains 4 of the 12 "mega-diversity" countries, and about 60% of the world's species. However, as of 2008, the Asian and Pacific region had the highest number of threatened species in any of the world's regions—almost one third of all threatened plants and over one third of all threatened animal species.[22] The most serious problems are in South-East Asia.

Box 1.2: Ecosystem services

Ecosystem services, described as the benefits provided to humans from ecosystems, are the basis for human life. Four types of ecosystem services are defined by the Millennium Assessment:

- provisioning services (such as provision of food and fresh water);
- regulating services (such as climate regulation, water purification, flood regulation);
- support services (such as nutrient cycling, soil formation); and
- cultural services (such as aesthetic, educational, spiritual and recreational values).

As economies and populations grow, and as climate change proceeds, the demand for such services increases. At the same time, environmental degradation can reduce the flow of those services or result in inequitable and unsustainable trade-offs—for example, the use of land to produce agro-industrial products for export can disrupt the functioning of watersheds that produce water to meet both agricultural and other kinds of needs.

Emerging opportunities—engagement, technologies and jobs, market changes and infrastructure investment

Uneasiness about economic growth as the primary determinant of prosperity has increased as environmental and social ills persist. In response, a wealth of research into alternatives to gross domestic product as a measure of progress has increased awareness of the need to define development goals in more qualitative terms.

While challenges have multiplied, new opportunities and incentives for improving the sustainability of resource use patterns have emerged. These include stakeholder engagement, new technologies and green jobs, market changes and investments in infrastructure development.

Stakeholder engagement. Experience with effective partnerships between governments and civil society is increasing. Several decades of experience with community organizations on issues such as rural development, community forestry, sustainable human settlements and biodiversity protection shows that community empowerment, knowledge networking and institutional innovations can provide localized solutions that improve the sustainability of resource management and socio-economic impacts. Such partnerships have improved land and ecosystem management practices on the basis of "co-investment in, and shared responsibility for stewardship".[23] Social and professional networks that are helping to catalyze change and accelerate the sharing of experiences are maturing and burgeoning with the spread of ICT.

Technologies and green jobs. Technologies, particularly renewable energy technologies, are maturing, and countries of the Asian and Pacific region are now global leaders in producing renewable energy technology. Global investment in renewable energy is projected to translate into 20 million jobs in that sector. Many of these jobs will be created in countries such as China and India, which are focusing on developing renewable energy as a way of improving energy security and boosting their

economies. The creation of "green jobs"—"the direct employment created in economic sectors and activities, which reduces their environmental impact and ultimately brings it down to levels that are sustainable"—is an important strategy for merging social, environmental, and economic concerns.[24]

Market changes. The potential for engaging the private sector as an active partner of governments, and for improving environmental performance, is growing. Several governments have an important body of experience with market-based instruments. Eco-certification has emerged as a response to the growing market demand for environmentally sound goods and services, with some consumers willing to pay a premium for certified products. Competitive forces are driving improvements in environmental performance of key industries, such as tourism, electronics (including ICT), and automobiles. Such opportunities will expand as the challenges of operating in a resource-constrained world become more apparent and consumers become increasingly aware and demand more socially and environmentally responsible action by corporations.

Infrastructure investments. Cities in the region are among the largest and fastest growing in the world. The urban population is expected to expand by 0.7 billion between 2010 and 2025. The region's cities and towns will need to provide jobs, housing, water, energy, transport, education, health and cultural infrastructure for over 120 000 people every day for the next 15 years.[25]

About two thirds of the projected $4.7 billion to $8.0 billion investment in the region is needed for new infrastructure.[26] The potential for designing infrastructure according to principles of sustainability, including accessibility, eco-efficiency and social inclusiveness, is enormous, simply because of the significant investments being made and the large unmet needs. In addition, infrastructure for the 35–40% of the region's urban residents who live in slums needs upgrading.[27]

New challenges for governance—dealing with complexity and uncertainty; building climate resilience

The linkages between the converging challenges imply that governance arrangements must promote cooperation, coordination and integration across the economic, social and environmental regimes. At present, these regimes encompass a large body of laws and institutions, including hundreds of global and regional multilateral agreements and a vast web of institutions, organizations and actors, with associated challenges.

Governments often find it difficult to fulfil their commitments in the environmental domain, partly because of this complexity and the plethora of agreements.[28] However, the planned clustering of a number of related multilateral environmental agreements may reduce administration costs and boost their overall effectiveness. Coordinated administrative arrangements among the Basel, Rotterdam and Stockholm Conventions alone could save up to $765 000 a year.[29]

The increasing levels of risk and uncertainty in the regional outlook point to the need for greater attention to policies and institutions that support the capacity of socio-ecological systems to cope with, adapt to and shape change.[30] The societies and economies that do well in this changing development context will be the ones which are able to grasp the opportunities presented.

Governments will be increasingly challenged to engage stakeholders in taking action, but also to establish specific policies and governance approaches to build climate resilient societies—societies characterized by high levels of adaptive capacity. The Intergovernmental Panel on Climate Change (IPCC) defines adaptive capacity (in relation to climate change) as "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damage, take advantage of opportunities, or cope with the consequences."[31]

Green shoots: investments, commitments and actions

Green growth was adopted at the fifth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED)—Box 1.3. Since then, the programmes and actions that have reflected the urgency of taking action have come from various quarters, including intergovernmental organizations, think tanks and governments.

Regional and international initiatives include ADB's Climate Change Program, Energy Efficiency Initiative, Carbon Market Initiative, Sustainable Transport Initiative, and Cities Development Initiative for Asia; the United Nations' proposals for a Green New Deal; the Green Economy Initiative (led by the United Nations Environment Programme [UNEP]);[32] and the Green Jobs Initiative (by UNEP, the International Labour Organization [ILO], the International Organization of Employers [IOE], and the International Trade Union Confederation [ITUC]). A report that emerged from the Green Jobs Initiative sparked interest in the potential for creating green jobs in developing countries. [33]

In the post-2008 period, economic recovery programmes and strategic actions have emphasized the need to promote synergies between economic growth and environmental sustainability in an unprecedented way. Asian and Pacific countries led the globe in commitments to "green" investments as part of their recent stimulus spending.

Stimulus investments in low-carbon power generation (renewable energy, carbon capture and storage); energy efficiency (buildings, vehicles, rail and electricity grid); and water supply and waste management have been heralded as a major step towards greening growth. Not only were two thirds of the global investments earmarked for green projects from this region, but the region also had the highest share of green investments in total stimulus investments, at about 23%.[34]

Major forums have also issued statements of their intention to promote green growth.[35] In the Organisation for Economic Co-operation and Development (OECD), 40 of its member and prospective member countries, comprising 80% of the global economy, approved a declaration on green growth in June 2009. The United Nations General Assembly has also requested the United Nations Secretariat to focus the upcoming United Nations Conference on Sustainable Development (Rio +20) on the theme of the green economy.

The April 2010 Association of Southeast Asian Nations (ASEAN) summit concluded in Ha Noi with the adoption of the ASEAN Leaders' Statement on Sustained Recovery and Development. The statement documents the leaders' determination "to promote green growth, investments in long-term environmental sustainability, and sustainable use of natural resources in order to diversify and ensure resilience of our economy." In May 2010, the 66th Session of the Economic and Social Commission for Asia and the Pacific adopted the Incheon Declaration on Green Growth.

Among the countries that have prominently pursued and invested in strategies and policy reform related to the greening of growth are China, Japan, and the Republic of Korea.[36] Japan and the Republic of Korea have established international initiatives to support more environmentally sustainable economic growth. Many other governments, including Cambodia, Fiji, Kazakhstan, the Maldives and Mongolia, have made major policy statements supporting green growth. Some examples of green initiatives and commitments are highlighted in Figure 1.1.

Figure 1.1: Examples of green policies and initiatives since 2005

1 **AUSTRALIA**
- Victoria government regional rebate for energy savings
- Green Power accreditation programme for renewable energy.

2 **BRUNEI DARUSSALAM**
- Tenaga Suria Brunei—solar power project

3 **CAMBODIA**
- Green Growth Road Map, 2010
- Sustainable rice production systems

4 **CHINA**
- Circular Economy Law 2009
- Solar feed-in tariff to drive renewable energy investments
- Eco-city development—Sino-Singapore Tianjin Eco-city
- Green supply chain management in the sugar industry— Guigang Eco-industrial Park

5 **FIJI**
- National Employment Centre decree, 2009—green jobs, green productivity, sustainable enterprise development

6 **INDIA**
- National Solar Mission
- National Mission on Enhanced Energy Efficiency

7 **INDONESIA**
- REDD benefit distribution policy, 2009
- Green Economic Development and Investment Strategy for Aceh province
- Payments for ecosystem services pilot policy and projects—Aceh Province
- Bus rapid transit—Transjakarta
- Sanitation Master Plan—integration of wastewater, solid waste and urban drainage

8 **JAPAN**
- 3Rs and waste minimization policy
- Extended producer responsibility
- Hatoyama Initiative

9 **KAZAKHSTAN**
- Zhasyl Damu—Green Development Strategy 2030
- Low carbon strategy
- Various green growth policies

10 **MALAYSIA**
- Renewable energy promotion
- Small Renewable Energy Program
- Green Building Index

11 **MALDIVES**
- Tourism green tax, carbon offsets
- Target of carbon neutrality by 2020

12 **MICRONESIA, FEDERATED STATES OF**
- Micronesian Challenge—conservation of 30% of nearshore marine and terrestrial areas

13 **NEW ZEALAND**
- Business environmental performance and eco-efficiency

14 **REPUBLIC OF KOREA**
- National Strategy and Five Year Plan for Low Carbon, Green Growth
- Framework Act and Presidential Decree on Low Carbon, Green Growth
- Green New Deal policy—2% of GDP investment in Green Growth
- Resource recirculation policy

15 **RUSSIAN FEDERATION**
- Target to increase energy efficiency by 40% by 2020
- Innovations for energy saving and efficiency, renewable energy

16 **SAMOA**
- Biogas energy financing for local communities

17 **SINGAPORE**
- Water, energy demand management
  > 30 government funding and incentive schemes
- Green Mark Incentive Scheme for buildings
- Water Efficiency Fund

18 **THAILAND**
- Alternative Energy Development Plan and target-20% by 2022

19 **TUVALU**
- Renewable energy target—100% by 2020

20 **VIET NAM**
- Capacity building and infrastructure for certified organic teas
- Payments for ecosystem services pilot policy and projects

Box 1.3: Green growth

Green growth was adopted at the 2005 Ministerial Conference on Environment and Development in Asia and the Pacific (MCED) as a key strategy for achieving sustainable development and for achieving Millennium Development Goals 1 (poverty reduction) and 7 (environmental sustainability). Green growth can be defined as economic progress that fosters environmentally sustainable, low-carbon and socially inclusive development. Pursuing green growth involves outlining a path to achieving economic growth and well-being while using fewer resources and generating fewer emissions in meeting demands for food production, transport, construction and housing, and energy.

Policies and investments that promote green growth seek to improve the "eco-efficiency of growth," which involves minimizing resource use and negative environmental impacts per unit of benefit generated by the economy. Green growth is a pre-requisite for building a green economy. A green economy is characterized by substantially increased investments in economic activities that build on and enhance the earth's natural capital or reduce ecological scarcities and environmental risks—activities such as renewable energy, low-carbon transport, energy- and water-efficient buildings, sustainable agriculture and forest management and sustainable fisheries).[37]

The growing interest of governments has been supported by capacity-building activity. The Seoul Initiative Network on Green Growth, the Kitakyushu Initiative for a Clean Environment and the ESCAP Green Growth Capacity Development Programme have organized policy dialogues and a series of capacity-building events, including within countries. Deeper levels of engagement at the national and subregional level have resulted in policy initiatives and pilot project activities that have been replicated in the field.

These statements of commitment and initiatives face important hurdles in the form of the ever-increasing per capita consumption levels and population growth. Any momentum achieved towards green growth by stimulus packages, investments or stand-alone initiatives will be quickly lost unless underlying economic forces and financing mechanisms are directed to keep the green growth engine going. As discussed in Part III, in the long run, green growth can only be achieved by fundamental changes in the systems that define economic growth patterns.

Together, approaches that promote green growth and measures that support resilience can help ensure that an economic system is sustainable over the long term. For policymakers, green growth and resilience intersect. Green growth cannot be achieved without the ability to transform in the face of crisis by grasping the opportunities presented in an evolving policy landscape. At the same time, efficient use of resources will allow economies and societies to better face a resource-constrained future.

PART II: RESOURCE USE—TRENDS AND IMPLICATIONS

Economies of Asia and the Pacific face the challenge of continuing to grow while reducing resource use, waste and emissions. Production and consumption activities use raw materials from the primary sectors (including agriculture, forestry, fisheries, mining and quarrying) as inputs to economic activity. The transformed resources are retained in the economy, as consumer goods or infrastructure; used as fuel or food; and exported, emitted or discharged from the economy as waste.

As economies grow, the supplies of raw materials, water, land and ecosystem services (discussed in Part I) face increasing pressures, including from the production of waste and emissions. Environmentally sustainable economic growth requires resources to be used more efficiently across the economy.[1] The initiatives and commitments described in Part I may lead to incremental improvements in the efficiency of resource use. However, the scale of the projected regional resource requirements implies that incremental improvements in resource efficiency are unlikely to ensure that regional and global economies can "operate" within the earth's carrying capacity—i.e. the capacity of the earth to meet the future need for both renewable and non-renewable resources, and to absorb emissions and waste.

Nor will incremental improvements in resource efficiency ensure that resources will be used most effectively—meeting people's needs in an equitable way and contributing to socio-economic progress. Prospects for sustainable development will be determined by national capacities to reduce the future demand for resources without compromising inclusive socio-economic progress.

The urgency of increasing the efficiency of resource use varies by country, by subregion and by the type of resource considered. Trajectories of and constraints on regional and national resource use should be monitored. At the same time, more attention must be paid to how well resources are being used to benefit people.

Trends—materials, energy and water

Trends in material use

New data commissioned by the United Nations Environment Programme (UNEP) and produced by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia provides data on the use of key types of materials—biomass, fossil fuels, metal ores and industrial and construction minerals (Box 2.1). The data show that by the start of the 21st century, the Asian and Pacific region had become the world's largest resource user, consuming 35 billion tonnes of metal ores, industrial minerals, fossil fuels, construction minerals and biomass per annum by 2005. This is 58% of the global resource use of about 60 billion tonnes.

At the same time, the composition of resources used in the region's economies has changed significantly. In 1970, biomass comprised about 47% of all materials used. In 2005, almost half of all materials consumed were construction minerals—sand, gravel, concrete and steel.

Figure 2.1 shows region-wide trends in domestic material consumption, a measure of the total amount of materials directly used in an economy. Average annual growth rates of total regional domestic material consumption remained unchanged during 1970–1990, slowed during 1990–2000 due to the Asian financial crisis, and

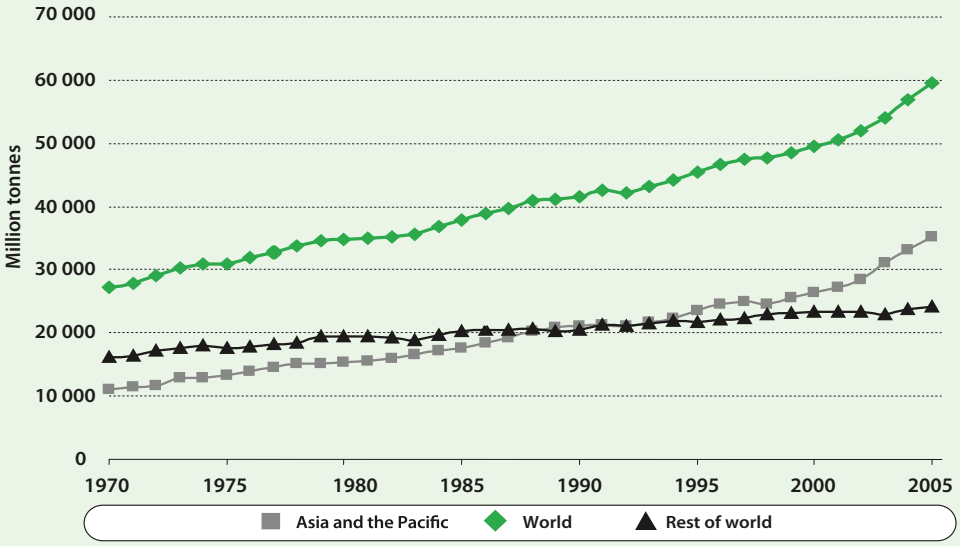
Box 2.1: The CSIRO and UNEP material flows online database

For the first time, a comprehensive data set for material flows and material intensity for 1970–2005 covers many Asian and the Pacific countries.[2] The online database is a reference on primary material flows for the Asian and Pacific region, and has been produced for use in two forthcoming reports: *Resource efficiency: Economics and outlook for Asia and the Pacific* (UNEP) and *Green growth, resources and resilience: Environmental sustainability in Asia and the Pacific, 2010,* previewed in this document. Previous to the establishment of this database, data on material flow had been limited to Australia, China, Japan and the Philippines.[3]

The data are presented for four categories of materials (biomass, fossil fuels, metal ores and industrial minerals, and construction minerals) and 11 subcategories. The data cover domestic extraction, physical trade balance (an indicator of the extent to which a country is a net exporter or importer of materials), and domestic material consumption. Other key indicators include total domestic extraction, physical trade balance, and domestic material consumption (a measure of the total amount of materials directly used in an economy) per capita and per dollar of gross domestic product. A technical annex on the data sources used and methodologies employed is available at the website.[4]

then more than doubled to 6.0% per year during 2000–2005. The acceleration of regional material consumption after 2000 had a significant impact on the average annual rates of global material consumption (Table 2.1).[5]

Figure 2.1: Domestic material consumption for Asia and the Pacific and the world, 1970–2005



Source: CSIRO and UNEP (2010) Asia-Pacific Material Flows Database, www.csiro.au/AsiaPacificMaterialFlows

Table 2.1: Average annual growth rate of material use

	Average annual growth rate of domestic material consumption (% per year)			
	1970–1980	1980–1990	1990–2000	2000–2005
Asia and the Pacific	3.2	3.2	2.3	6.0
Rest of world	1.9	0.5	1.3	0.8
World	2.5	1.8	1.8	3.7

Source: CSIRO and UNEP (2010) Asia-Pacific Material Flows Database, www.csiro.au/AsiaPacificMaterialFlows

Resource efficiency—materials, energy and water

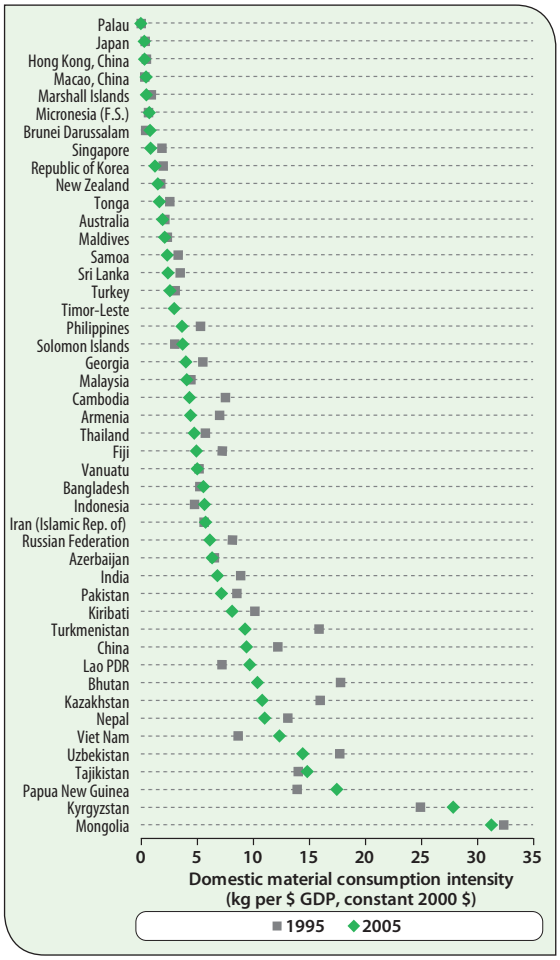
For economic growth to be environmentally sustainable, the amount of resources used to produce one unit of gross domestic product (GDP)—that is, "resource intensity" (used here as a measure of the efficiency with which resources in general, or specific resources such as energy, water and materials, are used) must decline over time. If this measure is increasing over time, it signals that an economy could be increasingly at risk of depletion from growing along a less eco-efficient growth path.

However, reductions in resource intensity are not a sufficient condition for sustainable development. Even if resource intensities decline, total resource use will increase over time if GDP grows in tandem with or faster than the rate of improvements in resource intensities. This is the case in most countries.

Materials. Most countries in the region reduced their "domestic material consumption intensities" between 1995 and 2005 (Figure 2.2). Significant reductions in material intensity were made in Japan, the Philippines, Singapore and, to a lesser extent, India. In many other countries, material intensity has been either stagnant or growing because of growth in primary export industries (e.g. in Australia and the Islamic Republic of Iran) or because the material requirements that have underpinned growth, modernization and changing consumption patterns have not been sufficiently offset by technological innovation.

Improvements in material intensity in several countries slowed after 2000 as GDP grew, including in China, Malaysia, Nepal, the Republic of Korea, Sri Lanka and Viet Nam.[6] At the same time, the total domestic material consumption accelerated (Figure 2.1). In 2005, the Asian and Pacific region's material intensity was almost double that of the world.[7]

Figure 2.2: Material intensities, 1995 and 2005



Note: kg = kilogramme; GDP=gross domestic product
Source: CSIRO and UNEP (2010) Asia-Pacific Material Flows Database, www.csiro.au/AsiaPacificMaterialFlows

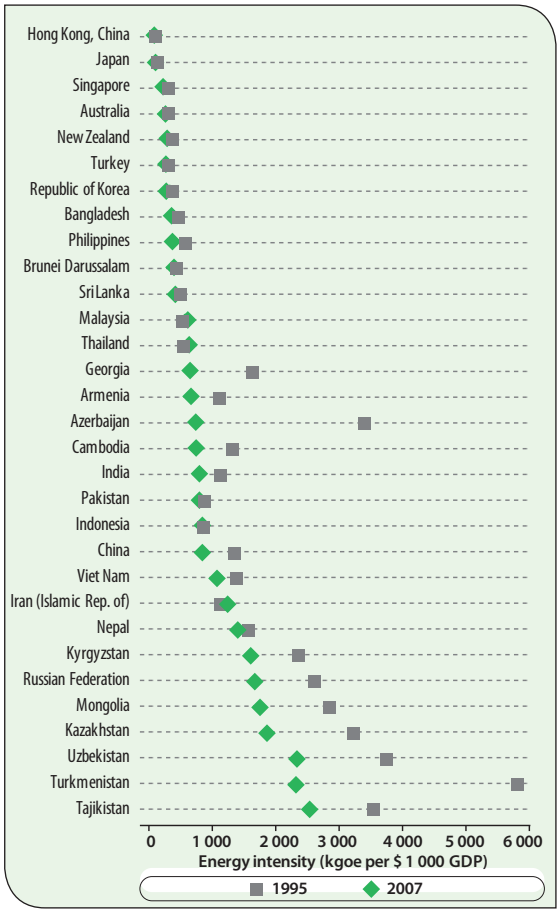
Energy. The majority of Asian and Pacific countries (especially middle-income countries) are reducing the energy intensities of their economies over time (Figure 2.3). Some economies became more energy intensive between 1995 and 2007, but in most, if not all, the situation is likely to improve because reductions in energy intensity are taking place faster than GDP growth. Indonesia, the Islamic Republic of Iran, Malaysia and Thailand showed signs of improvement after 2000, with the most improvements in Indonesia and Thailand.

On the other hand, despite overall reductions in energy intensities in two major economies—Australia and China—and six low-and middle-income economies—Bangladesh, Kazakhstan, Kyrgyzstan, Mongolia, Nepal and Viet Nam—the improvements in energy intensity slowed relative to economic growth rates during 2000–2005.[8]

The region as a whole has gone from being a net exporter of petroleum to being a large and persistent importer of petroleum since the early 1990s. This is of particular significance, because petroleum is the fossil energy source most likely to be in short supply globally in the near to medium term.

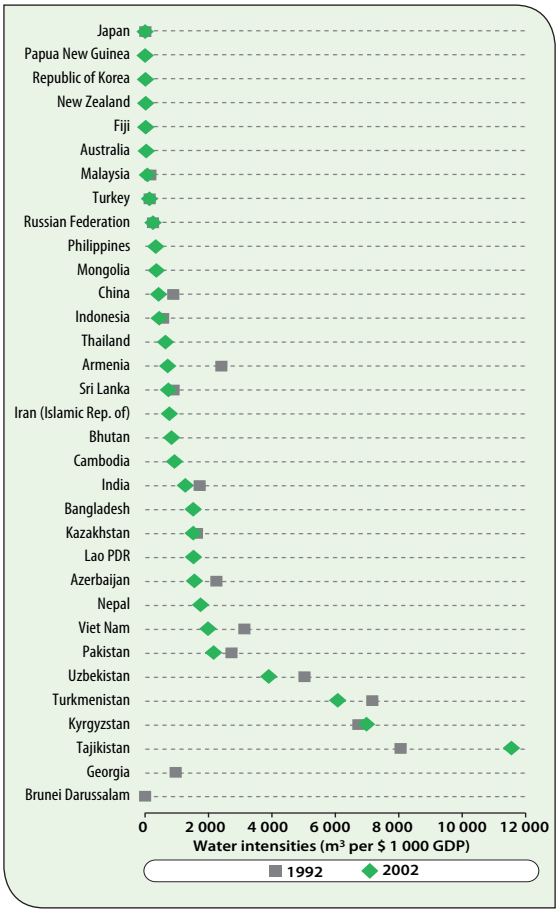
During 1975–2005, the shares of coal and gas as primary energy sources increased and shares of petroleum and traditional biomass-based energy sources decreased. The share of nuclear power in the energy mix also expanded as the demand for electricity grew.[9]

Figure 2.3: Energy intensities, 1995 and 2007



Notes: kgoe=kilogrammes of oil equivalent; GDP=gross domestic product
Source: Energy (total primary energy supply): International Energy Agency; GDP: World Bank, World Development Indicators, http://data.worldbank.org/indicator

Figure 2.4: Water intensities, 1992 and 2002



Notes: m^3=cubic metres; GDP=gross domestic product
Source: Total water withdrawal: Food and Agricultural Organization of the United Nations (FAO), AQUASTAT, http://www.fao.org/nr/water/aquastat/main/index.stm; GDP: World Development Indicators, http://data.worldbank.org/indicator

Water. Between 1992 and 2002, water use intensities declined in 14 of 17 economies for which data are available for both years (Figure 2.4). Yet water use intensities were highest in some of the countries that most lack water—such as Central Asian countries, Pakistan and Viet Nam, as of 2002. The countries with the most significant improvements in water use were Armenia, China, Malaysia and Viet Nam.

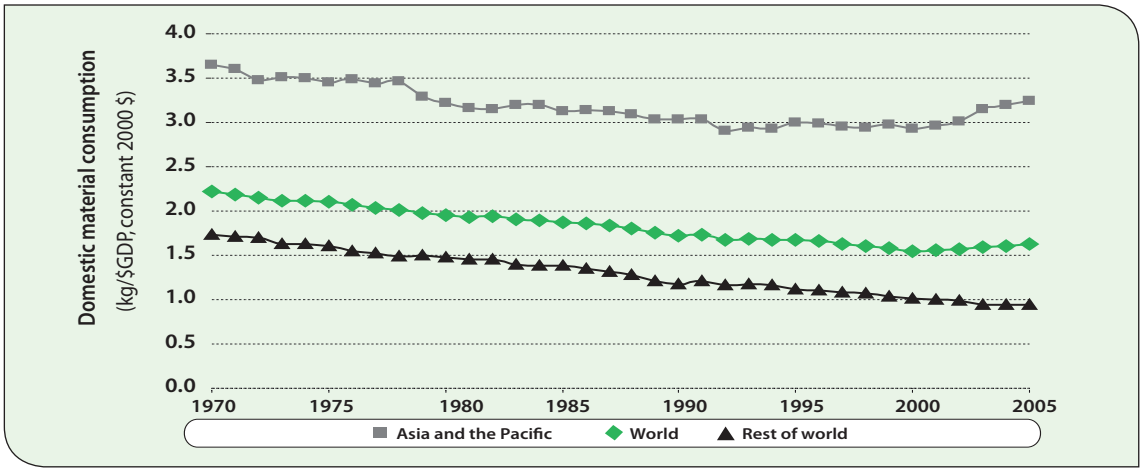
Explaining growth in demand for materials

A general belief is that, as the limits of raw materials are approached and their extraction becomes more costly, economics and human ingenuity will find ways to overcome the limitations of the earth's resources. However, analysis of the factors that influence resource use as well as overall trends in resource use, show that improvements in resource efficiencies and technological innovation have not so far mediated environmental pressure and impacts to the extent that might be expected in the region.[10] Massive infrastructure development associated with rapid urbanization as well as lifestyle changes and new consumption and mobility patterns among the growing number of higher-income urban households have overwhelmed the improvements in resource efficiency.

Eco-efficient consumption is an important challenge. While the eco-efficiency of production may respond to market signals relating to resource constraints or price competitiveness concerns, consumption patterns tend to become less eco-efficient as economies grow.[11] While improvements in the efficiency with which resources are used had helped to offset some of the growth in domestic material consumption in previous decades, this situation reversed in Asia and the Pacific from 1995 to 2005 (Figure 2.5), even as most economies became more efficient (i.e. less resource intensive over time). A key factor underlying the decreasing efficiency is that the share of economic activity in highly efficient economies such as Japan has been reduced, as economies with lower efficiencies have grown.

Expansion of construction, manufacturing, transport and food production, and changing production and consumption patterns have accelerated the transformation of materials, especially in East and North-East Asia. Large investments in infrastructure are part of this changing picture. When the growth in demand for raw materials slows in these countries, the growth in demand in other economies of the region is likely to take off. India's demand for raw materials could triple during the next 10 years as capital expenditure and infrastructure spending increase.[12]

Figure 2.5: Material intensity for Asia and the Pacific and the world, 1970–2005



Note: kg=kilogrammes
Source: CSIRO and UNEP (2010) Asia-Pacific Material Flows Database, www.csiro.au/AsiaPacificMaterialFlows

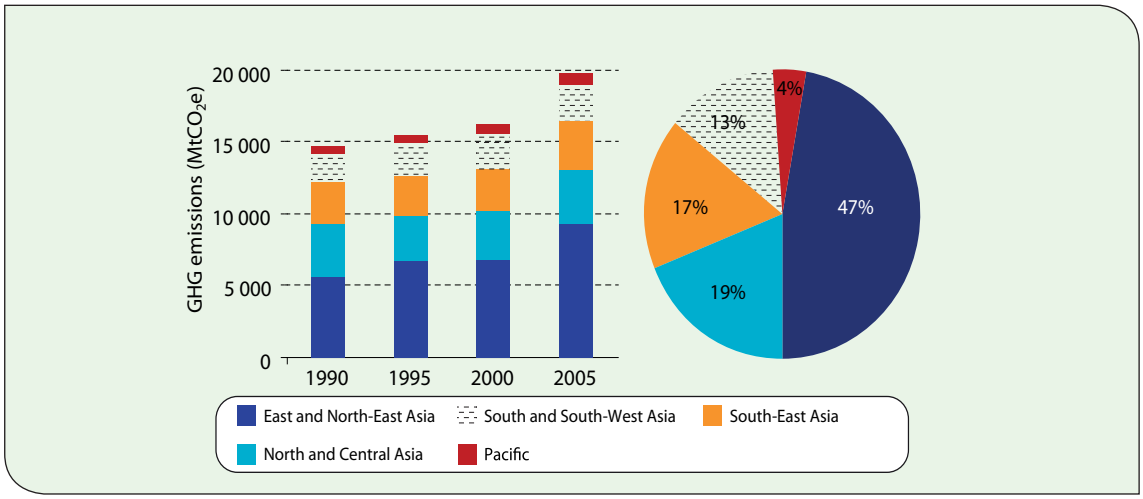
Climate change

Resource use contributes to climate change through the production of greenhouse gases (GHGs). Since 1990, global GHG emissions have grown from 32.3 billion tonnes to 40.2 billion tonnes in 2005—an average annual growth rate of 1.5%.

But GHG emissions from Asia and the Pacific grew more quickly, with an average annual growth rate of 2%. GHG emissions rose from 14.5 billion to 19.5 billion tonnes in only 15 years. The rate of GHG emissions also accelerated after 2000, mirroring the trends in material use that are highlighted in the previous section.

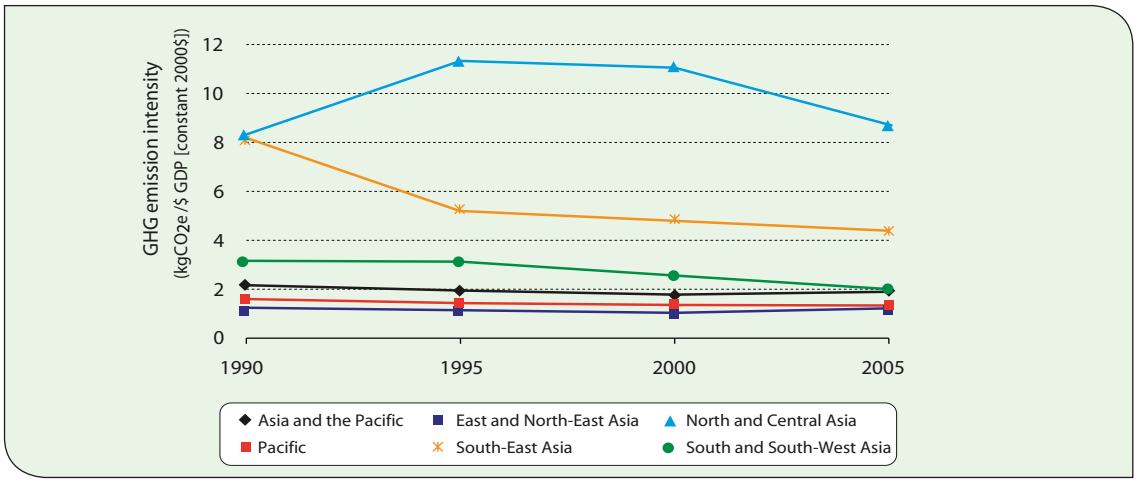
East and North-East Asia made the largest contribution to GHG emissions (Figure 2.6). Figure 2.7 shows changes in GHG emission intensity since 1990. Total regional GHG emissions intensities were relatively unchanged between 1990 and 2005.

Figure 2.6: Asian and Pacific greenhouse gas emissions, by subregion, 1990–2005



Source: World Resources Institute, Climate analysis indicator tool, http://cait.wri.org

Figure 2.7: Asian and Pacific greenhouse gas emission intensities, by subregion, 1990–2005



Note: $kgCO_2e$=kilogrammes of carbon dioxide equivalent

Source: World Resources Institute, Climate analysis indicator tool, http://cait.wri.org

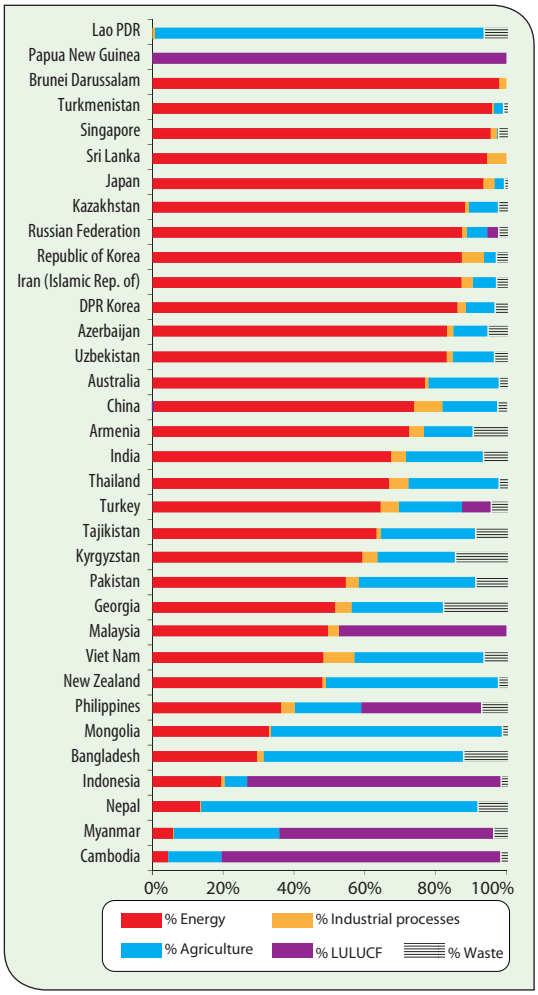
Several developing countries in the region have established formal, but voluntary targets to reduce the impacts of their economic growth on the climate (Part III). Success in meeting these targets will depend on the ability to give high priority to investments in low-cost (or most cost effective) measures, and in sectors which are important sources of GHGs (Figure 2.8a).

A significant proportion of GHG emissions from the region is from land use change, and for just under one third of the region's countries, more than half of GHG emissions are from the non-energy sectors. Among the categories of energy use, electricity and heat production is the major source of GHG emissions in about half of the region's countries for which there are data (Figure 2.8b).

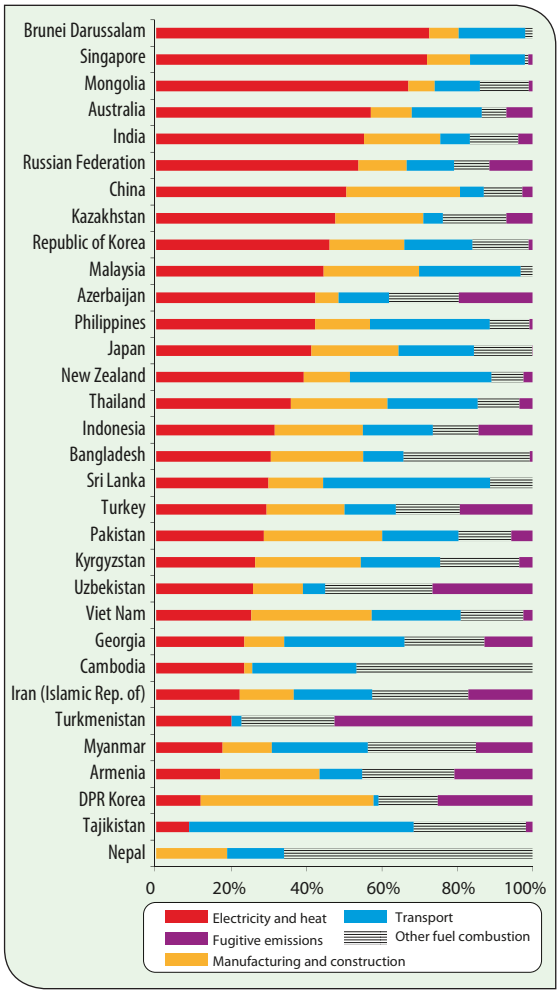
Improvements in the efficiency with which resources other than energy are used will help to make greater headway on climate mitigation—the production of GHGs will depend in large part on the amount of resources being transformed into goods and services through the use of energy (including services delivered by infrastructure for transport and human settlements).[13] More efficient use of resources implies lower energy consumption and therefore lower GHG emissions.

Figure 2.8: Greenhouse gas emissions, by sector, 2005

a. Major GHG emission sources



b. Shares of GHG emission, energy use



Note: LULUCF=Land use, land use change and forestry
Source: World Resources Institute, Climate analysis indicator tool, http://cait.wri.org

Translating resource use into benefits for people

The Asian and the Pacific region is challenged to ensure that economic growth translates into tangible benefits for people. The severity of the sustainability challenge varies among countries—some use resources more efficiently, and some are better endowed with resources. In some countries, basic needs are already met and economic development and human well-being are at very high levels.

While resource use per capita is in part determined by a country's geography and climate—factors beyond the control of policymakers—the use of resources for human benefit can be improved in every country. Sustainability of resource use can be examined in terms of (a) the long-term sustainability of the supply and "withdrawals" of resources, including their impacts on the environment; and (b) the extent to which resource use results in positive and equitable socio-economic outcomes. Economic development strategies (and economic structures), built environments, governance, markets, technologies, and investment in human and natural capital all influence how well resources are transformed into human welfare.

Socio-economic progress does not always demand high inputs of resources. For several kinds of resources, there is significant room for more "eco-efficient" growth—growth that creates more human benefit while using fewer resources and creating less waste. This potential changes with levels of development; countries at the lowest levels of socio-economic achievement gain relatively more incremental benefit from each added unit of resource use than do those at the higher levels.

Materials, energy and human development

For selected countries in Asia and the Pacific, Figure 2.9 compares domestic material consumption (per capita) with the Human Development Index (HDI), which is used as an indicator of socio-economic progress and human well-being and is based on life expectancy, education and GDP. For most countries socio-economic progress has been accompanied by increases in domestic material consumption per capita.

Although Singapore's socio-economic progress between 1995 and 2005 was achieved while reducing domestic material consumption per capita by almost one third, this reduction came after significant infrastructure investments in the early 1990s, including land reclamation. From 2003 on, domestic material consumption stabilized at 1993 levels.

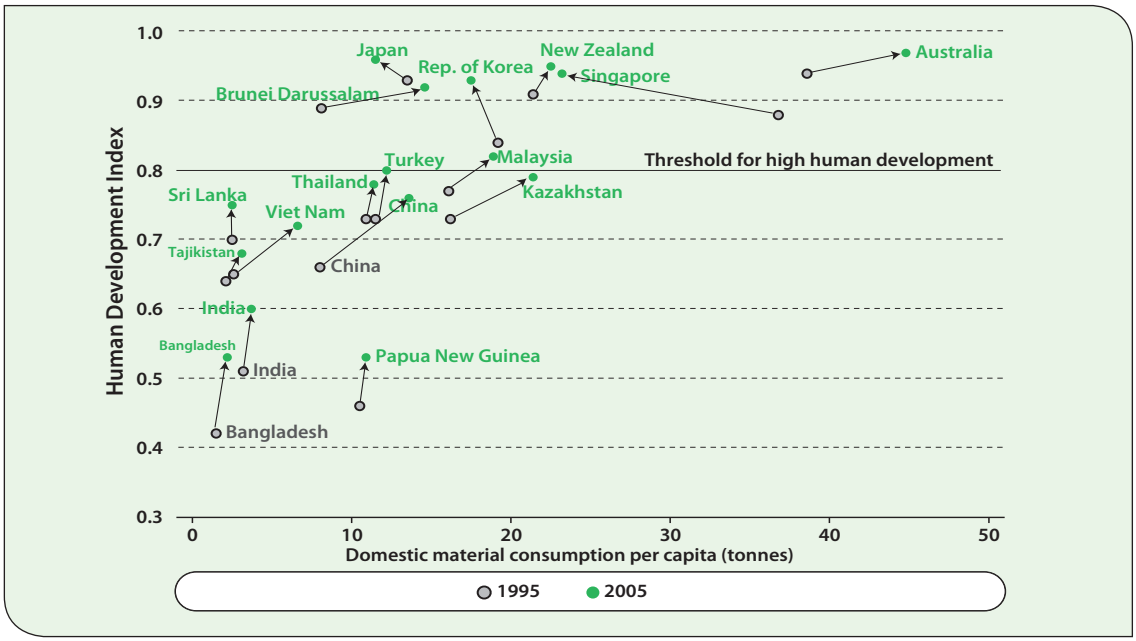
While the diversity of factors that influence resource use makes it difficult to compare countries, it is important for individual couintries to monitor changes in the relationships between their resource use and human well-being.

As shown in Figure 2.10, a small input of energy provides a major boost to human development in countries at the lower levels of socio-economic achievement. Conversely, costs are high when access to energy is insufficient. This comes in the form of unachieved socio-economic progress, as well as degraded forests and diminished ecosystem services as people turn to forests for fuel.

As of 2008, about 900 million people in the region had no access to electricity, and 1.7 billion relied on traditional biomass fuels, mostly in South Asia.[14] Although the electrification rate of developing countries during recent decades has generally improved, almost two thirds of the people in countries such as Bangladesh, Bhutan and Nepal do not benefit from access to modern energy.

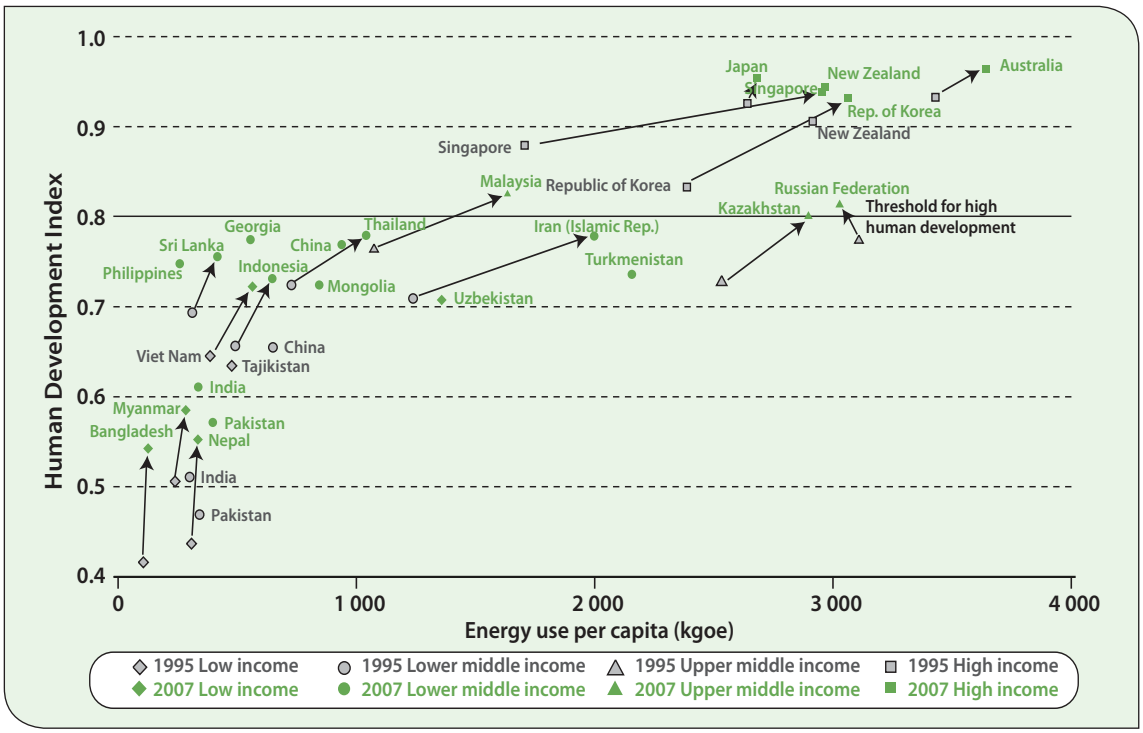
To improve human well-being, countries with the lowest HDI values should boost their populations' energy use by emphasizing energy infrastructure that targets underserved populations.[15] To accomplish this, green growth strategies, at both national and global scales, could look more carefully at ways to drive energy investments towards the countries and specific areas which would yield high returns in terms of improved socio-economic progress.

Figure 2.9: Human Development Index and domestic material consumption per capita, 1995 and 2005



Source: Human Development Index: United Nations Development Programme (UNDP), Human development report 2009; Domestic consumption per capita: Commonwealth Scientific and Industrial Research Organisation of Australia (CSIRO) and United Nations Environment Programme (UNEP) Material Flows Database, www.csiro.au/AsiaPacificMaterialFlows

Figure 2.10: Human Development Index and energy use per capita, 1995 and 2007



Source: Human Development Index: United Nations Development Programme (UNDP), Human development report 2009. Energy use per capita; based on data from International Energy Agency and World population prospects: The 2008 revision population database, http://esa.un.org/unpp

Land—meeting food demand

Asia and the Pacific has the lowest per capita availability of land among all the world's regions. Land fulfills many functions—for urban areas, recreation, and production of food and agro-industrial crops—but must also continue providing critical ecosystem services. Unfortunately, the use of agricultural land is not having the expected impacts on reducing hunger in many countries in the region. The numbers of undernourished people increased in at least six countries of the region. In a few countries, even though undernourishment rates have been reduced, the severity of hunger increased among the hungry, although the availability of agricultural land per capita remained constant.

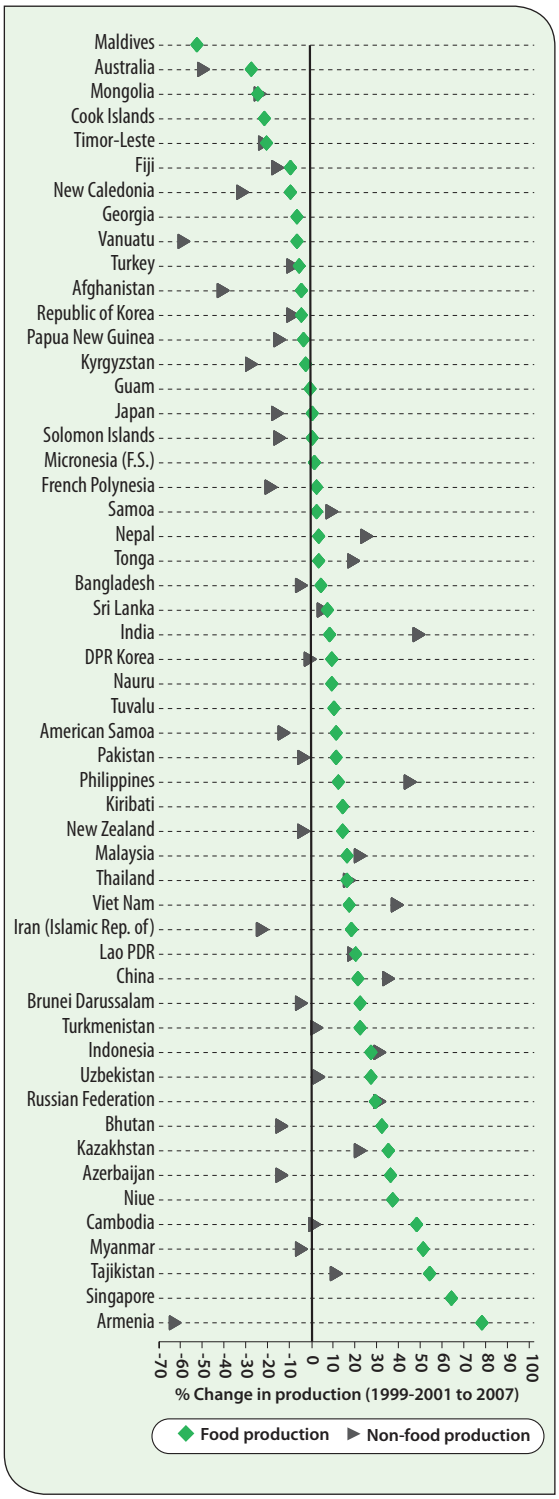
Due to the demand for biofuel feedstocks and other forms of biomass and due to urbanization processes, land previously used to grow food is being converted to other uses even in the face of persistent undernourishment. Because more than half a billion people in the Asian and Pacific region were already undernourished as of 2004–2006,[16] these trends present a significant challenge, especially given the projected food price increases and volatility, climate change and population growth.

Asia's production of non-food crops is growing faster than its production of food crops (Figure 2.11), and is becoming concentrated in several large countries, including those where there are increasing challenges in relation to hunger (Figure 2.12). This trend is evident for the region as whole and in each subregion with the exception of Central Asia,[17] which is boosting its food production dramatically (Figure 2.11), with positive impacts on undernourishment rates.

Figure 2.11: Changes in food and non-food production (indexed 1999–2001 to 2007)

Note: Subregional designations are as used by the Food and Agriculture Organization of the United Nations (FAO).
Source: FAOSTAT, http://faostat.fao.org/default.aspx

Figure 2.12: Changes in food and non-food production of regional countries (indexed 1999–2001 to 2007)



Source: FAOSTAT, http://faostat.fao.org/default.aspx

Water—managing water for people

The region's water resources are increasingly vulnerable and threatened. A growing population's need for water to drink, for other household uses, to grow food, to process raw materials and to produce energy is increasingly competing with nature's own demands for water to sustain ecosystems and the services on which livelihoods depend. Every day, millions of tonnes of untreated sewage and industrial and agricultural waste are discharged into the region's water systems. Clean water has become scarce and the poor continue to suffer first and most from water pollution, water shortages and the lack of adequate sanitation.

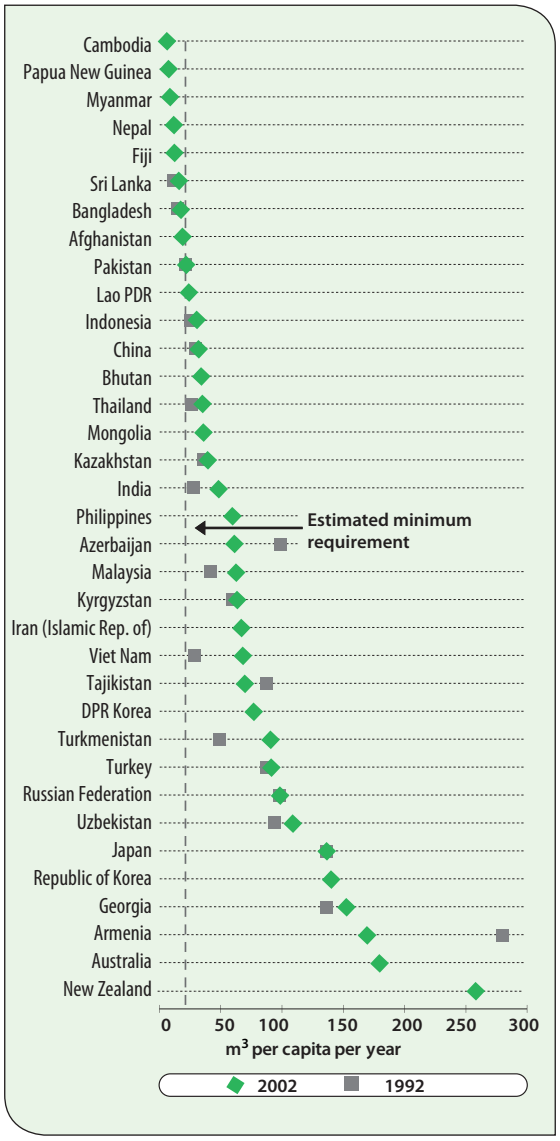
The Asian and Pacific region has the largest absolute share of renewable freshwater resources in the world, but on a per capita basis, the region has one of the lowest availabilities of water—at 5 224 cubic meters per capita compared with the world average of 8 349 cubic meters. The region supports about 60% of the world's population with 38% of the world's water resources. On average, about 11% of its total renewable resources is withdrawn annually, second in the world after the water scarce Middle East and on par with European utilization rates. Water resources in Asia and the Pacific are expected to be severely affected by increased climate variability.[18]

Physical water scarcity is only one part of the equation; water allocation is another. Agriculture is by far the main consumer of water in the region, and industrial use is increasing steadily. The share of domestic water withdrawal over total withdrawal in Asia and the Pacific is the lowest in the world at 7.7%, compared with that of Africa at 10%.[19] The ability to meet the growing demand of many economic activities for water will partly depend on the extent to which eco-efficient and effective water use can be achieved, especially given the potential effects of climate change.

Although more than three out of four Asian and Pacific countries seem to be meeting their populations' basic water needs (Figure 2.13),[20] high or adequate domestic water use per capita can hide shortfalls in service provision. Leakage, inefficient domestic water use, or underinvestment in providing access, especially

in rural and slum areas are still basic challenges, except where targeted and specific measures have been taken, as in Singapore.

Figure 2.13: Domestic water use per capita, 1992 and 2002



Note: m³=cubic metre
Source: FAO AQUASTAT, http://www.fao.org/nr/water/aquastat/main/index.stm

Because Asia and the Pacific is on track to halve the proportion of its people without access to safe drinking water, the region is an early achiever in this Millennium Development Goal. But the region has had much less success with expanding access to sanitation. Inequalities in access to water between rich and poor households are evident all over Asia; for sanitation, the gap is even more striking. As of 2008, 480 million people had no access to safe drinking water, while almost four times as many people, 1.9 billion, had no access to improved sanitation (Table 2.2).[21]

The availability of water is a major factor in food security. Although high proportions of water are used for agriculture in many countries of the region, the benefits for reducing poverty or hunger are not always captured. This situation is extreme in India, Pakistan, Sri Lanka and Tajikistan—all water-stressed countries—where more than 90% of water is used for agriculture yet more than one in five people in these countries remained undernourished in 2005. Where water is used less efficiently there is much room for improvement, as in Pakistan and Tajikistan. Conversely, where water is already used sparingly, as in many parts of India and Sri Lanka, there is less room for improvement.

Every subregion in Asia and the Pacific has experienced disputes over water. These disputes have implications for all water uses—household, industry, irrigation, hydropower production and important ecosystem services. During the last two decades, the number of water-related disputes, particularly at the local level, has risen, especially within large Asian and Pacific countries. Disputes have frequently occurred over ill-planned water infrastructure, ambiguous withdrawal rights or deterioration of water quality.

ESCAP has identified water "hotspots" based on a "water insecurity framework" that examines indicators of (a) the socio-economic and environmental outcomes of water use, and (b) the capacity of communities or countries to deliver expected outcomes in an equitable and sustained way. The water hotspots (Box 2.2) are countries in which the capacity to manage water resources for inclusive socio-economic progress is low or declining, and in which socio-economic progress has not been sufficient to serve as a basis for boosting resilience to water scarcity and water-related disasters.

Table 2.2: Access to improved drinking water and sanitation

	2000		2008	
Subregion	Population ('000)	%	Population ('000)	%
Improved drinking water				
North and Central Asia	200 291	93	202 088	94
East and North-East Asia	1 214 112	81	1 395 991	90
Pacific	27 517	88	30 673	88
South and South-West Asia	1 247 509	82	1 515 162	87
South-East Asia	414 154	80	493 042	86
Asia-Pacific with access to improved drinking water	3 103 582		3 636 956	
Asia-Pacific without access	664 609		480 608	
Improved sanitation				
North and Central Asia	189 818	87	192 180	88
East and North-East Asia	815 267	55	925 595	60
Pacific	27 037	87	30 348	87
South and South-West Asia	517 532	34	659 207	38
South-East Asia	306 150	59	395 345	69
Asia-Pacific with access to improved sanitation	1 855 804		2 202 675	
Asia-Pacific without access	1 912 387		1 914 888	

Source: ESCAP, based on data from the Joint Monitoring Programme for Water Supply and Sanitation, 2010, available at: www.wssinfo.org/datamining/introduction.html

Box 2.2: Water hotspots

	1	2	3	4	5	6	7	8	9	10	Total
Cambodia					x	x	x	x	x	x	6
Indonesia			x		x	x	x	x		x	6
Lao PDR					x	x	x	x	x	x	6
Papua New Guinea				x	x	x	x		x	x	6
Philippines	x		x		x	x	x	x			6
India	x				x		x	x		x	5
Myanmar				x	x	x	x	x			5
Thailand			x		x	x	x	x			5
Uzbekistan	x	x		x			x	x			5
Bangladesh					x	x		x		x	4
China					x	x		x		x	4
Malaysia			x		x	x	x				4
Pakistan	x	x	x				x				4
Timor Leste					x	x	x			x	4
Viet Nam					x	x	x	x			4
Afghanistan	x								x	x	3
Kazakhstan				x			x	x			3
Maldives	x			x				x			3
Mongolia				x				x		x	3
Nepal				x				x		x	3
Pacific Islands						x		x		x	3
DPR Korea				x	x						2
Kyrgyzstan				x			x				2
Tajikistan				x			x				2
Turkmenistan				x			x				2
Australia							x				1
Azerbaijan				x							1
Bhutan				x							1
Georgia				x							1
Iran (Islamic Rep. of)								x			1
Republic of Korea					x						1
Sri Lanka								x			1
Prevalence (countries affected)	6	2	5	14	15	13	17	19	4	14	

Legend:

1. Increasing water scarcity threat
2. High water utilization
3. Deteriorating water quality
4. Poor water quality and low water endowment
5. Flood-prone countries
6. Cyclone-prone countries
7. Drought-prone countries
8. Elevated ecosystem/ Climate change risk
9. Poor access to drinking water
10. Poor access to sanitation

The socio-economic and environmental outcomes of water use are assessed based on indicators of access to water and sanitation, health and patterns of water use. The capacity of communities or countries to deliver expected outcomes is assessed based on indicators of water availability, vulnerability and risk (disaster, ecosystems and climate change), and investment capacity. This analysis does not consider sectoral uses of water (for example water used for agriculture or industry). According to this framework, the countries with the most urgent sustainability challenges in relation to water are Cambodia, India, Indonesia, Lao People's Democratic Republic, Myanmar, Papua New Guinea, Philippines, Thailand and Uzbekistan.

Ecosystem services—natural capital

Environmental pressures impact on the health and diversity of ecosystems, and thus the supply of ecosystem services on which regional economies depend.

Resource risks and the approach of ecosystem "tipping points" described in Part I show that resource use has crossed or approached sustainability thresholds. Renewable resources such as fish, soil and groundwater are being used faster than the rates at which they are regenerated by nature. Non-renewable resources such as minerals and fossil fuels are being used faster than renewable substitutes for them can be developed. And, in contravention of the final condition for sustainability proposed by Herman Daly, the World Bank's former chief economist, pollution and wastes are being emitted faster than natural systems can absorb them, recycle them, or render them harmless.[22]

The overuse of environmental resources has implications for the supply, health and diversity of ecosystems and their services from which all economies and societies benefit. The capacity to deliver ecosystem services is tied to ecosystem health and productivity. The *2010 Global Biodiversity Outlook 3*[23] points out that "the provision of food, fibre, medicines and fresh water, pollination of crops, filtration of pollutants and protection from natural disasters are among those ecosystem services potentially threatened by declines and changes in biodiversity." The report also links the loss of cultural diversity with the loss of biodiversity.

"Natural infrastructure" provides many services that built infrastructure does, but with lower environmental impact, reduced energy and material use and little or no production of waste. For example, mangrove forests may replace sea walls, and wetlands can reduce the amount of chemicals used in water treatment. Ecosystem services provided by natural infrastructure support both big businesses and the less well-off.

The interim report of the study, "The Economics of Ecosystems and Biodiversity"[24] stresses that there is a strong link between poverty, vulnerability and the degradation of ecosystems. The Food and Agriculture Organization of the United Nations (FAO) notes that about 850 million hectares in Asia and the Pacific are affected by some form of land degradation and that "the ongoing threat of climate change adds additional stress to fragile ecosystem services on which the rural poor rely."[25] As climate change deepens and accelerates, and as the demands made on these services by expanding economies and populations grow, sustainable management of natural capital will be increasingly important for climate adaptation and building resilience to environmental change.

Sustainable management of natural capital will also be important for mitigating the potential for deepening social divides in the future due to the dearth of natural resources. Losses in natural capital caused by increased demand for resources mean a double blow for people who are already vulnerable: first, they are far more likely than are others to be denied access to critical resources; second, the ecosystem services on which they depend most directly are diminished. One of the key actions identified at a global level and a critical one for this region is "much greater efficiency in the use of land, energy, fresh water and materials to meet the growing demand."[26]

The productivity and health of regional ecosystems are in decline overall, as indicated by provisional

estimates of changes in net primary productivity (the conversion of solar energy into biomass, based on the presence of live, green vegetation) in ecosystems and in biodiversity. The estimates of areas in which there have been net losses of primary productivity shows that the Asian and Pacific region is doing better than the globe as a whole. This can be attributed to many causes, including climate. At the same time, however, some countries and areas have had a severe loss of their net primary productivity, including China (South China in particular), Indonesia, Malaysia, Myanmar, North-Central Australia and parts of the western slopes of the Great Dividing Range, and high-latitude forest belts of Siberia.[27]

Some ecosystem changes, such as coral bleaching in South-East Asia, the Pacific and other parts of the world, may be due to climate change. Coral reefs and their associated species that are important for food security have been affected by warmer, more acidic seawater; the increased frequency of storm surges and cyclones; and direct damage inflicted by people.

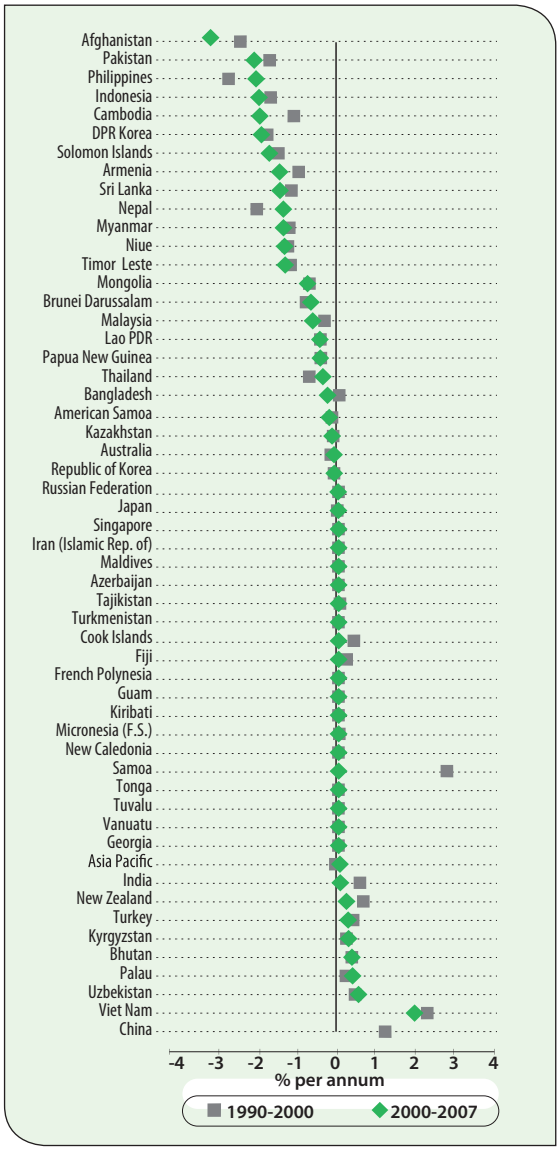
Significant changes are being observed in the region's forests (Figure 2.14), with accelerating degradation and loss of primary forests. Expansion of forest plantations based on non-native species is much more evident in Asian countries than in other regions. Mangrove forest cover has been reduced in most Asian countries, with the laudable exception of Bangladesh.

Inadequate access to energy is intimately connected with the changes in forest ecosystems observed—wood removed from Asian forests is used mainly for energy.[28] Nevertheless, alternative land uses, in particular agro-industrial production, are still the main incentive for deforestation.

The carbon sequestration services that forests provide are receiving increased attention to and investment in international carbon markets. The large-scale planting of trees has resulted in a net gain in forest cover in Asia and the Pacific (primarily in China), but degradation and deforestation have resulted in large decreases in forest biomass, which serves to sequester carbon.[29] Other globally and locally important ecosystem services, including biodiversity habitat, are also affected. Locally important ecosystem services such as disaster mitigation and watershed regulation are also likely to be reduced when forests in specific areas are degraded.

Although signatories to the Convention on Biological Diversity had agreed to significantly reduce biodiversity loss by 2010, it is widely acknowledged that the 2010 target has not been met. The Asian and Pacific region has the world's highest number of threatened species, and the most serious problems are in South-East Asia.

Figure 2.14: Average annual change in forest area, 1990–2000 and 2000–2007



Source: FAOSTAT, http://faostat.fao.org

PART III: TAKING ACTION

In 2010, policymakers are working within a new economic reality. Economic growth strategies that have depended on supplies of free or undervalued natural resources and undervalued human capital are no longer economically, socially or environmentally sustainable. Reflecting this new reality, significant commitments and initiatives for greening of growth have emerged in the last five years.

The green growth initiatives highlighted in Part I of this preview report will take the region only part of the way. The scale of the demand for resources and the trends highlighted in Part II show that incremental improvements in environmental stewardship will not suffice to secure a brighter future for the region. The problems lie much deeper.

No one pays the "real" price of the benefits received from nature or the "real" costs of environmental degradation. Both the natural environment and people, who are inseparable from it, are short-changed by this "externalization" of economic and social costs that underpins the unsustainable use of resources. The fundamental economic transformations needed for building a green economy can be achieved only through correcting policy and market failures, and thus redirecting investment flows.

For the transition to succeed, government leadership and private sector engagement are needed to bridge the gap between the short-term costs of the greening of growth and its long-term benefits. And the transition must be supported by and involve the public. Policies and actions to engage the public in finding the best solutions and to orient public attitudes and values towards sustainable lifestyles and consumption patterns are needed. Changes to economic "infrastructure" and complementary action will be necessary to engage both the public and private sectors in key policy arenas, matching the constraints and opportunities faced by each country.

Overhauling the economic system

Green growth—defined as economic progress that fosters "environmentally sustainable, low-carbon and socially inclusive development"[1]—is a response to a new economic reality.

People are increasingly realizing that natural capital is constrained rather than plentiful.[2] Job creation, especially for the youth, is at the top of government agendas. Strategies for the investments in, and the use of, human, financial and natural capital must change throughout the region to reflect this new paradigm.

A shift is needed from focusing on the quantity of growth, to a better quality of growth—building eco-efficient economies that promote equitable socio-economic progress. This shift will require systemic changes that go beyond merely incremental mainstreaming of the environmental concerns into current economic development strategies.

Systemic changes can only be facilitated by the transformation of both the "invisible" and "visible" economic infrastructure. The "invisible infrastructure" of the economy includes prices, fiscal policies, technology, and regulations, as well as policies and institutions that influence access to, use of and investments in different kinds of capital. For example, putting a price on carbon shifts energy investments towards renewable energy and away from fossil fuels by enhancing the value of renewable and low-carbon energy relative to fossil fuel energy.[3] Invisible infrastructure also refers to the human capital—the skills, knowledge and competencies—that will help support a shift to green growth.

The "visible infrastructure" of the economy refers to the built and natural environments. The planning and design of the built environment locks in consumption and production patterns and lifestyles for decades. If a building is designed

without sufficient attention to water and energy efficiency, the result is decades of wasted energy and water. Scale this problem up to the city level and add urban planning challenges and insufficient investment in public transport, and the result is a vast waste of time, energy and water; traffic jams; a lower quality of life; and a city that is no longer attractive for people or business.

The natural environment and specific ecosystems (such as wetlands, watershed areas, mangrove forests and coral reefs) make up a country's "natural infrastructure", which is the basis for economic activity and for sustaining life. Sustainable management helps secure critical ecosystem services that support the economy—such as water regulation and flood control.

Action to "green" the visible and invisible economic infrastructure is the basis for achieving a shift to more efficient resource use; widening employment opportunities; achieving a better quality of life; and, therefore, a better quality of growth.

A framework for greener, more resilient economies and societies

Establishing a vision and tracking progress

Policies and investments that promote green growth seek to improve the "eco-efficiency" of the economy, which involves minimizing resource use and negative environmental impacts while maximizing the benefits generated by the economy. This action requires integrated strategies that increase the productivity with which energy and other resources are used, while ensuring that the growth rate and the types of economic activities are able to generate jobs quickly enough to reduce unemployment and maintain and enhance labour productivity (Box 3.1).[4]

Reducing the intensity of resource use and pollution requires strong leadership and policy commitment that back a vision. Several countries have signalled their intent to improve resource efficiency through a number of high-level initiatives: examples are China (aiming for a resource-efficient economy); Japan (working to reduce, reuse and recycle—the 3Rs); Malaysia (developing a New Economic Model); the Maldives (working for carbon neutrality); the Republic of Korea (implementing low-carbon green growth); Singapore (implementing the Sustainable Singapore Blueprint); and Tuvalu (aiming for 100% renewable energy use by 2020). Countries have developed policy frameworks to support stated goals, such as Japan's 3R Initiative. 3R approaches have been adopted in Viet Nam, Pakistan and the Philippines, and legislation promoting resource efficiency in countries such as China (the Circular Economy Law), India (efficient material use in national environmental policy), and New Zealand (2008 Waste Minimization Act).

To support such actions, indicators that demonstrate the efficiency of resource use within economic systems are needed to help track whether economies are becoming more or less eco-efficient over time as in Part II.[5] Indicators that measure the intended outcomes of green growth (and related social progress) are also needed. Such indicators could include, for example, the number of new green jobs created, the proportion of "eco-certified" products in total market share, and the reduction in pollution-related health burdens or traffic congestion costs.

Building an integrated policy framework

Shifts in social preferences and investment decisions can only be accomplished through integrated, complementary and mutually reinforcing strategies and policy innovations. Green growth strategies, paths or tracks help to reduce the demand for natural resources

without reducing benefits for people and for economies. Each strategy or path to change the visible and invisible infrastructure of national economies address the basic requirements for systemic changes and should be tailored for each country's context. The strategies include sustainable infrastructure development; green tax and budget reform; green jobs; sustainable consumption; and "greening" of markets, businesses, industries and investments in natural capital. The most effective strategies will be implemented in mutually supportive ways. Action on sustainable consumption, for example, necessarily requires action to "green" markets and ensure that environmentally sound goods and services are readily available, by giving incentives for producing such products. Similarly, policies to promote the development of sustainable infrastructure will only be successful if supported by national policies on developing skills for green jobs.

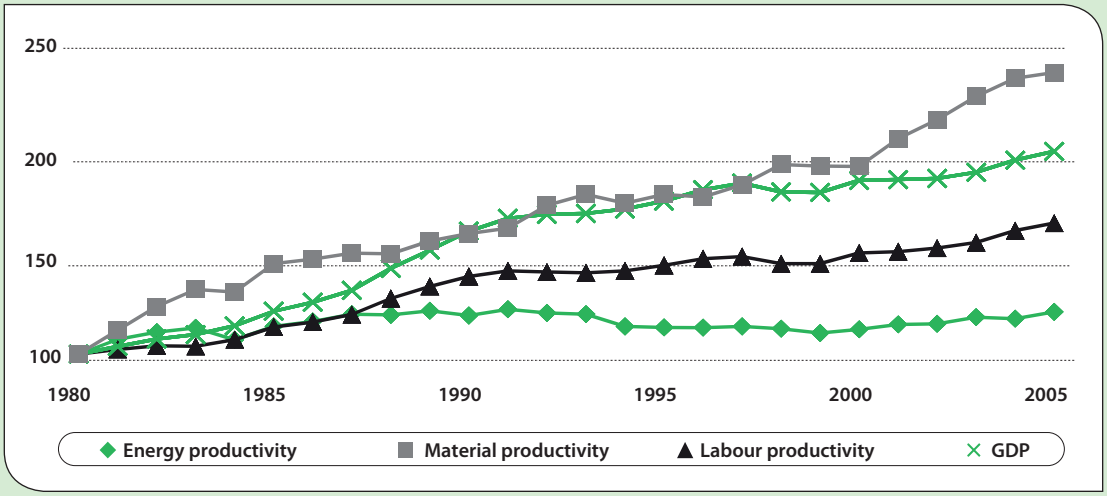
Table 3.1 identifies key policies, partners and investment targets which contribute to the implementation of each strategic area of intervention needed to support systemic change. Many encouraging policy experiences are found across the region. Special attention is needed, however, to cross-cutting policies that will support the necessary improvements in resource efficiency and human capital that will serve as the foundation for greener economies.

Box 3.1: Setting a path for sustainable growth

Historically, rapid increases in labour productivity have been achieved by substituting inputs of materials, energy and technology for those of labour. In Asia and the Pacific, energy productivity grew at an annual rate of only 1.3% and material productivity at only 0.8% during 1970–2005,[6] while the average annual growth of labour productivity in the region was about 2.1%, one of the fastest rates in the world.[7]

A new economic reality in which natural resources (materials and energy) are now scarcer, or more difficult to access than ever before, will require policymakers to consider how to radically increase resource productivity while maintaining and enhancing labour productivity to provide employment, maintain living standards and reduce poverty. Japan has shown that this is possible to some extent—that increases in material productivity can surpass improvements in labour productivity (Figure). While labour productivity in Japan increased by more than 50% between 1980 and 2005, material productivity more than doubled and energy productivity changed relatively little during that time period.

Japan: GDP and labour and resource productivity (indexed 1980 to 2005)



Source: United Nations Environment Programme, *Resource efficiency: Economics and outlook for Asia and the Pacific* (Canberra, CSIRO Publishing, forthcoming).

Table 3.1: Greening growth: strategies, policies, partners and investments

Strategy	Selected policies and examples of countries where implemented	Implementation partners	Investment focus
Sustainable infrastructure development	• Building codes for energy and water conservation (Singapore) • Energy and water efficiency incentives, price restructuring (Singapore) • Independent/decentralized power production (Indonesia, Philippines, Thailand) • Vision and master planning for sustainable infrastructure development • Incentives for restricting urban sprawl, eco-efficient renovation, ecological restoration • Land tax	• Local governments and city planners • Universities • Architects, contractors • Non-governmental organizations • Local communities	• Renewable energy technology • Human capital development • Mass transit development • Retrofitting of buildings • Community development funds
Greening markets, businesses, and industries (including sustainable agriculture)	• Green procurement (China, Japan, Philippines, Republic of Korea,) • Eco-labelling (Republic of Korea) • Green technology investments • Ecological tax reform • Innovation, eco-innovation financing • Cleaner production programmes (Cambodia, China, Indonesia, Malaysia, Russian Federation, Sri Lanka, Thailand, Viet Nam) • Feed-in tariffs (Indonesia, Thailand) • Extended producer responsibility (Japan, Republic of Korea)	• Businesses • Research and development institutes • Wider public	• Life cycle assessments • Cleaner production programmes • Eco-industrial parks • Soft loans for green projects • Innovation agency development • Green technology • Human capital • Organic farming systems, sustainable commercial farming systems
Sustainable consumption	• Water and energy, resource pricing (Singapore) • Green procurement (Japan, Philippines, Republic of Korea) • Information tools including eco-labelling • Extended producer responsibility (Japan, Republic of Korea)	• Private sector • Farmers • Universities • General public • Local government • Financial Institutions	• Sustainable infrastructure development • Demand-side management (e.g. licensing for cars, expansion of public transport) • Standards for eco-labelling • Education for sustainable development
Investment in natural capital	• Payments for ecosystem services (China, Viet Nam) • Eco-labelling • Ecological tax reform, green fees, incentives for investment.	• Community groups • Water and hydropower utilities • Local governments • Businesses	• Enabling policy development and awareness • Biophysical data
Cross-cutting instruments	• Re-orienting investment, internalizing ecological costs • Ecological tax reform • Ecosystem service markets, payments for ecosystem services • Eco-labelling • Energy and water pricing • Border tax adjustment • Investment in human capital, green jobs • Education for sustainable development • Employment policies • Green skills development • Investment policies in labour-rich green sectors (China) • Policies that support a "just" transition for workers		

A virtuous cycle for green growth

Green growth requires a boost through, for example, green stimulus investments, the removal of harmful subsidies, and improved access to financing. Capital markets that integrate environmental, social and governance considerations and public–private financing mechanisms that mitigate risk[8] and bridge the gap between short-term expenditure and long-term benefits are needed.

Resource savings and enhanced competitiveness created through green growth strategies provide economic benefits and release financial capital. For example, in Viet Nam, an investment of $1 million to plant nearly 12 000 hectares of mangroves is estimated to save $7 million per year in the cost of maintaining coastal infrastructure. With financial capital freed for governments, the private sector and individuals, more money can be channelled into, for example, meeting human needs (such as for energy and water), investing in human and natural capital, and improving progress in each policy area.

However, revenues will only be recycled into environmentally and socially desirable activities if price and other incentives (and disincentives) direct these revenues to sustainable goals. Policy instruments that internalize ecological costs are integral to the green growth policy arenas identified in Table 3.1. By changing the price signals in the market, they increase the economic viability of "green" activity. This serves to fuel the green growth engine over time, continually expanding investments in green sectors. As multiple benefits are revealed, societal and private sector support for building a green economy grows, creating a virtuous cycle.

This model of how green growth strategies work together emphasizes two points. The first is that fiscal policies, prices, incentives, and investments that make up the invisible infrastructure of the economy are at the heart of successful green growth programmes. The second is that without the right incentives, a permanent shift in investments is unlikely to take place. Any momentum achieved towards green growth will be quickly lost unless underlying economic forces and financing mechanisms are directed to sustaining green growth over the long term.

Governance for green growth and resilience

Governance for green growth will require committed leadership by governments. It will also need policies, regulation, legislation, institutions and actions that work together to engage the private sector and the public and to facilitate action. Among the key areas that need institutional and legislative support are (a) fiscal reform and economic incentives aimed at shifting funding and social preferences in more sustainable directions, (b) institutions that bridge the gaps in knowledge and implementation capacities, (c) strengthened property rights in rural areas, (d) explicit recognition of ecosystem services in law, (e) new kinds of indices for tracking progress towards sustainable development, and (f) strengthened standards and regulations.

The focus on cross-cutting policies requires strengthened links between institutions that guide fiscal and economic strategy, the institutions that manage resources and the institutions that use resources. Environmental governance arrangements at national, regional and international levels should also be available to support the systemic changes a green economy requires, through effective institutional and sectoral coordination and implementation of environmental goals that have been agreed upon internationally.

Dealing with complex challenges, uncertainty, risk and new opportunities will require inclusive and adaptive governance approaches (Box 3.2). The design and implementation of policy initiatives and resource management actions will require negotiation among an expanding number of stakeholders. Policies will also increasingly need to be evaluated from multiple viewpoints as a way to deal with uncertainties and to ensure that the entire society is engaged in a shift to a more sustainable future.[9] Such action will lead to more resilient economies and societies.

Box 3.2: Inclusiveness and adaptive governance

Governance refers to the ways in which a society shares power, through structures and processes that shape individual and collective action.[10] Governance is not the sole purview of the state, but rather emerges from the interactions of many actors, including the private sector and not-for-profit organizations.

Inclusiveness in governance is important for the deliberations to be well informed, for fair representation of interests, and for shared learning. Without inclusiveness, the interests and capabilities of disadvantaged and vulnerable groups are likely to be ignored, leading to an unfair allocation of burdens, risks and benefits.

Measures to improve adaptiveness in governance are crucial to allow for a wider range of risks and adjustments, such as dealing with increasing uncertainties about the future climate. An important component of adaptive governance is designing policies and providing institutional support that enhances the capacity of communities and economies to resist initial shocks and to adapt to changing conditions, thus transforming crisis into opportunity. At the same time, because local-level adaptations by communities or households in one place may impact others, adaptive governance requires institutions and centralized expertise that better monitor and coordinate local-level adaptations as needed. This is especially the true for water resources management where local-level adaptations may increase competition for water or decrease the benefits from ecosystem services.[11]

In the Asian and Pacific region, aspects of inclusive and adaptive governance approaches have been applied to some of the key issues: climate change and agriculture, water resources management and urbanization. Cities are complex systems which integrate, respond to and influence a diverse range of social, economic and environmental processes. The growing numbers of people displaced by environmental change, including natural disasters is just one of the challenges some cities face, such as in Bangladesh, China, Mongolia and Pakistan. City governments need to help new residents adapt and integrate into the fabric of the city. Fragmented decision-making and rigid planning work against inclusiveness and adaptive governance.

Priority actions

Building the engine for green growth requires strong leadership and policies to enhance the economic feasibility and social acceptability of green growth initiatives. Some of the most important arenas for policy action aimed at supporting systemic changes include internalizing ecological costs (ensuring that the true costs of using nature's capital are reflected in the market), investing in human capital, developing sustainable infrastructure, promoting investments in natural capital and promoting low-carbon development.

Low-carbon development

Low-carbon development strategies offer a way for policymakers to bring climate change responses, economic growth and sustainable development strategies together. Obligatory action to reduce greenhouse gas (GHG) emissions is not acceptable to developing countries, but the risks related to the pursuit of high-carbon growth trajectories have motivated several countries to establish strategies and policies for low-carbon development which are not subject to legally binding mitigation commitments under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC).

Voluntary targets for reducing GHG emissions, or carbon intensities (GHG emissions per unit of gross domestic product [GDP]), that have been formally communicated to the UNFCCC secretariat are documented in Table 3.2. In addition, Tuvalu has announced a target of using 100% renewable energy by 2020. For targets to be effective, a national system of monitoring and evaluation is

necessary, that is, establishing a baseline against which progress can be measured, monitoring and promoting progress at specific intervals, and developing the capacity of stakeholders to independently identify measures to improve the implementation of specific instruments and recommend how to adjust strategies to achieve the targets. As an example, China's 11th Five-Year Plan established targets for reducing resource and pollution intensities (including for carbon dioxide and energy) and for monitoring activity has facilitated China's adjustment of its strategies.

Table 3.2 shows that common elements of low-carbon development strategies include (a) regulating energy demand, including through investments in energy efficiency and infrastructure; (b) ensuring energy security based on increasing renewable and low-carbon energy sources of energy as a proportion of total energy used; (c) adopting supportive technologies and policies in non-energy sectors; and (d) managing land sustainably.

For developing countries, high priority has to be placed on ensuring that climate action works for development. This means continuing economic growth; meeting poverty reduction goals; and providing access to energy, housing and other needs—but based on economies that are less carbon-intensive than is currently the situation.

Climate mitigation goals can directly support the achievement of development goals through multiple co-benefits that include, amongst others, reduced operating costs, increased access to energy services, greater community empowerment, and improved livelihood opportunities and quality of life. For example, improved cooking stoves can reduce greenhouse gas emissions and emissions of black carbon,[12] and thus also help to reduce the exposure of women and children to health impacts such as upper respiratory infections.

While improving energy efficiency is among the easiest and most cost-effective of the many actions needed for mitigating climate change, energy efficiency measures must be linked to development benefits. For example, through innovative financing mechanisms, cost savings from energy efficiency measures could be directed towards investments in expanding access to modern (and renewable) energy by the people who most need it. As shown in Part II, even a small input of energy can significantly boost socio-economic progress in countries and areas that most lack energy access.

Innovative financing mechanisms and incentives are also needed to engage stakeholders in taking action. India has announced plans to introduce a "Clean Energy Cess" that will tax each tonne of coal used. The proceeds will be the basis for a fund that will finance research and projects for the deployment of clean energy technologies.[13] The funds raised by this policy are estimated at about $660 million for the 2010/11 fiscal year.[14] A concessional duty of 5% on solar photovoltaic and thermal technology that will reduce capital costs for investors and several incentives to encourage the use of low-carbon technologies are also planned.

Measures to support energy efficiency improvements and low-carbon technology deployment may be targeted at specific sectors that are responsible for high levels of GHG emissions. One study of a range of industries in the Republic of Korea shows that some with high emissions can reduce their climate impacts without significant impacts on their levels of output—and with little or no impacts on employment.[15] Complementary measures are needed to support the sectors that are most vulnerable to action to reduce GHG emissions. While the study found that action to reduce emissions increased productivity in several sectors (mining, non-metallic mineral products, electric power, water and gas supply), such action reduced productivity in others, including basic metal products, coal and petroleum and chemical products.

The costs of mitigation are also important to consider, because climate investments can have short-term opportunity costs. A comprehensive study of more than 200 GHG abatement opportunities across 10 sectors assessed the potential, costs and investment required

Table 3.2: Nationally appropriate mitigation actions: Asian and Pacific developing countries

Country	Voluntary target	Means of reduction
China	-40% to -45% of 2005 emissions intensities by 2020	
India	-20% to -25% of 2005 emissions intensities by 2020	Excludes agricultural sector emissions
Indonesia	-26% of emissions by 2020	Peatland management, reduced deforestation and degradation, forestry and agriculture carbon sequestration, energy efficiency, alternative and renewable energy, solid and liquid waste reduction, low-emissions transport
Marshall Islands	-40% of carbon dioxide emissions below 2009 levels by 2020	National Energy Policy and Energy Action Plan
Maldives	Carbon neutrality by 2020	
Mongolia		Increase renewable energy options, improve coal quality, efficiency of and electricity use for heating, household energy use, combined heat and power plants, building energy efficiency, energy efficiency in industry, vehicle fuel efficiency, livestock productivity, forestry
Papua New Guinea	-50% of greenhouse gas (GHG) emissions by 2030 Achieve carbon neutrality before 2050	Quantitative targets set for reducing emissions from forestry, agriculture, oil and gas, transport, power generation, mining and fire
Republic of Korea	-30% of business as usual GHG emissions by 2020	
Singapore	-16% of business as usual GHG emissions by 2020	Mitigation and energy efficiency measures announced under the Sustainable Singapore Blueprint

Note: Based on official communications to the secretariat of United Nations Framework Convention on Climate Change (UNFCCC). Some communications have specified elements of conditionality.
Sources: Nationally appropriate mitigation actions of developing country parties; website of the UNFCCC, accessed on 2 August 2010 at http://unfccc.int/home/items/5265.php

in each sector.[16] The study highlights that many GHG abatement measures can be achieved while saving costs—at "negative cost" per tonne of carbon dioxide equivalent. Such opportunities include (in order of their potential for cost savings) industrial GHGs other than carbon dioxide, standby losses, sugarcane biofuel, fuel efficiency in vehicles, water heating, air conditioning, lighting systems, fuel efficiency in commercial vehicles, and building insulation.[17]

Several reports have concluded that, at the global scale, effective climate action is achievable with appropriate investment, technology transfer, coordination and international support.[18] The opportunities for reducing emissions at the lowest costs are fragmented across sectors and regions. More than half of the potential for such reductions is in developing countries,[19] where investments in GHG emission reductions can be channelled towards meeting development goals.

International cooperation is needed to ensure that countries that lead on the way in low-carbon development do not suffer short-term losses in competitiveness as a result, and that countries that are unable to invest directly in low-carbon development are not left behind. Amongst international coordination arrangements that are discussed as potentially ensuring that the

production of renewable energy is competitive, is a global "feed-in tariff" programme which is proposed to apply a special purchase price for electricity generated from renewable energy sources. Such a price incentive to renewable energy producers would generate further investment in renewable energy, eliminate the long-term need for price support, and meet the need to improve access to modern energy in some developing countries.[20]

Invisible infrastructure: reforming the incentives framework and creating new markets

Ecological tax reform and other economic instruments

Because the real social and ecological costs of resources are rarely reflected in current market practices, resources are often underpriced and used inefficiently and with socially unsustainable production methods. Economic and fiscal policy, as well as supportive regulations and other kinds of instruments, will be needed to correct these market failures. Regulations, standards and prices that reflect the true social and ecological costs of products are needed to shift consumer choices towards more efficient uses of resources. Information tools, such as eco-labels, can be vital in this effort. Values of ecosystem goods and services and diminishing stocks of natural resources need to be better reflected in the economy, as a fundamental response to the changing economic reality. New markets may need to be created to effect this paradigm shift if the old markets are not up to the task or cannot be adequately reformed. International and regional cooperation will be required so that implementing countries do not lose economic competitiveness and to ensure economies of scale.

Ecological tax reform. Markets can be reformed by applying green taxes to the "bads"—pollution or inefficient use of resources—and reducing tax or financial burdens on the "goods"—environmentally and socially viable production and consumption patterns. Such a revenue-neutral approach would not increase the overall tax burden, but would have a positive impact on employment and polluting behaviour by providing incentives for production and consumption that are cleaner and make more efficient use of resources. For example, in China, a standard road tax has been replaced with a fuel tax which maintains government income but encourages energy efficiency and judicious use of private cars. In this way, a double dividend is reaped for the economy and for society.

This approach shifts investments towards efficient use of resources, more employment, and environmentally beneficial activity. Tax systems are most effectively modified within a broader budget reform exercise and a flexible system of budget redistribution.

Key components of an ecological tax reform package can include rebating (as appropriate) new revenue to companies and consumers most directly affected by rising resource costs and phasing the tax shift in gradually and predictably. Providing transitional assistance for communities, workers and industries that are strongly affected by the tax is also important.[21]

Subsidy reform. Subsidies are important economic instruments that provide incentives for production, reducing economic burdens for both businesses and people. While subsidies are politically attractive, they can discourage conservation and efficiency improvements. And subsidies don't always benefit the lower income groups; sometimes they benefit the more affluent instead. For example, in Indonesia an estimated 40% of high-income households benefited from 70% of the fuel subsidies, whereas 40% of the poorest households only benefited from 15%.[22]

Subsidy reform can be a cost-effective means for achieving environmental protection, economic development and energy security.[23] In the energy sector, the need for subsidy reform is becoming

widely acknowledged, with the G-20[24] agreeing to gradually phase out fossil fuel subsidies in September 2009. The International Energy Agency estimates that fossil fuel subsidies increased from $342 billion in 2007 to $557 billion in 2008 and that the suggested phasing out between 2011 and 2020 would reduce carbon dioxide emissions by about 6.9%.[25]

Perverse subsidies for fossil fuel use can be redirected to renewable energy, technologies that improve the efficiency with which energy is used, better management of transmission and generation, cleaner production methods, green jobs and public transport, thus boosting the transition towards sustainability and green employment. Likewise, rational pricing of water resources reflecting the true cost of water is required to encourage conservation, efficiency improvements, and commercial investment in water treatment and reuse.

At the same time, subsidy reform needs to be carefully managed to avoid negative social impacts. Social safety nets need to be improved, expanded and/or reformed, and leakages to higher income groups minimized. The case of Sri Lanka demonstrates that the national safety net and its core component—the Samurdhi food stamps program—were substantially better targeted than kerosene subsidies. In addition, user charges for education and health services in the poorest rural and urban areas may be reduced or eliminated, and cash transfers provided in a way that does not foster diversion to increased consumption. In Indonesia, for example, energy subsidy reductions were coupled with cash transfers to low-income groups (Box 3.3).[26]

Box 3.3: Subsidy reform in Indonesia

The budgetary implications of high oil prices and fuel subsidy policies have led to actions to reduce subsidies and restructure energy prices. In 2008, Indonesia reduced its petroleum subsidies, leading to a fuel price increase of 28.7%.[27] The removal of subsidies is a politically sensitive issue and has, in the past, led to protests and violence. However, Indonesia diverted the funds from these subsidies to social protection policies and poverty alleviation. This mitigated the economic burden of the higher fuel prices, but also ensured that those who could afford it were paying a more realistic price for the energy used, which by itself can be a powerful tool for energy efficiency.

Payments for ecosystem services. Another way of internalizing ecological prices is to recognize the value of ecosystem services in the economy. This will strengthen the protection and sustainable management of ecosystems, thereby helping to avoid economic losses, secure critical ecosystem services, achieve cost savings on infrastructure development (for example, building water treatment plants), and strengthen climate adaptation efforts through ecosystem-based adaptation approaches.

The economic benefits of ecosystem services can be spread over a wide range of stakeholders and accrue from different sources. For example, beneficiaries may include water and energy users, pharmaceutical firms, and ecotourism operators. Pricing the ecosystem services can enhance both the number of stakeholders and the benefits they get from preserving the resources, as more of the beneficiaries of ecosystem services will see themselves as investors in the services.

Innovative initiatives, backed by flexible regulatory frameworks, have engaged many beneficiaries in different ways. Many measures fall under the broad category of "payment for ecosystem services".[28] These measures can complement and strengthen spatial planning and regulatory approaches to conservation.

Payments-for-ecosystem-services schemes can utilize taxes or user fees for ecosystem services that are not accounted for in the market, such as fees and payments for ecotourism, "green fees" for intensive water users, and charges for energy and water uses which depend on the services provided by watersheds (e.g. for hydropower production) and forests (e.g. for carbon absorption in the case of thermal power plants). For example, Viet Nam has taken the important step of providing a legal basis for payments for ecosystem services; this has facilitated investments by hydropower companies and water utilities in watershed management.

Human capital for a green economy: green jobs, new skills

"Green jobs" refers to "the direct employment created in economic sectors and activities, which reduces their environmental impact and ultimately brings it down to levels that are sustainable.[29] The projected benefits of new job creation are one of the most attractive features of green growth for policymakers. Renewable energy, in particular, is opening up opportunities for new green jobs (Box 3.4).

Box 3.4: Green jobs potential in renewable energy

Global investment in renewable energy is expected to reach $343 billion in 2020 and to almost double again to $630 billion by 2030. These projections could translate into 20 million jobs in the renewable energy sector, more than the current jobs in the fossil energy industry (mining, petroleum extraction, refining and power generation), which has been shedding jobs despite rising production.[30]

Countries that are focusing on developing and deploying renewable energy stand to benefit enormously. China's renewable energy industry and its domestic market have grown significantly as a result of (a) the Renewable Energy Law of 2005, which targets a 10% renewable energy share in the country's total energy consumption by 2010 and a 15% share by 2020; and (b) the Medium- and Long-Term Development Plan for Renewable Energy of 2007. Consequently, China is taking a leading position globally, particularly in wind power, solar water heating and small hydropower. These jobs can be expected to make up for the closure of energy-intensive industries as part of the country's efforts to reduce the energy intensity of the economy.

Public policy can do a great deal in boosting green jobs. However, long-term green growth prospects require education and skills programmes for qualified entrepreneurs and skilled workers to support job creation. Education for sustainable development is essential at all levels, formal and informal. School curricula and skills training need to be rapidly scaled up to meet the emerging demands for skilled labour.

A "just transition" for workers and enterprises in support of the shift towards a low-carbon economy will provide workers affected by job losses with access to retraining and various forms of support and benefits, and must be based on social dialogue between government, industry and trade unions. Social justice and labour rights, including occupational health and safety, must be addressed. Transitions should also benefit the people most directly affected by climate change, such as farmers and fishermen.

Another way to create new green jobs is to provide support for new green industries, as well as the greening of existing industries.[31] To this end, government intervention can focus on overcoming the barriers and risks that currently restrict capital flows into the sectors that support green growth, including high and front-loaded capital costs of clean energy projects, and the need for longer maturity loans than are available in commercial markets. Government policy can play an important role in providing incentives through clear regulatory and institutional frameworks and risk guarantee instruments. Creating an environment that is conducive to the formation and expansion of small and medium-sized green start-up enterprises is also important. Such an environment can be created through fiscal and tax policies, including tax rebates for investments in specific sectors.

Visible infrastructure: sustainable built environments and investment in natural capital

Sustainable infrastructure

Asia's cities are predicted to be the centres of global economic growth in the foreseeable future, and urban centres in the Pacific are growing at record rates. About two thirds of the $4.7 trillion to $8 trillion needed for infrastructure investment in Asia and the Pacific during the next decade[32] will be in the form of new infrastructure, which creates a massive opportunity to take a holistic approach to infrastructure design, financing, ownership and operations.

Conversely, the window of opportunity to change resource use patterns is closing, as the development of conventional infrastructure locks regional economies into unsustainable patterns of resource use for many decades, reducing the prospects for sustainable outcomes. Planners and decisionmakers are increasingly aware of the these issues and are paying attention to sustainability considerations in infrastructure investments.

Sustainable infrastructure offers an alternative to business as usual. Building sustainability into infrastructure involves replacing and upgrading existing infrastructure with more eco-efficient systems and building around the needs of people at a scale that increases accessibility, eco-efficiency and social inclusion.

Sustainable infrastructure need not cost more than conventional infrastructure if investments are sequenced and financed appropriately, balancing up-front capital cost with lifetime operating costs. Investing in efficiency normally pays for itself in resource savings and can offset the need for some large-scale centralized infrastructure. For example, improving end-use efficiency can avoid or defer investments in new large-scale power plants. Energy efficiency—sometimes referred to as the "fifth fuel"—can be encouraged throughout the supply chain (fuel production, power generation, power transmission and distribution, and end use). However, the realization of huge potential efficiency gains remains hampered by a lack of instruments to monetize conservation and efficiency and to reward sustainable consumption.

Similar gains in the efficiency with which resources are used can be made in other sectors, but they require a shift in policy, planning and analysis to reward efficiency and conservation rather than production and consumption. Water conservation and reuse programmes (analogous to energy conservation and efficiency programmes) could ameliorate some of the long-term water supply problems.

With infrastructure financing constrained by more vigilant management of financial risk, a strong case can be made for modular and scalable design approaches, which start with relatively smaller budgets and lower risk. Decentralized systems can be community-owned and quickly built, with economic, environmental and social benefits equivalent to or better than those for centralized infrastructure.[33] That mobile phone networks are now cheaper and faster to build than landlines is a lesson to be applied elsewhere.

While centralized infrastructure is still needed, megaprojects may entail substantial opportunity costs in terms of the time required to mobilize financing and deliver the services promised. Infrastructure planners should evaluate alternative scenarios based on the amount of financing available and realistic assumptions about project size versus timely implementation. The goal should be to optimize access to investment, particularly in the near to medium term.

Energy. Public policies that support a rapid increase in the installed capacity of renewable energy will provide a "big push" for public and private investments, and the demand for fossil fuels could be reduced as global economies continue to grow.[34] Financing can be more effectively used for distributed generation (including co-generation and tri-generation systems) and smart mini-grids than for expanding national grids with centralized power generation. Distributed generation systems using traditional biomass feedstock such as animal wastes and woody biomass are a logical application for

delivering reliable energy services in poor rural areas. Other low-cost options for basic services include hand-cranked light-emitting diode (LED) and solar photovoltaic lighting. Such distributed, modular systems may be inherently more resilient to the impacts of climate events than centralized plants.

A variety of policy, regulatory and financial instruments are being considered, tested and utilized in the region to promote cleaner and more efficient energy use. A good example is the creation of funds for energy conservation, such as the Thailand Energy Conservation Fund (Box 3.5). Other important measures being pursued in the region include renewable portfolio standards, feed-in tariffs, reverse auctions, net metering, time-of-use tariffs, "cash-for-clunkers," and carbon finance. Where sustainable infrastructure investments have higher up-front costs (for example, in the case of green buildings), interest rate incentives can equalize or reduce the total cost of construction and financing.

Box 3.5: Promoting energy efficiency in Thailand

In Thailand, legislation in 1992 established the Energy Conservation Promotion Fund (the ENCON Fund), which receives revenue from a small levy of about 0.04 to 0.25 Thail baht per litre (less than $0.01) on gasoline, diesel, fuel oil and kerosene sales. The annual revenue from this levy ranges from 2 billion to 5 billion Thai baht ($60 million to over $150 million).[35] The fund is used to promote energy conservation, including through research, development, demonstration projects, incentives (such as grants or soft loans), capacity building activities and policy studies. The Energy Efficiency Revolving Fund is funded by the ENCON Fund and specifically focuses on stimulating investment in energy efficiency by involving the Thai finance sector in providing low-interest loans for energy efficiency projects.[36]

Water. In the water sector, policies could promote modular waste treatment plants, including stand-alone systems and retrofits to existing sewer systems, reduction of losses in transmission networks, and end-use efficiency improvements that include on-site treatment and reuse in commercial and residential buildings.[37] The city of Beijing implemented a local regulation for decentralized wastewater treatment systems in apartment and office buildings, and has achieved a 10% water reuse rate.[38] Community-based water provision models have been found to reduce leakage and increase access to water services in Jakarta[39] and Sri Lanka.[40] Rainwater harvesting in homes, public buildings and communities can support these decentralized measures.

Furthermore, ecological sanitation systems and biogas digesters have a proven track record in the region. They are easy to deploy, simple to operate, quick to install, and cheaper than western-style centralized sewage treatment systems, which rely heavily on costly collection networks.[41]

Transport. In the transport sector, fuel switching and improved vehicle fuel efficiency have helped to address health-threatening levels of transport-related air pollutants and have mitigated increases in GHG emissions. However, mass transit and non-motorized transport require much more investment. Latin America's successful bus rapid transit systems (using dedicated bus lanes to provide faster, more efficient service) could be widely replicated as a cost effective option if planning and design are integrated with other measures to manage the demand for transport. Such systems are operating or being planned in several countries in the region, including China, India, Indonesia, and Thailand.[42]

Policymakers will need to consider reforming energy and fuel subsidies and using economic instruments such as congestion charges and parking fees to manage transport demand. Revenues raised through appropriate pricing, can help provide the resources required for the policies, institutions, technology, infrastructure and operations necessary to implement low-carbon, sustainable transport systems.

Eco-efficiency at the urban scale. Attempts to apply eco-efficiency criteria at the national level have resulted in establishing broad eco-efficiency targets in countries such as China. However such

criteria have rarely been applied at the city level. Eco-efficiency, however, is highly relevant for sustainable urban development, particularly in addressing the challenge of expanding access to goods and services in response to rapid urbanization, while minimizing environmental impacts.

Efforts to improve environmental quality can be powerful catalysts for action in urban environments. In cities that are industrial centres, cleaner production and the development of eco-industrial parks can form the basis for a new vision for a city, as in the case of the city of Kitakyushu, Japan. More recently in Ulsan, the Republic of Korea, the development of an eco-industrial park has spurred the wider integration of eco-efficiency principles into urban development. Indicators chosen for assessing projects within the eco-industrial park included (a) reduction in energy and emissions, (b) payback time, and (c) job creation. For example, the investment by the Yoosung Company and Hankook Paper to exchange steam, produced from waste, had a payback time of less than half a year; investments in new techniques resulted in hiring new employees; and the reduction in energy use and air pollution was evident.

The success in tackling cleaner production issues was one of the drivers behind a more holistic strategy for the city itself, which has now adopted the "Ecopolis Ulsan" vision and plan.[43]

Maintaining natural infrastructure

As discussed in Part I, natural capital provides critical ecosystem services that can reshape an economy and garner significant economic benefit. An example is provided by Suncheon City in the Republic of Korea. The city turned its tidal ecosystem, with extensive wetlands and reed fields, into an ecotourism attraction which has generated 64 000 jobs and garnered other economic benefits valued at $100 million.

Appropriate ecosystem management practices are also essential for reducing the vulnerability of people and the environment to climate change. "Ecosystem-based adaptation" offers an alternative to costly human-made structures, such as dykes and concrete walls to prevent damage by coastal storms; civil engineering interventions for flood prevention along rivers, streams and communication networks; and major investments in irrigation infrastructure. In comparison, as natural buffers, ecosystems are much less expensive to maintain and often more effective than physical engineering structures (Box 3.6).

Involving multiple stakeholders, including scientific and local experts, as well as communities, in accounting for and evaluating ecosystem services allows for a better understanding of underappreciated services, along with opportunities to improve sources of livelihood. These efforts should involve planning and zoning together with users and other stakeholders and compensating people who manage the lands for their costs of doing so sustainably.

One of the first policy initiatives is identifying ecosystems that are most at risk and have the highest socio-economic value. While obtaining adequate information about the value of specific ecosystem services and presenting it in a way that is relevant to economic decision-making is sometimes difficult, it can yield important results that can influence future land use decisions (Box 3.7).

Local communities can be engaged in the sustainable management of ecosystems so that their socio-economic value can be maintained. Payments-for-ecosystem-services schemes being explored in the region as well as co-investment approaches that involve partnerships between managers of ecosystems and those who benefit from the ecosystems' sustainable management.[44] can be facilitated by supportive government policies.

International investors (donors, companies and individuals) are also increasingly willing to invest to protect biodiversity and benefit carbon sequestration. For example, carbon emission reductions generated through reducing emissions

from deforestation and forest degradation (REDD) are being sold on voluntary carbon markets and are financing investments in sustainable forest management and protection. Under the right conditions, REDD investments enhance the value of forested lands in the "real" economy, and provide a unique opportunity to address both climate change and rural poverty while securing an important aspect of the economic infrastructure—the ecosystem services provided by the forests and biodiversity protected.

Box 3.6: Ecosystem-based adaptation practices

Relevant practices, as proposed by the International Union for Conservation of Nature (IUCN), in its 2009 ecosystem-based adaptation document,[45] include

- sustainable water management, where river basins, aquifers, floodplains, and their associated vegetation are managed to provide water storage and flood regulation services;
- disaster risk reduction, where restoration of coastal habitats such as mangroves can mitigate the impacts of storm surges, saline intrusion and coastal erosion;
- sustainable management of grasslands and rangelands, to enhance pastoral livelihoods and increase resilience to drought and flooding;
- establishment of diverse agricultural systems, wherein using indigenous knowledge of specific crop and livestock varieties, maintaining genetic diversity of crops and livestock, and conserving diverse agricultural landscapes secures food provision under changing local climatic conditions;
- strategic management of shrub lands and forests to limit the frequency and size of uncontrolled forest fires; and
- establishment and effective management of protected area systems to ensure the continued delivery of ecosystem services that increase resilience to climate change.

Box 3.7: Valuing ecosystems and the services they provide

Calculating the full economic value of healthy ecosystems is highly complex, as many services—such as protecting coastlines, creating sediments for beaches and exchanging gases—do not have easily established market prices. Therefore, estimates based solely on economic net benefits tend to be too low.

The 2009 report, *The Economics of Ecosystems and Biodiversity*,[46] highlights the values of ecosystems. The analysis shows that coral reefs provide a range of economically important services: natural hazard management (valued at up to $189 000/hectare/year), fisheries (up to $3 818/hectare/year), genetic material and bio-prospecting (up to $57 000/hectare/year), and tourism (up to $1 million/hectare/year). The values are site-specific. Another example is a coastal wetland in northern Sri Lanka which, through its function of attenuating floods, provides an economic contribution of $1 907/hectare/year, and, through its function of treating industrial and domestic wastewater, contributes $654/hectare/year to the economy.

Sustainable agriculture

Sustainable agriculture is a critical aspect of maintaining and building natural capital. Some countries have successfully reformed their rural sector so that poverty and hunger have been reduced, but often by compromising the long-term prospects for meeting food security needs. The health of the agriculture sector cannot be secured without attention to the sustainable use of agricultural land and to the people who make the most investments in land—the farmers.

Due to increasing competition for land, changing production and consumption patterns, and the projected scarcity and rising prices of energy-

based agricultural inputs, governments need to pay special attention to ensuring that food production strategies are focused on the optimal and most efficient use of agricultural lands and water to ensure equitable social, as well as economic, benefits. Driving investments towards the production of food, and reducing the intensity of agricultural inputs without compromising long-term productivity are basic strategies for improving food security. Developing Asia and the Pacific needs fair and open global markets, with reduced subsidies in the developed world, as an increasing number of countries will need to import large amounts of food to feed their burgeoning populations.

The countries which have managed to make important inroads into reducing undernourishment boosted food production and reduced non-food production significantly. For instance, Tajikistan, which has one of Asia's highest undernourishment rates, has reduced the number of undernourished people without expanding agricultural land or importing more food. Food aid contributes a significant share of Tajikistan's total food consumption, but was halved in 2005. At the same time the country expanded its economy, recording rapid economic growth in recent years.[47]

Attention to agriculture is especially important for ensuring resilience to climate change—the agriculture sectors of regional countries are among the most vulnerable to climate change and related natural disasters. For food production to increase a focus on developing more eco-efficient, rather than more intensive, agriculture production models will be required.[48] This means redoubling efforts in research and development to bridge the growing gap between current knowledge and the knowledge that will be needed to face future challenges.[49] This should include efforts at preserving genetic diversity as a basis for competitiveness and resilience—major breakthroughs in new varieties and sustainable commercial farming systems that promote efficient use of all types of agricultural inputs are needed.

Conclusions

The choices that Asian and Pacific countries make during the next few decades are critically important for the future of the region and of the planet. The region is rapidly becoming the world's dominant economic force and already contains the largest proportion of the planet's population. Overcoming the constraints and bottlenecks that impede the region's shift to a green economy must be seen as an imperative.

A significant time elapses between the initial costs and long-term benefits of greening. Governments need to find ways to close this gap; new financing approaches and incentives are needed to successfully engage the private sector and the public in taking action. Changing price signals to internalize economic and social costs through ecological tax reform and other policy instruments is critical for building a green economy. Fears about creating new economic burdens and declining cost-competitiveness can only be dispelled through joint action by governments—international and regional co-operation is critical to the success of green growth.

The public is increasingly aware of the sustainability challenges faced. In some cases, people are demanding more action. While environmental quality needs to be improved through enhanced environmental governance, the scale of the challenges faced will mean inevitable changes in lifestyle. Political leadership and strengthened efforts at creating awareness of the issues and solutions will be needed. The green economy needs to be built on reoriented values and new skills and capacities to meet the burgeoning demand for green jobs. Education for sustainable development needs to be extended to all levels of society, from schools to on-the-job training.

One of the most difficult challenges to implementing green growth is the perception that the poor will pay for actions to promote it; for example, as ecological costs are internalized, energy and other prices increase. Thus, complementary measures are critical, especially in the context of ecological tax reform. In the transition to a green economy, people who lose environmentally damaging jobs need to be assisted through

retraining and compensation. However, not all environment-related jobs offer adequate wages, safe working conditions and workers' rights. Green jobs, by definition, must also be decent[50] —care must be taken to ensure that jobs created are safe and rewarding.

Most fundamentally, a clear vision backed by a well-thought-out strategy and confident leadership is needed. Green growth is uncharted territory and represents major economic paradigm changes. No country has achieved this by itself, or can be expected to "go it alone." Emphasis needs to be placed on the quality of growth—equitable poverty reduction and access to basic services for all, including disadvantaged groups; sustainable use of natural resources; health; education; decent jobs; a quality living environment; family relationships; and participation in society—in addition to such partial measures of human-well being as GDP per capita. Quality of growth also will increasingly mean that resources are used to benefit the most disadvantaged people. Technology can facilitate green growth, but is not the panacea. There is no "silver bullet" technology in prospect that will transform economies and solve all the challenges, but the Asian and Pacific region can become a global leader in many promising green economy technologies.

The policy approaches identified in this preview report are often impeded by vested interests in the status quo. Recognizing who stands to win and who could lose is essential in crafting a consistent set of policies that will act in concert to achieve the necessary stepwise transition towards sustainable development. Green growth policies will generally appeal to governments and the public, but lobbyists for affected industries and people who are ideologically opposed to increased government intervention can be very effective bottlenecks. Multi-stakeholder processes, where all parties are engaged in framing workable solutions, are needed in all sectoral policy debates. Ultimately, however, vision and political leadership will be necessary to bring in the changes, along with a populace willing to accept and foster the changes.

Constraints and bottlenecks are balanced by tremendous opportunities for green growth, green jobs, and an improved quality of life and well-being for all citizens. Achieving the structural transformations needed during the next few decades in Asia and the Pacific will entail surmounting huge challenges. Long-term visions, matched by medium-term goals, are needed to ensure that stepping stones towards sustainable development are gradually being attained. Green growth should be viewed as one of the important milestones to reach along the ultimate path to sustainable development. There is little choice, as "business as usual" is a recipe for a different type of transformation—to a planet that will become increasingly hostile to human existence.

ENDNOTES AND REFERENCES

PART I

1. Economic and Social Commission for Asia and the Pacific (ESCAP), Asian Development Bank (ADB), and United Nations Development Programme (UNDP), Achieving the Millennium Development Goals in an era of global uncertainty: Asia–Pacific Regional Report 2009/10 (Bangkok, United Nations, 2010).
2. ESCAP, "Review of the state of the environment in Asia and the Pacific, 2005." Report to the 5th Ministerial Conference on Environment and Development, Preparatory Meeting of Senior Officials, 24–26 March 2005, Seoul (E/ESCAP/SO/MCED(05)/1).
3. A ministerial forum to address the health effects of these environmental changes was established in South-East and East Asia in August 2007 with the support of the World Health Organization (WHO) and the United Nations Environment Programme (UNEP).
4. ESCAP, ADB, UNDP, op. cit.
5. The 14th annual world wealth report (Merrill Lynch Global Wealth Management and Capgemini, 2010).
6. Food and Agriculture Organization (FAO), Briefing paper: "Hunger on the rise–soaring food prices and 75 million people to global hunger rolls", 17 September 2008, cited in ESCAP, *Economic and Social Survey of Asia and the Pacific 2009: Addressing Triple Threats to Development* (New York, United Nations, 2009).
7. ESCAP, *Economic and social survey of Asia and the Pacific 2009: Addressing triple threats to development* (Bangkok, United Nations, 2009).
8. Rockström, J. et al, "A safe operating space for humanity", *Nature* 461, 472–75 (24 September 2009). The Global Environment Facility (GEF) Scientific and Technical Advisory Panel notes that "severe hypoxia and ocean dead zones are manifestations of the global environment reaching critical thresholds, beyond which recovery may be impossible, or very costly," report of the Scientific and Technical Advisory Panel to the Fourth GEF Assembly (GEF/A.4/3, April 20, 2010).
9. The review covered Indonesia, the Philippines, Thailand and Viet Nam. See ADB, *The economics of climate change in Southeast Asia: A regional review* (Manila, ADB, 2009).
10. (a) Beinhocker, E. , D. Farrel, and A. Zainulbhai, "Tracking the growth of India's middle class", *The McKinsey quarterly*. (2007), vol. 3., pp. 50–61; (b) Estimated by Mastercard Worldwide, AsiaPacific, cited in Wong, Y. , "Understanding the affluent consumers of China", *Insights* (Second Quarter 2007), p. 3
11. ESCAP, ADB, UNDP report on Millennium Development Goal achievement in Asia and the Pacific, forthcoming.
12. Commission of the European Communities, The raw material initiative—meeting our critical needs for growth and jobs in Europe." Communication from the Commission to the European Parliament and the Council. SEC (2008) 2741. Brussels, 4.1 2008, COM(2008)699 final, accessed on 25 March 2010 at http://www.euromines.org/who_is_downloads/raw_materials_initiative.pdf
13. ESCAP, based on International Energy Agency data.
14. ESCAP, *Economic and social survey of Asia and the Pacific 2009: Addressing triple threats to development*, op. cit.
15. See for example, comments by an International Energy Agency (IEA) official, cited in "The IEA puts a date on peak oil production," Dec 10th 2009, Paris, accessed on 25 August 2010 at http://www.economist.com/node/15065719.
16. Halada, K., "Resource availability and the promotion of the 3Rs", presentation at the Asia Regional Seminar for Sustainable Resource Management, Tokyo, 10 December 2009.
17. (a) Koven, P., "China imposes export quotas on rare earth elements." *Financial Post*, 12 July 2010, acessed on 12 August 2010 at http://www.financialpost.com/news/China+imposes+export+quotas+rare+earth+elements/3267458/story.html#ixzz0xpoJwPoK. See also Dingding, X., "Rare earth, common problem;" 3 September 2009, China Daily, accessed on 27 August 2010 at http://www.chinadaily.com.cn/business/2009-09/03/content_8649171.htm; (b) The demand for rare earth metals has multiplied in recent years and supplies are approaching limits due to a combination of physical availability and underdeveloped extractive industries. Some minerals, such as lithium, which is widely used in the batteries needed for hybrid vehicles and renewable energy technologies, are available in only a few countries, some where conflict is an issue.
18. Rosegrant, M. , X. Cai, and S.A. Cline, *World water and food to 2025: Dealing with scarcity* (Washington, DC, International Food Policy Research Institute [IFPRI], 2002), accessed on 15 July 2010 at http://www.ifpri.org/publication/world-water-and-food-2025.
19. Under the most severe of Intergovernmental Panel on Climate Change (IPCC) global emissions scenarios, A1F1.
20. Peng, S., J. Huang, J. Sheehy, R. Laza, R. Visperas, X. Zhong, G. Centeno, G. Khush, and K. Cassman, "Rice yields decline with higher night temperature from global warming," *Proceedings of the National Academy of Science USA,* (July 6, 2004), vol. 101 no. 27 9971–75, accessed on 24 August 2010 at http://www.pnas.org/content/101/27/9971.full.pdf+html
21. Millennium Assessment, *Ecosystems and human well-being: Desertification synthesis* (Washington, DC, Island Press, 2005).
22. ESCAP, *Statistical yearbook for Asia and the Pacific 2009* (Bangkok, United Nations, 2010).

23. van Noordwijk, M. and B. Leimona, "CES/COS/CIS paradigms for compensation and rewards to enhance environmental services", Working paper no 100, WP0129-10 (Bogor, World Agroforestry Centre [ICRAF], 2010).

24. UNEP, International Labour Organization (ILO), International Organisation of Employers (IOE), and International Trade Union Confederation (ITUC), *Green jobs: Towards decent work in a sustainable low-carbon world* (Washington, DC, Worldwatch Institute, 2008).

25. Based on data from the United Nations Population Division, *World urbanization prospects: The 2007 revision* (New York, United Nations, 2007).

26. The $4.7 million estimate is from Menon, J., "Regional efforts to create an attractive investment climate", Presentation to the 2nd OECD–Southeast Asia Regional Forum, "Enhancing Competitiveness through Regional Integration, Bangkok, Thailand, 27–28 April 2009. The $8 trillion estimate is from ADB and the Asian Development Bank Institute (ADBI), *Infrastructure for a seamless Asia* (Tokyo, ADBI, 2009).

27. Estimates based on data presented in United Nations Settlements Programme (UN-HABITAT), State of the world's cities report 2008/09, (Nairobi, UN-HABITAT, 2010).

28. UNEP and FAO, Simultaneous extraordinary meetings of the Conferences of the Parties to the Basel, Rotterdam and Stockholm conventions, available at http://excops.unep.ch/outcomes/excops-outcomes.pdf (accessed on 7 August 2010).

29. Ibid.

30. Folke, C., S. Carpenter, T. Elmqvist, L. Gunderson, C.S. Holling, B. Walker, J. Bengtsson, F. Berkes, J. Colding, K. Danell, M. Falkenmark, L. Gordon, R. Kasperson, N. Kautsky, A. Kinzig, S. Levin, K-G. Mäler, F. Moberg, L. Ohlsson, P. Olsson, E. Ostrom, W. Reid, J. Rockström, H. Savenije and U. Svedin, "Resilience and sustainable development: building adaptive capacity in a world of transformations." Scientific background paper on resilience for the process of the World Summit on Sustainable Development, on behalf of the Environmental Advisory Council to the Swedish Government, April 2002.

31. IPCC, Working Group II Report, "Impacts, adaptation and vulnerability" (glossary) (2008). The relationships between resilience and adaptive capacity are variously described. There is substantial overlap of the two. Gallopín concludes that there is a "diversity of views." While some authors equate the two, others identify adaptive capacity as a component of resilience (reflecting "learning aspects"), while still others see resilience as "key to adaptivity" (Folke et al., 2002, ibid) or identify adaptability as the capacity to manage resilience (Resilience Alliance website: http://www.resalliance.org/1.php); (Gallopin, G.C., "Linkages between vulnerability, resilience and adaptive capacity". Global Environmental Change vol. 16, no. 3, pp. 293–303). The IPCC (2008) seems to have benefited from the work of the resilience community and is consistent with the idea of resilience being a specific aspect of adaptive capacity. Its definition of resilience focuses on system response to stress, change and disturbance (by implication, negative), while its definition of adaptive capacity focuses on responses to "negative" events, as well as change that can provide opportunities.

32. Calls for a Green New Deal came from the Secretary General of the United Nations in late 2008. UNEP issued a report on a Global Green New Deal calling on governments to allocate a significant share of stimulus funds to green sectors such as energy-efficient buildings, sustainable transport, renewable energy and energy-efficient technologies, ecological agriculture, and water conservation, while the United Nations Division of Economic and Social Affairs' proposal for a Global Green New Deal for Sustainable Development was proposed as "part of a broader counter-cyclical response to the crisis" specially directed to support developing countries.

33. UNEP, ILO, IOE and ITUC, op. cit.

34. UNEP Green Economy Initiative, based on data from Robins, N., R. Clover, and C. Singh, A *climate for recovery: The colour of stimulus goes green* (London, HSBC Global Research, 2009).

35. These forums include the September 2009 International Conference on Green Industry in Asia, the January 2010 High-Level Asia-Pacific Dialogue on the Brussels Programme of Action for the Least Developed Countries, the February 2010 Pacific High-Level Dialogue on the Five-Year Review of the Mauritius Strategy for Further Implementation of the Barbados Programme of Action for Sustainable Development of Small Island Developing States (MSI+5) and the Pacific Conference on the Human Face of the Global Economic Crisis, the March 2010 Asia Productivity Organization International Conference on Green Productivity to Enhance Competitiveness.

36. The Republic of Korea has adopted Low-Carbon Green Growth as a national vision. The Government of China has passed framework legislation to support greener growth, including the Circular Economy Law (effective in January 2009); the Renewable Energy Law that increases capital investment for new and renewable energy development in areas such as hydropower, solar, biogas and other low-carbon energy sources in rural areas (effective January 2006); and the amendment of the Energy Conservation Law (effective April 2008) to include price and fiscal reforms in support of energy resource conservation.

37. UNEP, Green economy report: A preview, accessed on 10 August 2010 at http://www.unep.org/GreenEconomy/LinkClick.aspx?fileticket=JvDFtjopXsA%3d&tabid=1350&language=en-US

PART II

1. The 2005 *State of the environment in Asia and the Pacific* report discussed economy-wide resource efficiency (or eco-efficiency) as a basic requirement for environmentally sustainable economic growth. Economic and Social Commission for Asia and the Pacific (ESCAP), *State of the environment in Asia and the Pacific, 2005: Economic growth and sustainability*. (Bangkok, United Nations, 2006).

2. The database covers both the Asia and Pacific region as defined by the United Nations Environment Programme (UNEP), and the region as defined by ESCAP and so results for the total Asian and Pacific region, will differ depending on the organizational definition used. Armenia, Azerbaijan, Georgia and the Russian Federation are part of the ESCAP region, but not of the UNEP Asian and Pacific region.

3. See Chen, X. and L. Qiao, A preliminary material input analysis of China, *Population and environment* vol. 23, no. 1, pp. 117–26, (2001); Japan Environment Agency, Quality of the environment in Japan, 1992, (Japan Environment Association, Tokyo, 1992); Moriguchi, Y., Rapid socio-economic transition and material flows in Japan, *Population and environment*, vol. 23, no. 1, pp. 105–15 (2001); Rapera, C., Linking the trends in material flows with poverty in the Philippines. International journal of global environmental issues, vol. 5, nos. 3–4, pp. 181–93 (2005); Schandl, H., F. Poldy, G. Turner, T. Meascham, D. Walker, and N. Eisenmenger, Australia's resource use trajectories, *Journal of industrial ecology*, vol. 12, nos. 5–6, pp. 669–85 (2008); Schandl, H. and G. Turner, *The dematerialisation potential of the Australian economy*, *Journal of industrial ecology*, vol. 13, no. 6, pp. 863–80 (2009).

4. At www.csiro.au/AsiaPacificMaterialFlows

5. Domestic material consumption refers to imports of materials plus domestically extracted materials minus exports of materials. It includes intermediate and final consumption until released to the environment. Data produced by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) in collaboration with UNEP. The UNEP report *Resource efficiency: Economics and outlook for Asia and the Pacific* (Canberra, CSIRO Publishing, forthcoming) presents a detailed account of resource use in Asia and the Pacific. The material flow and resource productivity data for most countries in Asia and the Pacific is available at http://www.csiro.au/AsiaPacificMaterialFlows.

6. Based on "decoupling analysis" in which the rate of change of environmental pressure (economic activity, in this case, indicated by GDP) is compared with the rate of change of material intensity. If the intensity of an economy's use of the resource is decreasing as GDP grows, then a growth path which is less-resource intensive is indicated.

7. CSIRO and UNEP (2010) Asia-Pacific material flows database, www.csiro.au/AsiaPacificMaterialFlows.

8. Based on decoupling analysis, in which the rates of change of energy intensity are compared with the rates of change of GDP. Improvements are seen if energy intensity is improving faster than GDP grows.

9. CSIRO and UNEP (2010) Asia-Pacific material flows database, www.csiro.au/AsiaPacificMaterialFlows.

10. The drivers of changes in resource were analyzed using the IPAT equation: I = P*A*T. This equation conceptualizes total impacts on the environment (*I*) as the product of population (*P*), multiplied by the level of affluence of the population (or changes in income) (*A*), multiplied by a technological coefficient (*T*). *I* might be defined as the extractive pressure on the environment, such as the domestic material consumption. *A* is often taken to be GDP per capita. Given that technological change has an enormous influence on the intensity of resource use, the intensity of impact per unit of GDP generated can be used as a proxy for technological change. The result shows that both growing population and income have been important drivers with income gaining in importance over time. While reductions in resource intensity were able to offset some of the growth during 1970 –1990, this was much less the case in the 1990s and has certainly not been the case since 2000.

11. ESCAP, *State of the environment in Asia and the Pacific, 2005: Economic growth and sustainability*, (Bangkok, United Nations, 2006).

12. *The economist*. More of everything: does the world have enough resources to meet the growing needs of the emerging economies? 16 September 2006.

13. von Weizsäcker, E., K. Hargroves, M. Smith, C. Desha and P. Stasinopoulos, *Factor five: Transforming the global economy through 80% improvements in resource productivity* (Earthscan, 2009).

14. ESCAP estimate based on International Energy Agency data.

15. Martinez and Ebenhack (2008) observe that an additional 400 kilogrammes of oil equivalent (kgoe) per capita for energy-poor countries could support doubling of the Human Development Index for those which have not crossed the medium high development threshold (0.5 HDI). Martinez, D., and B. Ebenhack, Understanding the role of energy consumption in human development through the use of saturation phenomenon, *Energy Policy* (2008), vol. 36, pp. 1430–35.

16. ESCAP estimate based on data from the Millennium Development Goal database.

17. Food and Agriculture Organization of the United Nations (FAO) subregions and ESCAP subregions differ.

18. ESCAP, *Statistical yearbook for Asia and the Pacific* (Bangkok, United Nations, 2010).

19. ESCAP, ibid.

20. Gleick (1996) estimates the basic water requirement for human needs at 50 litres per person per day, based on "drinking water for survival, water for human hygiene, water for sanitation services, and modest household needs for preparing food." Gleick, P., "Basic water requirements for human activities: Meeting basic needs," *Water international*,

vol. 21 (1996), pp. 83–92, accessed on 18 September 2009 at http://www.bvsde.paho.org/bvsacd/cd17/basic_wate.pdf. A recommended minimum requirement of 20 litres per day was adopted in 1977 by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF), but various other recommendations have been made, noting that minimum requirements can differ depending on climate, physiology, demographics, infrastructure and technology among other factors.

21. Calculation by ESCAP staff, based on data from WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation, 2010, accessed on 10 May 2010 at www.wssinfo.org/datamining/introduction.html

22. Daly, H., "Sustainable growth: An impossibility theorem", In Daly, H. and K. Townsend, eds., *Valuing the earth: Economics, ecology, ethics*, p. 267 (Cambridge and London, Massachusetts Institute of Technology Press, 1993).

23. Convention on Biological Diversity Secretariat, *Global biodiversity outlook 3*. p. 9 (Montreal, Convention on Biological Diversity Secretariat, 2010). See http://gbo3.cbd.int/the-outlook/gbo3/executive-summary.aspx

24. See http://www.teebweb.org/

25. Im-Erb, R., Y. Niino, S. Sombatpanit, R. Biancalani, Proceedings of the Regional land degradation assessment in drylands (LADA) Workshop for Southeast Asia, RAP publication 2009/16, FAO Regional Office for Asia and the Pacific, Bangkok, 2009.

26. Convention on Biological Diversity Secretariat, *Global biodiversity outlook 3*. p. 12 (Montreal, Convention on Biological Diversity Secretariat, 2010).

27. The remotely-sensed normalized difference vegetation index (NDVI) helps to assess the presence of live green vegetation and is used as a proxy for net primary productivity in the GLADA global assessment. Z. Bai, D. Dent, L. Olsson, and M. Schaepman, "Global assessment of land degradation and improvement: 1. Identification by Remote Sensing", GLADA Report 5, Version November 2008, Report 2008/1 (International Soil Reference and Information Centre [ISRIC]-World Soil Information, Wageningen).

28. FAO, *Global forest resources assessment: Key findings* (2010), accessed on 12 March 2010 at http://foris.fao.org/static/data/fra2010/KeyFindings-en.pdf

29. Ibid.

PART III

1. Economic and Social Commission for Asia and the Pacific (ESCAP) working definition, used in its Green Growth Capacity Development Programme, accessed 3 August 2010 at http://www.greengrowth.org/capacity_building/capacity.asp

2. Ayres, R. U., and B. Warr, *The economic growth engine: How energy and work drive material prosperity* (Cheltenham, Edward Elgar, International Institute for Applied Systems Analysis, 2009).

3. Chichilnisky, G. and K. Sheeran, *Saving Kyoto* (London, New Holland Publishers, 2009); Chichilnisky, G. "The Greening of the Bretton Woods", *Financial times*, January 10, 1996, p. 8; G. Chichilnisky, "Global payments for ecosystem services: principles and practice", in Koellner, T. ed., *Ecosystem services and global trade of natural resources* (Abingdon, Routledge, 2010); Chichilnisky, G. "Managing the Global Commons: Principles and Practice", (European Environmental Agency, 2010 [forthcoming]).

4. Ayres, R. U., and B. Warr, op. cit. The authors propose that "the historic link between output (gross domestic product [GDP]) growth and employment has been weakened, if not broken" (p. xvi). They note that although there was increased employment in the last few decades as a result of increases in labour productivity, a post-2000 acceleration in labour productivity in the United States of America yielded very little increase in employment. Their work questions the correlation between productivity, growth and wealth creation.

5. Most of these indicators are eco-efficiency indicators—indicators of resource productivity, resource or pollution intensity—as shown in Part II. They support decoupling analysis—analysis of the trends in the relationship between economic growth and environmental impacts.

6. Based on data from the Commonwealth Scientific and Industrial Research Organisation of Australia (CSIRO) and the United Nations Environment Programme (UNEP) Asia-Pacific material flows database, www.csiro.au/AsiaPacificMaterialFlows

7. Calculated for this report by CSIRO.

8. UNEP, *Green economy report: A preview* (Nairobi, UNEP, 2010), accessed on 16 August 2010 at http://www.unep.ch/etb/publications/Green%20Economy/UNEP_Rio20PrepCom_GERPreview_06May10_FINAL.pdf

9. (a) Kates, R.W., T.M. Parris, and A.A. Leiserowitz,"What is sustainable development? Goals, indicators, values and practice". *Environment* (2005), vol. 47, no.3, pp.: 8–21. (b) Lebel, L., J.M., B. Anderies, C. Campbell, C. Folke, S. Hatfield-Dodds, T. Hughes, and J. Wilson', "Governance and the capacity to manage resilience in regional social-ecological systems", *Ecology and society* (2006), vol. 11, no.1, p.19, available at http://www.ecologyandsociety.org/vol11/iss1/art19/ (c) Smith, A., A. Stirling, and F. Berkhout, "The governance of sustainable socio-technical transitions", *Research policy* (2005), vol. 34 pp. 1491–1510.

10. Young, O., "The effectiveness of international institutions: hard cases and critical variables", in J. Rosenau and E. Czempiel, eds. *Governance without government: Order and change in world politics* (Cambridge, Cambridge University Press, 1992), pp.160–94.

11. Niino, Y. e-mail to ESCAP dated 26 March 2010, "Re: Regional report."

12. Black carbon is the product of the incomplete combustion of fossil fuels, and is an important contributor to climate change impacts from human activity. Using traditional fuels and burning fossil fuels inefficiently is a significant contributor to regional emissions.

13. P. Mukherjee, Minister of Finance, "Speech on the Budget" 2010-2011, February 26, 2010. Accessed on 3 August 2010 at the website of the Ministry of Finance, Government of India, http://indiabudget.nic.in/ub2010-11/bs/speecha.htm

14. Singh, D., "India commits to low carbon development by imposing coal tax", accessed on 31 August 2010 at http://blogs.worldwatch.org/revolt/india-coal-tax/ website of the Worldwatch Institute.

15. Chun, R.H., K.H. Kim, and K. Han, "Environmental regulation and its effects on competitiveness: the case of Korean industries", in Chung, RK, and E. Quah, eds., *Pursuing green growth in Asia and the Pacific,* (Singapore, Cengage Learning, 2010).

16. McKinsey, "Pathways to a low-carbon economy", Version 2 of the Global greenhouse gas abatement cost curve, January 2009, accessed on 31 August 2010 at https://solutions.mckinsey.com/ClimateDesk/default.aspx

17. Ibid.

18. World Bank, *World development report 2010: Development and climate change,* (Washington, DC, 2010)*;* and World Bank, *Winds of change: east Asia's sustainable energy future* (Washington, DC, 2010); United Nations Division of Economic and Social Affairs, World Economic and Social survey 2009: Promoting development, saving the planet (New York, United Nations, 2009). The 2006 Stern report famously concluded that (a) the cost of cutting greenhouse gas (GHG) emissions is likely to be significantly lower than the costs associated with the impacts of climate change; and (b) at a macro level, there is considerable potential for economic benefits to be associated with GHG emission reductions. See Stern, N. *Stern review on the economics of climate change* (London, HM Treasury, 2006).

19. McKinsey, op. cit.

20. A feed-in tariff is a special purchase price which is paid by electricity companies for electricity generated from renewable energy sources as an incentive to renewable energy producers. The purchase price is typically higher than the price paid for electricity generated from other sources. See United Nations Department of Economic and Social Affairs (DESA), *World economic and social survey 2009: Promoting development, saving the planet*, (New York, United Nations, 2009), accessed on 3 May 2010 at http://www.un.org/esa/policy/wess/wess2009files/wess09/wess2009.pdf

21. Bernow, S., R. Costanza, H. Daly, et al., "Ecological tax reform", *Bioscience* (1998), vol. 48, no. 3, pp. 193–96.

22. Data from the National Economic Survey (SUSENAS), Cited in Basri, M. and G. Papanek, Social Protection Policy in Indonesia, In S. W. Handayani and B. Babajanian eds, *Proceedings of the workshop on social assistance*. Asian Development Bank (ADB) (forthcoming).

23. Markandya, A., "The cost of environmental regulation in Asia: command and control versus market-based instruments", *Asian development review* (1998), vol. 16, no. 1, pp. 1–30.

24. Members of the Group of Twenty (G-20) Finance Ministers and Central Bank Governors: Argentina, Australia, Brazil, Canada, China, European Union, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russian Federation, Saudi Arabia, South Africa, Republic of Korea, Turkey, United Kingdom and United States of America.

25. D. Coady, M. El-Said, R. Gillingham, et al., *The magnitude and distribution of fuel subsidies*. IMF Working Paper Series. (Washington, DC, International Monetary Fund [IMF], 2006).

26. Ministry of Economic Affairs, Government of Indonesia, "Government explanation on Government of Indonesia Decree regarding the reduction of fuel subsidy and other related policies." Press release, Jakarta, May 23, 2008, accessed at the website of the Ministry of Energy and Mineral Resources, http://www.esdm.go.id/press-release/53-pressrelease/1757-government-explanation-on-the-reduction-of-fuel-subsidy-and-other-related-policies-.html

27. Ministry of Economic Affairs, Government of Indonesia, Ibid.

28. Payment for ecosystem services is defined as "a voluntary, conditional transaction with at least one seller, one buyer, and a well-defined environmental service". Wunder, S. ,*Payments for environmental services: Some nuts and bolts.* CIFOR Occasional Paper No. 42 (Bogor, Indonesia, Centre for International Forestry Research [CIFOR], 2005).

29. UNEP, International Labour Organization (ILO), International Organisation of Employers (IOE), and International Trade Union Confederation (ITUC), *Green jobs: Toward decent work in a sustainable low-carbon world* (Worldwatch Institute, Washington, DC, 2008).

30. UNEP, I LO, IOE, ITUC, ibid.

31. Discussed by the United Nations Industrial Development Organization (UNIDO) Green Industry Initiative in " A greener footprint for industry: Opportunities and challenges of sustainable development" (Vienna, UNIDO, 2010), accessed on 20 August at http://www.unido.org/fileadminister/user_media/UNIDO_header_site/About/Green_Industry_Initiative.pdf

32. The $4.7 million estimate is from Menon, J., "Regional efforts to create an attractive investment climate", Presentation to the 2nd OECD–Southeast Asia Regional Forum, "Enhancing Competitiveness through Regional Integration, Bangkok, Thailand, 27–28 April 2009. The $8 trillion estimate is from ADB and the Asian Development Bank Institute (ADBI), Infrastructure for a seamless Asia (Tokyo, ADBI, 2009).

33. ESCAP, *Greening growth in Asia and the Pacific: Follow-up to the World Summit on Sustainable Development: Taking action on the regional implementation plan for sustainable development in Asia and the Pacific, 2006-2010* (Bangkok, United Nations, 2009).

34. DESA, A global green new deal for sustainable development, Policy brief no. 12. accessed 29 August 2010 at http://www.un.org/esa/policy/policybriefs/policybrief12.pdf; DESA, World economic and social survey 2009: Promoting development, saving the planet (New York, United Nations, 2009).

35. Based on the exchange rate of 32/$1, May 2010.

36. Energy Futures Australia Pty Ltd and Danish Management Group (Thailand) Co. Ltd., "Thailand's energy efficiency revolving fund: A case study", prepared for the Asia-Pacific Economic Cooperation (APEC) Energy Working Group, accessed on 20 June 2010 at http://efa.solsticetrial.com/admin/Library/David/Published%20Reports/2005/ThailandsEnergyEfficiencyRevolvingFund.pdf

37. For example, biomass–biogas systems are being deployed in rural and agricultural households in Viet Nam with support from the ADB Energy for All Program. Decentralized treatment plants are being deployed in large buildings in China; see ADB, *Toward resource efficient economies in Asia and the Pacific* (Manila, ADB, 2008).

38. Ibid., Box 7.2.

39. UNEP, *Green economy report*. op. cit.

40. ESCAP, *State of the environment in Asia and the Pacific 2005: Economic growth and sustainability* (Bangkok, United Nations, 2006).

41. ADB, *Toward resource efficient economies*. op. cit.

42. Bus rapid transit (BRT) systems can provide the passenger capacity of a heavy rail system at lower cost. BRT systems of various designs have been implemented in China, India, Indonesia, and Thailand, with mixed success. The recently commissioned BRT systems in Guangzhou in China, and Ahmedabad,in India have been identified as the most successful to date. For a summary on the Ahmedabad BRT, see Christopher Kost, "Janmarg, the people's way", *Sustainable transport* (Winter 2009), No. 21 (New York, Institute for Transportation Development and Policy, 2009). For a discussion on the Guangzhou BRT system, see Nadal, L. , K. Fjellstrom, and M. Hu, "Fast and green: China's push for bus rapid transit and green urban areas," presentation at China Environment Forum, The Woodrow Wilson International Center for Scholars, Washington, DC., 30 June 2010; accessed on 3 July 2010 at http://www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.event_summary&event_id=622607

43. Park, H-S., case study for ESCAP, unpublished, 2010.

44. van Noordwijk, M. and B. Leimona, "CES/COS/CIS paradigms for compensation and rewards to enhance environmental services", Working paper no 100, WP0129-10 (Bogor, World Agroforestry Centre, 2010).

45. Colls, A., N. Ash, and N. Ikkala,. *Ecosystem-based adaptation: A natural response to climate change* (Gland, International Union for the Conservation of Nature and Natural Reources [IUCN], 2009).

46. The Economics of Ecosystems and Biodiversity (TEEB), *The economics of ecosystems and Biodiversity, for national and international policymakers—Summary: Responding to the value of nature* (2009), accessed on 30 March 2010 at http://www.teebweb.org

47. ADB, *Asian development outlook 2009: Rebalancing Asia's growth* (Manila, ADB, 2009).

48. ESCAP, "Synthesis of the thematic reports on agriculture and land, rural development, desertification and drought", paper prepared for the Regional Implementation Meeting for Asia and the Pacific at the sixteenth session of the Commission on Sustainable Development (CSD-16), 26–27 November 2007, Jakarta, Indonesia, ESD/RIM/2007/1, 12 November 2007, accessed on 15 August 2010 at http://www.un.org/esa/sustdev/csd/csd16/rim/escap_synthesis.pdf

49. ESCAP, "Report of the regional implementation meeting for Asia and the Pacific for the sixteenth session of the Commission for Sustainable Development", ESD/RIM/2007/Rep., accessed on 21 December 2007, at http://www.un.org/esa/sustdev/csd/csd16/rim/escap_doc.pdf

50. As defined by the ILO, "decent work" sums up the aspirations of people in their working lives. It involves opportunities for work that is productive and delivers a fair income, security in the workplace and social protection for families, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in decisions that affect their lives and equality of opportunity and treatment for all women and men.

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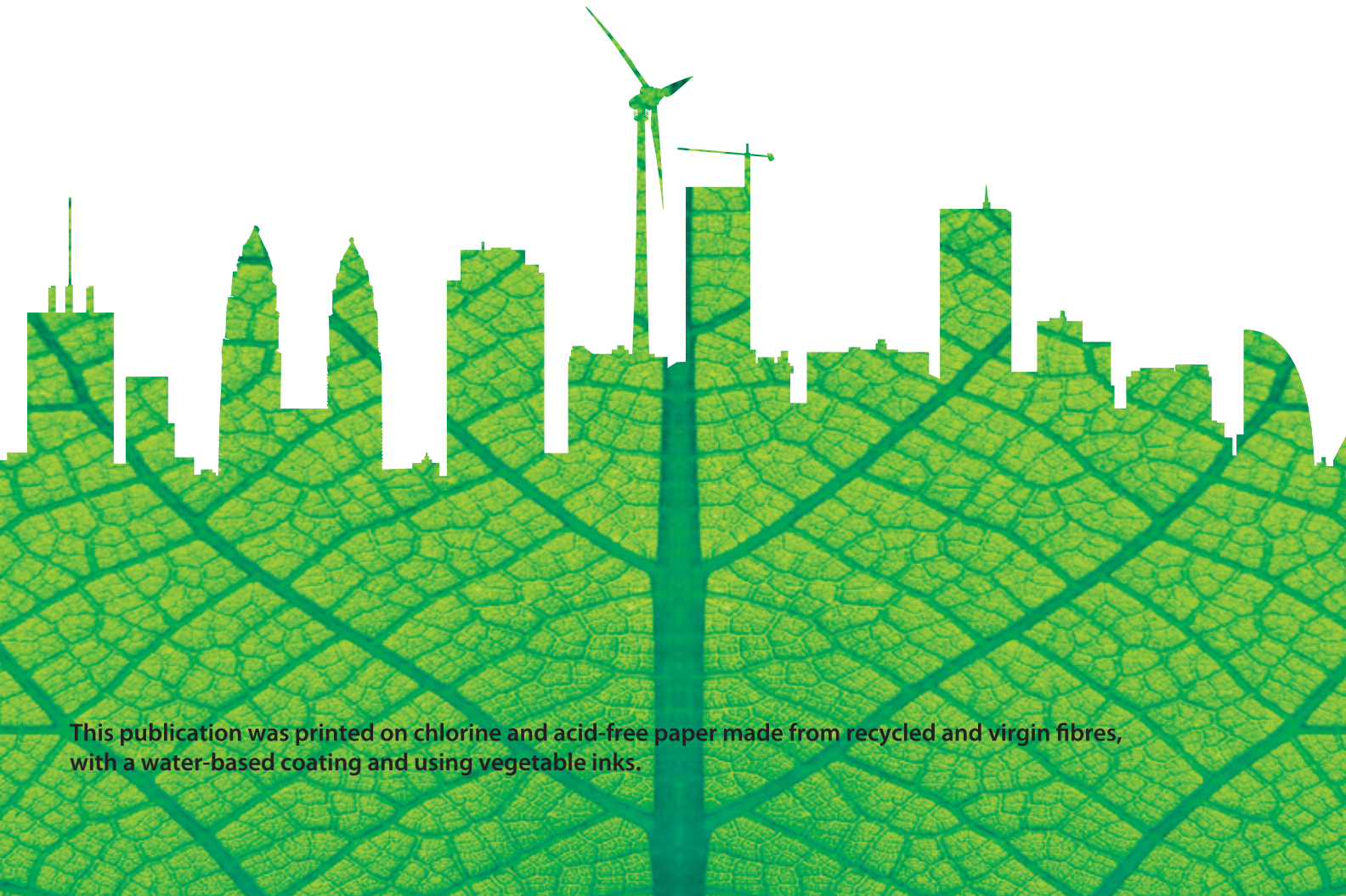

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