Low Carbon Green Growth Roadmap for Asia and the Pacific

Turning resource constraints and the climate crisis into economic growth opportunities

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

KOICA
Korea International Cooperation Agency

ESCAP promotes regional cooperation for inclusive and sustainable economic and social development in Asia and the Pacific, a dynamic region characterized by growing wealth, diversity and change, but also challenged with persistent poverty, environmental degradation, inequality and insecurity. ESCAP supports member States with sound strategic analysis, policy options and technical cooperation activities to address development challenges and to implement innovative solutions for region-wide economic prosperity, social progress and environmental sustainability. ESCAP, through its conference structure, assists member States in forging a stronger, coordinated regional voice on global issues by building capacities to dialogue, negotiate and shape the development agenda in an age of globalization, decentralization and problems that transcend borders. A key modality for this strategy is the promotion of intraregional connectivity and regional integration.

United Nations publication

Printed in Bangkok
ISBN: 978-974-680-329-8
ST/ESCAP/2631

Cover design by Jeff Williams

This publication was prepared under the project Development of a Low Carbon Green Growth Roadmap for East Asia with funding from the Korea International Cooperation Agency (KOICA), under the East Asia Climate Partnership.

Also available online at:

www.unescap.org/esd/environment/lcgg/

This publication was printed with vegetable-based oil ink on green series paper made of 100 per cent eco-fiber

Low Carbon Green Growth Roadmap for Asia and the Pacific

Turning resource constraints and the climate crisis into economic growth opportunities

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

KOICA
Korea International Cooperation Agency

Foreword

The Asia-Pacific region stands at an important crossroads: high levels of economic growth have lifted great numbers of people out of poverty, and many of our development goals are now within reach. The region cannot realize this promise, however, by following the conventional growth strategies in the context of new challenges and uncertainties.

The days of abundant resources and falling prices are over. Resource constraints, price volatility and the climate crisis have removed business as usual as an option and require a serious re-examination of resource- and carbon-intensive growth strategies. If our region is to sustain the high economic growth that we need to achieve our development goals, then we must shift to a different growth trajectory.

Regionally, we must improve resource efficiency and urgently set in motion a new economy in which improving efficiencies and investing in natural capital become the drivers of economic growth.

Green growth can help us to achieve these goals by turning crises into opportunities and by promoting the development of an inclusive and sustainable Asia-Pacific region. Since green growth was adopted as a regional sustainable development strategy in 2005, at the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED-5), many governments have recognized its potential and have taken important steps towards greening their economies.

Realizing the promise of green growth requires a bold and ambitious transformation of economic systems. The very structure of economies, ranging from governance and fiscal policies to lifestyles and infrastructure, has to be reshaped. This Roadmap provides policymakers in the region with a comprehensive list of policy options and practical implementing strategies to consider adopting, based on their own national priorities and circumstances. In particular, the unique and innovative aspects of the Republic of Korea's green growth strategy offer a valuable reference to other countries in the region.

Green growth can be effective only if pursued collectively. The 2012 United Nations Conference on Sustainable Development (Rio+20) provides an exceptional opportunity to forge these necessary global partnerships. The countries of Asia and the Pacific should lead this process by generating the regional momentum necessary to move towards a green economy capable of lifting people out of poverty and achieving inclusive, resilient and sustainable development.

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

A message from the Chairman of the Presidential Committee on Green Growth of the Republic of Korea

The concept of 'low carbon green growth' as a nation's new development paradigm was first presented to the world by President Lee Myung-bak of the Republic of Korea in his speech on 15 August, 2008, commemorating the 60th anniversary of the Republic. It was arrived at by President Lee as his government's final answer, after months of discussion with his advisors since his inauguration, to the nation's 10-year-old question of how Korea could continue the developmental success of the earlier era amidst the adverse trends at home and abroad of the new century. By proposing low carbon green growth for Korea which had come only halfway towards a rich developed country, he was boldly proposing, as he elaborated in his subsequent remarks, an active pursuit of greenhouse gas reduction and environmental protection for sustainable growth and continued development, and to exploit green technologies and clean energies, in particular, as new growth engines and as a source of new jobs. The message was clear – that greening meant innovation and this would drive growth. Particularly remarkable, and even stunning, was his commitment as the head of a state to climate change mitigation, as well as his focus on green innovation for renewed growth.

The Korean government has been pursuing green growth in a comprehensive and vigorous way since then. I find a good coverage of the subsequent evolution of Korea's green growth policies in this Roadmap in various illustrative pieces. I thank the authors for this. I should only add here that green innovation has begun to flourish and green business dynamism as well as green lifestyles have begun to take root in Korea by now, although, admittedly, far more have to be done. In parallel to those domestic efforts, the Korean government has also been pursuing the goal of promoting green growth as a global agenda, especially, as a new development strategy to be shared by the emerging and developing economies. It launched the East Asia Climate Partnership initiative as well as the Global Green Growth Institute. It was successful in promoting the green growth strategy as a new core agenda for the OECD. As the host for the G20 Summit held in November 2009, it managed to push green growth into the summit agenda. It has launched the Global Green Growth Summit. It has just now opened a Green Technology Center for international green technology cooperation, and in particular, for cooperation with the developing countries.

The Korean government is proud that its such international efforts have been instrumental in popularizing green growth as an attractive new strategy in an increasing number of emerging and developing countries. In this way, Korea is engaged in the international effort to open a new chapter in the history of the human civilization - a chapter for a planet-responsible new civilization.

The Korean government was pleased to sponsor this Roadmap as part of this effort. It consists of a comprehensive set of uniquely thoughtful and practical prescriptions for green growth for the countries both in and out of Asia and the Pacific. I am happy to report that the strategy so well elaborated by this Roadmap is fully supportive of Korea's National Green Growth Development Strategy. I hope that all the governments in the ESCAP region will find the policies and advices offered by this Roadmap agreeable and implementable, and also that the Roadmap will inspire those governments to cooperate to create an enabling environment for green growth in the region. The government of the Republic of Korea, and its Presidential Committee on Green Growth, in particular, are willing and ready to offer assistance to fellow regional countries for their respective green growth, as well as to play a leading role in regional cooperation for green growth.

Soogil Young, Ph.D.
Chairman
Presidential Committee on Green Growth
Republic of Korea

Acknowledgements

This Roadmap has been prepared under the project "Development of a Low Carbon Green Growth Roadmap for East Asia" with funding from the Korea International Cooperation Agency (KOICA), under the East Asia Climate Partnership. Sincere appreciation is expressed to the Government of the Republic of Korea for its generous support.

This Roadmap and its ancillary materials have been prepared by a team of consultants under the direction of Rae Kwon Chung, Director of the Environment and Development Division of ESCAP, and coordinated by Lorenzo Santucci.

The lead authors were: Rae Kwon Chung, Lorenzo Santucci, Makiko Koriyama, Eunyoung Lee, Hyunju Lee, Seungwon Chung, Maki Sato, Joohee Jung, Shunquan Zhu, Pimjai Hoontrakul, Alan J. Chin and Yoko Monoe.

Staff from the Environment and Development Policy Section of ESCAP who contributed to specific sections include: Masakazu Ichimura, Aneta Nikolova, Hitomi Rankine and Kelly Hayden.

Other ESCAP staff who provided valuable inputs and comments: from the Environment and Development Division: Adnan Aliani, Hongpeng Liu, Kohji Iwakami, Wontae Kim, Taehyung Kim, Salmah Zakaria, Kyungkoo Kang, Karin Andersson, Ermina Sokou, Natalja Wehmer, Joris Oele, Abhijeet Deshpande and João Aleluia. From the Statistics Division: Rikke Hansen, Jillian Campbell, Nixie Mabanag, Panpaka Supakalin and Nongnuch Hiranyapaisansakul. From the Trade and Investment Division: Joongwan Cho. From the Transport Division: Changnam Ko. From the Sub-regional Office for East and North-East Asia: Kilaparti Ramakrisha and Sangmin Nam.

A series of policy consultations and expert group meetings were instrumental in the development of the Roadmap. This included the following: Inception Brainstorming Meeting (31 August–1 September 2010, Bangkok, Thailand), Expert Group Meeting on Infrastructure (8 October 2010, Incheon, Republic of Korea), Regional Symposium on Trade and Climate Change (13–14 October 2010, Bali, Indonesia), Workshop on Low Carbon Growth (18 October 2010, Bangkok, Thailand), Expert Group Meeting on Integrating Ecological Prices (4–6 November 2010, Bangkok, Thailand), Expert Group Meeting on Eco-Tax Reform (27–28 April 2011, Seoul, Republic of Korea), East-Asia Low Carbon Green Growth Policy Forum (7–8 July 2011, Busan, Republic of Korea) and the Third Asia-Pacific Mayors' Forum on Environmentally Sustainable Urban Infrastructure (30–31 August 2011, Suncheon, Republic of Korea). The contribution of the participants of these workshops is gratefully acknowledged.

Professor Paul Ekins of the UCL Energy Institute, University College London, provided peer review for this Roadmap. The valuable comments from Dr Stefan Speck of the European Environment Agency are also gratefully recognized.

External experts who prepared the policy papers for the development of the Roadmap include: Dr Seungjoon Park (Kwansei Gakuin University), Dr Masato Yamazaki (National Institute of Advanced Industrial Science and Technology), Dr Shiro Takeda (Kanto Gakuen University), Dr Brahmanand Mohanty (Asian Institute of Technology), Holger Dalkmann and Ko Sakamoto

(Transport Research Laboratory), Timothy Haahs, Rachel Yoka and Megan Leinart (Timothy Haahs & Associates, Inc.), Dr Reeho Kim, Dr Jungsoo Mun and Dr Jongbin Park (Korea Institute of Construction Technology), Dr Chang Gil Kim (Korea Rural Economic Institute), Dr Truong Phuoc Truong (University of Sydney) and Jeffrey Scott Crawford.

Interns who contributed to the literature review and research assistance include: Andrew Amelung, Juneho Chung, José Cumsille, Rakesh Gupta, Elly Hyanghee Lee, Nalini Murkutla, Paulina Michel, Valida Prentice, Yusuke Takagi, Denise Thiel and Qiao Qiao Xu. Research support from Yoonsoo Chang, Younkeong Cho and Cathy Shaojin Li in their personal capacity is also gratefully acknowledged.

Editing was provided by Karen Emmons.

The graphic design and layout was created by Jeff Williams.

Administrative assistance was provided by Rujira Khrueachotikul and Sirikul Chan-amnuaysook.

About this Roadmap

The ***Low Carbon Green Growth Roadmap for Asia and the Pacific*** is offered to member States to help their policymakers turn the till-now trade-off between the ecological crisis and economic growth into a synergy in which resource constraints and climate crisis become opportunities for the growth necessary to reduce poverty in the region.

In 2005, the Asia-Pacific region initiated the concept of green growth at the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED-5) in Seoul, Republic of Korea. The ideas of the Green New Deal, a green economy and green jobs followed, mostly as response measures to the financial crisis that broke out in 2008.

The region continues to lead in pursuing green growth. In particular, the Government of the Republic of Korea was the first one to launch a green growth strategy with its own unique and innovate features as a new development paradigm, and to promote it as a global strategy for sustainable development. The Republic of Korea first declared low carbon green growth as the new national vision for the country to follow in August 2008. At that time, it was the only country that made such a declaration, coming even before the financial crisis broke out. The declaration was followed up with the setting of a comprehensive policy package as well as the necessary institutional framework. Cambodia adopted a National Green Growth Roadmap in 2010. At the MCED-6 in Astana, Kazakhstan, the Kazakh Government presented its pioneering Green Bridge initiative to link Asia and the Pacific with Europe through green growth.

Despite the increasing demands for policy options to make economic development green, a clear blueprint that can lead us to a green economy, especially developing countries, is not yet readily available.

This Roadmap bridges the gap by providing five tracks for an economic system change to pursue green growth as a new economic development path. The Roadmap draws upon innovative approaches and experiences in promoting low carbon green growth in the region, and in particular from the Republic of Korea. Accompanying the overview of challenges and the detailing of policy options, 63 fact sheets and 51 case studies are presented in the CD-ROM enclosed in this publication and at the Roadmap website (www.unescap.org/esd/environment/lcgg/) for policymakers in the region as actionable options for shifting their countries to green growth.

For more details on the ESCAP green growth initiatives and activities, see www.greengrowth.org and the ESCAP website (www.unescap.org/esd/).

Rae Kwon Chung
Director
Environment and Development Division, ESCAP

How to read this Roadmap

The *Low Carbon Green Growth Roadmap for Asia and the Pacific* consists of several products:

1. This manual, which lays out the challenges for the region, the paradigm of the green growth strategy and the roadmap for pursuing it in several critical sectors, including the policy options
2. Sixty-three fact sheets that provide detailed information and analysis of the policy options identified in the manual, including strengths, challenges and implementing strategies
3. Fifty-one case studies that provide detailed information about successful practices that can be found in the Asia-Pacific region and elsewhere
4. Eight policy papers that provide in-depth analysis for specific sectors, such as fiscal reform, urban planning, transport, green buildings, water infrastructure and trade

The Roadmap is divided into three parts: Part I provides an overview of the challenges and opportunities confronting the region in terms of low carbon green growth and elaborates on the system change required to pursue the new development path. Part II presents five tracks as core elements of the system change necessary for low carbon green growth and a section that elaborates on the means of implementing the policy options. Part III provides detailed information and analysis of the policy options identified in Part II through fact sheets and case studies.

In Part II, the following icons are used to indicate where more information about a topic or example is available in a fact sheet or a case study:


further information can be found in a fact sheet in Part III


further information can be found in a case study in Part III

At the end of each track (and subsection), the reader will find a list of the relevant fact sheets, case studies and policy papers.

This manual consists of Parts I and II, while Part III is provided in the interactive CD-ROM enclosed in this publication, along with the policy papers. All documents are also available online at:

www.unescap.org/esd/environment/lcgg/

Training programmes for government officials in developing countries are available through an online e-learning facility at

http://elearning.greengrowth.org/

Contents

Fact sheets

1. Appliance standards and labelling
2. Bioenergy
3. Building certification
4. Building energy standards and codes
5. Cap-and-trade scheme
6. Carbon capture and storage
7. Carbon pricing
8. Cellular development
9. Citywide slum upgrading
10. Combined heat and power
11. Compact development
12. Congestion and road-use charge
13. Corporate social responsibility and environmental reporting
14. Decentralized energy system
15. Decentralized wastewater management
16. Double dividend and revenue neutrality
17. Eco-city
18. Eco-labelling
19. Eco-resorts and hotels
20. Ecotourism
21. Electric vehicles
22. Energy service companies
23. Environmental tax reform and competitiveness
24. Environmental tax reform and environmental fiscal reform
25. Extended producer responsibility
26. Feed-in tariff
27. Geothermal energy
28. Green finance
29. Green industry
30. Green jobs
31. Green marketing
32. Green New Deal
33. Green public procurement
34. Green technology
35. Hybrid energy system
36. Hydropower
37. Integrated land use and transport planning
38. Integrated resource recovery centre
39. Integrated water resource management
40. Intercity high-speed railway systems
41. Intracity bus rapid transit and trolley buses
42. Intracity conventional buses
43. Intracity heavy rail and metro systems
44. Intracity light rail
45. Low-carbon development plan
46. Nationally appropriate mitigation action and measurement, reporting and verification
47. Ocean energy
48. Passive houses
49. Policy options to improve the quality of public transport
50. Preservation of open and green spaces
51. REDD and REDD+
52. Renewable energy
53. Research and development and technological innovation
54. Restricting license plates
55. Reusing and recycling water
56. Smart grid
57. Solar energy

Case studies

Boxes

Figures

Tables

Photo credits

Page 36: Traffic jam in Bangkok: GQ / Shutterstock.com
Page 80: Building in Bangkok, Thailand: 100 Words / Shutterstock.com
Page 90: Electric car: Rob Wilson / Shutterstock.com
Page 90: Shinkansen: Norman Pogson / Shutterstock.com
Page 110: Smart meter: Jeff Wilber / Shutterstock.com
Page 130: Baled aluminium cans: Huguette Roe / Shutterstock.com

Acronyms and abbreviations

3R	reduce, reuse, recycle
ABC	Active, Beautiful and Clean
ADB	Asian Development Bank
APCAEM	Asian and Pacific Centre for Agricultural Engineering and Machinery
APCTT	Asian and Pacific Centre for Transfer of Technology
APEC	Asia-Pacific Economic Cooperation
BOT	build-operate-transfer
BRT	bus rapid transit
BSP	Biogas Support Programme
BTA	border tax adjustment
CCS	carbon capture and storage
CDM	Clean Development Mechanism
CERs	certified emission reductions
CGE	computable general equilibrium
CIF	Climate Investment Fund
CSIRO	Commonwealth Scientific and Industrial Research Organization
CSR	corporate social responsibility
CO_2	carbon dioxide
COP	Conference of the Parties
EFR	environmental fiscal reform
ESCAP	Economic and Social Commission for Asia and the Pacific
ESCO	energy service company
ETR	environmental tax reform
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GEF	Global Environmental Facility
GHG	greenhouse gas
GNH	Gross National Happiness
GW	gigawatt
GWh	gigawatt per hour
HDI	Human Development Index
IEA	International Energy Agency
IRRC	integrated resource recovery centre
ISO	International Organization for Standardization
IWRM	integrated water resource management
kWh	kilowatt hour
KEMCO	Korea Energy Management Corporation
LED	light-emitting diode
LID	low-impact development
MCED	Ministerial Conference on Environment and Development in Asia and the Pacific
MDG	Millennium Development Goal
MW	megawatt
NAMA	nationally appropriate mitigation action

NGO	non-government organization
ODA	official development assistance
OECD	Organisation for Economic Co-operation and Development
PACE	Property Assessed Clean Energy
PAYT	pay as you throw
PES	payments for ecosystem services
PPP	public-private partnership
R&D	research and development
REC	renewable energy certificate
REDD	Reducing Emissions from Deforestation and Forest Degradation
REPI	Resource and Environment Performance Index
RPS	renewable energy portfolio standards
SEEA	United Nations System of Environmental and Economic Accounting
SEWA	Self-Employed Women's Association
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
VAT	value-added tax
WEEE	waste from electrical and electronic equipment

Executive summary

Developing countries in the Asia-Pacific region have experienced rapid economic growth in recent years, taking advantage of the opportunities brought about by globalization and an export-led growth model. High economic growth rates have helped lift millions out of poverty and achieve significant development gains. The high growth rates that the region is proud of, however, can only be sustained if resource constraints and climate change are adequately addressed.

To do so, the region has to embrace a new growth strategy that can turn the trade-off between economic development and environmental protection into a win-win synergy in which "going green" drives economic growth.

The concept of green growth emerged in the Asia-Pacific region to turn resource constraints and the climate crisis into an economic opportunity that generates a double dividend (higher growth with lower environmental impact) by improving the efficiency of resource use and increasing investments in natural capital to drive economic growth.

Realizing the promise of green growth will require a bold and ambitious transformation of the economic system. The "visible structure" of the economy, comprising such physical infrastructure as transport, buildings and energy systems, together with the "invisible structure", which encompasses market prices, governance, regulations and lifestyles, have to be re-oriented to resource efficiency. This Roadmap explains how to begin such a transformation.

The Roadmap is divided into three parts: Part I provides an overview of the challenges and opportunities confronting the region in terms of low carbon green growth and elaborates on the system change required to pursue the new development path. Part II presents five tracks as core elements of the system change necessary for low carbon green growth and a section that elaborates on the means of implementing the policy options. Part III provides detailed information and analysis of the policy options and successful practices identified in Part II through more than 100 fact sheets and case studies.

Resource constraints, the climate crisis and the need for eco-efficiency

Resource constraints are threatening future growth prospects.

The days of resource abundance and low fuel prices are over. The world is entering a new era of high and volatile resource prices.

The 2012 report of the United Nations Secretary-General's High-Level Panel on Global Sustainability warned that by 2030 the world will need at least 50 per cent more food, 45 per cent more energy and 30 per cent more water.

Countries in the region are particularly vulnerable to energy and food price volatility. ESCAP estimates that in 2011 alone, 42 million people in the Asia-Pacific region were pushed back into poverty due to energy and food price increases. Achievements related to the Millennium Development Goals, in particular poverty reduction, are in jeopardy.

The Asia-Pacific region uses three times the resources as the rest of the world to create one unit of GDP, and between 2000 and 2005 the resource intensity of its economy increased, in contrast to trends in the rest of the world. Resource-intensive growth patterns have exacerbated the vulnerability of the region to resource price volatility while negatively affecting its ecological sustainability.

Climate change threatens development gains.

Countries in the Asia-Pacific region are the most vulnerable to climate-related disasters. As much as 85 per cent of deaths and 38 per cent of global economic losses due to disaster originated in this region from 1980 to 2009. Recent climate-related disasters, such as Cyclone Nargis in Myanmar in 2008 and the floods in Pakistan in 2010 and in Thailand in 2011, have been among the worst ever recorded in those countries.

If we are to limit the rise in global temperature to less than 2° C by 2050, as acknowledged by the parties of the United Nations Framework Convention on Climate Change, global emissions have to reduce by half by that time. The Asia-Pacific region, while emitting relatively low levels of greenhouse gases on a per capita basis, is one of the fastest-growing sources of climate-impacting emissions.

The region needs to urgently improve its ecological efficiency.

Resource constraints and the climate crisis mean that business-as-usual practices are no longer an option and call for a re-examination of resource- and carbon-intensive growth strategies. If we are to raise the standards of living of a growing population, we need to drastically improve the efficiency of using natural capital, and our economies need to become ecologically efficient.

The gap between ecological and economic efficiencies has to be closed.

Eco-efficiency is inclusive of both economic and ecological efficiencies. Renewable energy, such as solar and wind power, is ecologically efficient but not economically competitive under the current market price structure because it is more expensive than fossil fuel. This is a reflection of distorting policies that have warped the true-value pricing of fossil fuels. The market price structure has to be reformed so that solar and wind power become economically attractive.

Market price restructuring has to be done without damaging the economy or affecting the poor. This Roadmap suggests this can be achieved through properly designed environmental tax reform (ETR) and environmental fiscal reform (EFR), shifting taxes from labour and income to resource consumption, based on the principle of revenue neutrality. ETR and EFR can generate a double dividend of creating more jobs and growth while reducing environmental impacts and improving resource efficiency.

Turning crisis into opportunity: Green growth to deliver a double dividend

Low carbon green growth: A new growth strategy for Asia and the Pacific

Green growth can turn crisis into opportunity and help develop an inclusive, resilient and sustainable Asia-Pacific region. Green growth can improve energy, water and food security and help achieve the MDGs.

The concept of green growth was born in the Asia-Pacific region and is now practised globally.

The concept of green growth was first introduced in the Ministerial Declaration adopted at the Fifth Ministerial Conference of Environment and Development in Asia and the Pacific (MCED-5), convened by ESCAP in 2005 in the Republic of Korea.

Since then, many governments have turned to green growth approaches, most notably the Republic of Korea, which was the first country to declare, in August 2008, low carbon green growth as its national vision, with the conviction that addressing the resource and climate crises could drive economic growth.

The potential of a green paradigm to drive growth and employment creation was later acknowledged by heads of State across the world in the aftermath of the 2008 financial crisis, with many stimulus packages including green components.

The Green New Deal endorsed by the G-20 was the first collective policy initiative for which the top global political leadership recognized the potential synergies of "going green" and "gaining economic growth".

Green growth is a smart strategy for sustainable development and a process for arriving at a green economy.

Green growth is an implementing strategy to achieve sustainable development that focuses on improving the eco-efficiency of production and consumption and promoting a green economy, in which economic prosperity materializes in tandem with ecological sustainability.

Green growth provides a positive agenda for pursuing the three pillars of sustainable development – economic growth, social inclusiveness and environmental protection – by seeking to develop synergies instead of focusing on the trade-offs and trying to balance them.

Green growth is a crucial economic strategy for developing countries.

Rather than imposing an environmental conditionality on development or attempting to commercialize nature, green growth is a strategy to sustain the growth necessary to reduce poverty in the face of resource constraints and the climate crisis. A green growth approach is a way to generate and sustain development gains and achieve higher and better-quality growth in the medium and long terms.

Green growth provides a unique leapfrogging opportunity for developing countries.

Low carbon green growth can be a leapfrogging strategy for developing countries to pursue economic development without repeating the conventional "grow first, clean up later" path. By introducing a tax system based on resource consumption rather than only on income and labour, developing countries can pursue a cleaner and more efficient development path. A large share of the infrastructure required in the region still needs to be developed – this provides a unique opportunity to avoid the high-carbon, environmentally destructive path that industrialized countries have wedded themselves to through previous infrastructure decisions.

Realizing the promise of green growth requires a bold and ambitious transformation of the economic system.

A green economy will not materialize through incremental changes. A shift towards green growth requires a fundamental system change, restructuring both the visible (physical infrastructure) as well as the invisible structures of the economy (market prices, fiscal policies, institutions, governance and lifestyles).

The extent to which green growth can deliver a double dividend (such as higher growth with lower environmental impact) depends on the breadth and depth of the system change.

Can developing countries with limited technological and financial resources pursue green growth?

Yes. Financing and green technologies are necessary but not sufficient. System change, such as market price restructuring and designing infrastructure to be eco-efficient, is more critical in starting the process of green growth.

Is green growth only for developing countries?

No. For developing countries, green growth can be an economic strategy to sustain growth in the face of resource constraints and climate crisis; for industrialized countries, it can be a strategy to reverse the current economic downturn by generating jobs and stimulating greater growth.

Green growth will not happen if left only to the market – government must drive it.

The greening of the economy will not happen automatically through the market. This is mainly due to two gaps. First, there is a time gap between short-term costs and long-term benefits. Second, there is a price gap between current market prices and the real cost of natural resource use and ecosystem services. Governments have to close these two gaps through economic system change. Although the market has an important role, only governments can lead the systematic transition.

Strong government leadership and political commitment are required to bring businesses and the public on board.

A huge basket of business opportunities will emerge from green growth that the private sector should seize on rather than resist or block.

At the same time, green growth must engage the public. People need to support the paradigm shift by responding with positive public acceptance and by recognizing the benefits of lifestyle changes aimed more at the quality of life rather than the quantity of consumption.

Governments have to actively promote a forward-looking consciousness among those in office and the general public to mobilize political support for low carbon green growth.

An inclusive social policy has to go hand in hand with the transition towards a green economy.

In the long run, a green economy can produce better outcomes in terms of poverty reduction because it increases growth prospects, reduces the vulnerability of socio-economic systems to external shocks and crises and sustainably manages the natural resources that underpin such systems.

There is no guarantee, however, that the costs and benefits of the transition will be evenly distributed. Thus, it is critical that a system change towards green growth be supplemented by inclusive social policies that ensure the fair distribution of the costs and benefits.

Countries in the region are already taking action.

China has introduced a number of measures for green growth since 2005 and resource and energy efficiency were featured prominently in both its Eleventh and Twelfth Five-Year National Social and Economic Development Plans. In 2008, India adopted a National Action Plan on Climate Change, encompassing an extensive range of measures, including eight national missions focusing on renewable energy, energy efficiency, clean technologies, public transport, resource efficiency and tax incentives. Kazakhstan introduced elements of green growth into the National Sustainable Development Strategy since 2007 and adopted the Zhasyl Damu – Green Development Strategy 2030. Cambodia developed a National Green Growth Roadmap in 2010.

The Republic of Korea unfurled the most comprehensive action towards green growth when in 2008 the president declared low carbon green growth as the national vision for the country to follow for the next 60 years. That milestone was followed by the launching of a National Green Growth Strategy, complete with five-year midterm plans and implemented by a coordinating institution, the Presidential Committee on Green Growth, under the legal framework of the Framework Act on Low Carbon, Green Growth.

Collective action can maximize returns.

Fully realizing the potential of green growth will require collective action. System change entails

risks and uncertainties, and some countries may be reluctant to be the first movers. Collective action and partnerships can reduce the risk and uncertainty and shepherd the transition towards a green economy.

The need for regional cooperation in the Asia-Pacific region on green growth was recognized at the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED-5) in 2005, where the Seoul Initiative on Green Growth was launched. In Kazakhstan in 2010, MCED-6 highlighted the need for inter-regional cooperation and delegates endorsed the Astana Green Bridge Initiative to link Europe, Asia and the Pacific through green growth.

The region needs to step up such initiatives.

A global partnership is urgently required.

Although the policy framework for system change is the most critical aspect in shifting towards green growth, developing countries still need financial, technological and capacity building support to start up the green growth process. A global partnership is urgently needed to enable developing countries to adopt green growth policies and initiatives that can help meet their development goals. The 2012 United Nations Conference on Sustainable Development (Rio+20) provides a unique opportunity to do this.

As it pioneered the concept of green growth, the region can further drive the discussions and shape the global agenda on the green economy and green growth. This will require enhancing a coordinated Asian and Pacific voice and leadership. The region is already spearheading such global partnership at the regional level through a number of initiatives, such as the East Asia Climate Partnership of the Republic of Korea and the Global Green Growth Institute.

A low carbon green growth roadmap for Asia and the Pacific

The concept of green growth was not born out of economic theory. Rather, it is a vision put forward by policymakers in an attempt to find practical ways of reconciling economic growth and environmental sustainability. So far, no country has yet to follow a green growth path. There are some positive examples. But these are mainly found in industrialized countries and are limited in scope. There is not yet an established economic theory or prescription for green growth.

Although many countries in the region are already following through on various policies, there is no single comprehensive blueprint that provides guidance on how to pursue a green growth path.

This Roadmap aims to fill this gap, by providing policymakers in the region with a comprehensive set of policy options and implementing strategies necessary to pursue system change for low carbon green growth.

Five tracks to pursue low carbon green growth.

There is no one-size-fits-all approach to low carbon green growth. Socio-economic circumstances and political priorities differ from country to country; so should green growth strategies. There are, however, some key areas of policy intervention that can introduce the system change required for green growth that should be the backbone of any green growth strategy.

This Roadmap identifies five main tracks on which to drive the system change for low carbon green growth:

1. Improving the quality of growth and maximizing net growth
2. Changing the invisible structure of the economy: Closing the gap between economic and ecological efficiencies
3. Changing the visible structure of the economy: Planning and designing eco-efficient infrastructure
4. Turning green into a business opportunity
5. Formulating and implementing low-carbon development strategies

TRACK 1: Improving the quality of growth and maximizing net growth

Focusing only on maximizing the quantity of growth will in the long run undermine the prospects of sustaining it. Countries in the Asia-Pacific region, both industrialized and developing, need to shift away from the conventional economic paradigm of maximizing production (as measured by GDP). What is paramount at this point in the world's history to protect resources and thus future growth is a new development paradigm focused on improving the quality of growth, and in particular the economic, social and ecological qualities of growth patterns. Employment generation, economic resilience, social inclusiveness and ecological sustainability are all important goals for any economy striving for a better quality of growth.

Growth patterns of the countries in the region show different economic, social and ecological qualities. Countries at a similar level of per capita income exhibit different ecological footprints, levels of social cohesion and economic resilience.

Many countries are already moving beyond the GDP-only paradigm and taking a more balanced and sustainable perspective to economic growth strategies. In China after decades of rapid growth, for example, the quality of growth is now considered more important than its speed and bold quantified targets for energy and resource efficiency and air pollution reduction have been introduced. Similarly, India is integrating ecological values into its national accounts.

Green growth is an attempt to improve the ecological and economic qualities of growth patterns by minimizing the hidden ecological and economic losses.

Current market prices do not capture the social and ecological values of consumption and production and this leads to increasing losses that are not reflected in GDP or other statistics of economic growth. If the costs related to pollution and environmental degradation or lost economic opportunity costs such as traffic congestion were factored in, the actual net growth

often would be much lower than the calculated GDP growth rate.

Green growth strategies can maximize net growth by reducing the hidden ecological and economic costs (GDP losses) that erode the human, social and natural capital.

Green growth can also deliver higher growth in the long run through innovation and efficiency gains triggered by the system change.

Quality of growth is a broader concept going beyond the idea of green growth. Quality of growth provides a conceptual basis and underpins the pursuit of green growth. Green growth has to be a part of an overall policy framework of improving the economic, social and ecological qualities of growth. Quality-of-growth perspectives have to be integrated into socio-economic development planning. As well, modalities to identify and measure hidden GDP losses need to be developed and improved.

TRACK 2: Changing the invisible structure of the economy: Closing the gap between economic and ecological efficiencies

The invisible structure of the economy comprises many factors that affect the way an economy operates; these include the market price structure, lifestyles, institutions and governance, regulations and standards. System change for green growth requires a re-alignment of all these factors towards being as eco-efficient as possible.

In particular, system change for low carbon green growth requires inter-ministerial institutions and in-depth coordination between central, regional and local governments. Long-term plans and targets are also important because they decrease uncertainty for businesses and encourage investments.

The most important factor, however, is allowing prices to reflect the real costs of production and consumption. This requires the use of fiscal instruments, such as taxes and subsidies. The challenge is to introduce such interventions in a way that does not affect the poor or reduce competitiveness but is politically acceptable.

Properly designed environmental tax reforms (ETR) and environmental fiscal reforms (EFR) can achieve this and generate the double dividend of lower environmental impact and higher growth and employment.

ETR entails shifting the burden of taxes from conventional levies on labour and income to environmentally damaging activities, such as resource use or pollution. This proposition is based on the principle of revenue neutrality. ETR can generate a double dividend of more jobs and growth and reduced resource consumption and pollution.

Market price restructuring though ETR and EFR can close the gap between economic and ecological efficiencies.

There has been concern that ETR will negatively affect competitiveness and the poor, and that the hypothesis of the double dividend is not conclusive. However, examples of countries that

have tried it show positive results and prove that competitiveness and income regressiveness effects can be effectively tackled.

Although ETR so far has been mainly tried in northern European countries, it has great potential in the Asia-Pacific region. ESCAP analysis shows that a carbon tax would be effective in reducing CO_2 emissions from the region, with the biggest reductions in developing countries while having a positive effect on the economy if the revenue is used to reduce taxes on labour, corporate income or consumption.

Global CO_2 emissions could be reduced by up to 7.86 per cent by 2020 if countries in the Asia-Pacific region alone implemented ETR.

ETR provides a leapfrogging opportunity for developing countries to develop their tax system based on resources and pollution instead of income, thereby putting their economies into a different, more resource-efficient development path.

TRACK 3: Changing the visible structure of the economy: Planning and designing eco-efficient infrastructure

Prices will take a long time to change the design of physical infrastructure. Given the long life span, infrastructure becomes "locked in" to the nature of the design. This takes a toll on the environment and societies if that design is high-carbon, environmentally destructive in nature. It serves economic growth, environmental protection and social inclusiveness needs when the planning and design of infrastructure take into account eco-efficiency criteria.

The carbon intensity and energy efficiency of the future greatly depends on the kind of infrastructure we design and invest in today.

Investing in eco-efficient new infrastructure and the retrofitting of old infrastructures provides great opportunities for economic growth, employment generation and achieving the MDGs.

Policy tools to evaluate infrastructure options need to integrate the concept of eco-efficiency from a life-cycle perspective. For example, when evaluating transport projects, such as a highway, energy consumption and carbon emissions generated from its use cannot be ignored.

Useful tools and mechanisms exist, such as the strategic environmental assessment, environmental impact assessment, life-cycle assessment and other integrated assessments. But these are often not used or are poorly functioning. Achieving eco-efficient infrastructure requires strengthening the use of these tools and mechanisms.

A shift towards eco-efficient infrastructure requires:

- **Urban areas** to be planned and designed as compact and walkable, mixing different land uses and enhancing public and green spaces.

  The region is undergoing rapid urbanization. Urban sprawl and car-centred development are putting the liveability and sustainability of healthy cities at risk. Cities and towns

require an urgent shift towards eco-city development.

- **Transport** systems to shift from a road to rail emphasis, with greater investment in public transport and more control on the use of private cars.

  The region is experiencing rapid motorization. Car-centred transport systems leads to hidden costs, such as chronic congestion, energy consumption, carbon emissions, air pollution and traffic accidents, which add up to more than 10 per cent of a country's GDP. A shift to sustainable mobility is urgently required.

- Existing **buildings** to be retrofitted to substantially improve their energy efficiency, and new building design to be based on green building standards.

  Buildings consume up to 40 per cent of energy. Improving the efficiency of buildings can reduce CO_2 emissions and the total amount of energy used.

- **Energy systems** to improve the efficiency fossil fuel consumption, expand the share of renewable energy sources and embrace next-generation technologies.

  In the Asia-Pacific region, 675 million people do not have access to modern energy services. Increasing the share of renewable energy through a decentralized and hybrid system and developing a low-carbon energy system can help respond to this demand – thus breaking down one of any society's great disparities.

- **Water** infrastructure to emphasize water-sensitive and low-impact development, based on decentralized water resource management and rainwater management.

  The per capita availability of water in the Asia-Pacific region is the second lowest in the world due to the population size but also as a result of misuse and overuse. If properly managed, a decentralized water resource management system can secure water resources, prevent urban flooding and restore the ecosystem.

- **Waste** to be turned from a cost (burden) into a resource and waste management must prioritize treatment at the source and recycling.

  Rapid urbanization and economic growth has resulted in a corresponding growth of waste that municipalities are finding increasingly difficult to dispose and on which they spend the lion's share of their budget. Reducing the amount of waste that needs to be disposed at the landfill is crucial. Recovering resources from waste through recycling, composting and turning waste into energy can solve the waste challenge while generating revenue and jobs.

TRACK 4: Turning green into a business opportunity

Greening the economy will require new and upgraded infrastructure, greening current industries and creating new ones as well as new and better goods and services. Businesses stand to gain from this transition. But governments have to create the enabling conditions for businesses to thrive in a green economy.

Governments need to bridge the gap between short-term costs and long-terms benefits and reduce uncertainty and risk for investors. Governments need to create a market for environmental goods and services.

This will require a mix of regulatory, economic, fiscal and information instruments, in particular: allowing market prices to reflect the real cost of energy and natural resources; using public finances strategically to leverage private investment; greening public procurement practices; supporting R&D; promoting transparency (through environmental reporting) and consumer awareness (through eco-labelling) as well as setting predictable long-term and transparent regulation (greenhouse gas emissions targets) and giving businesses enough time to adjust.

Turning green into a business opportunity should follow a three-pronged strategy:

- **Greening existing industries:** This entails encouraging industries to use resources more efficiently, phasing out toxic substances, substituting fossil fuels with renewable energy sources, improving occupational health and safety conditions, taking increased producer responsibility and reducing the overall risks for the environment. It also requires governments to promote cleaner production, industrial symbiosis and the 3R (reduce, reuse, recycle) approach.

- **Promoting new green products and services:** Green growth provides an opportunity for new industries to emerge. Enhancing energy systems, for example, provides an opportunity to develop the renewable energy industry as well as next-generation technologies, such as smart grids. The spread of these technologies can create a market for other goods, such as smart meters and smart appliances. A push towards sustainable mobility also provides an opportunity to develop industries around new technologies, such as electric vehicles. Greening the economy will require new services. A drive towards energy efficiency, for example, can provide opportunities for energy service companies (ESCOs).

- **Turning natural capital into a business opportunity:** Preserving ecosystems and investing in natural capital provide new space to generate profit and employment. National parks kept for biodiversity conservation and traditional culture can attract international tourists interested in ecotourism. Suncheon, Republic of Korea, for example, managed to attract more than three million visitors a year and economic benefits amounting to US$89 million by turning its wetlands into an ecotourism attraction. Additionally, sustainable agriculture practices, such as organic agriculture, marry the need for preserving ecological integrity with the need for profit.

TRACK 5: Formulating and implementing low-carbon development strategies

Governments in the region realize the importance of addressing climate change. At the same time, there is an urgent need to sustain economic growth to meet pressing socio-economic development goals and improve living standards. Low carbon green growth is about harmonizing environmental protection and economic growth and using climate action to drive economic growth. This requires mainstreaming climate change mitigation and adaptation into the national development planning process.

More and more countries are aligning climate change and development priorities through a more integrated, comprehensive, consistent and coordinated approach through the planning and implementation of low-carbon development strategies. The medium to long term targets and goals of the strategy provide clear signals to the private sector and the public on the direction for future investments, research and development for technology innovation and infrastructure development which can generate various growth opportunities. National greenhouse gas inventories need to be established and strengthened as an essential tool to support the planning process, as well as to track emission trends and their reduction.

Low-carbon development strategies can also provide the basis for planning, developing and implementing nationally appropriate mitigation actions (NAMAs). NAMAs allow developing countries to be recognized internationally for their voluntary actions that are based on their country context and can provide opportunities for attracting financing and technology transfer. Towards this end, a system for measurement, reporting and verification needs to be introduced to monitor emissions and reductions and promote transparency of financial flows and the deployment of technological support that are provided to a specific NAMA.

Putting a price on carbon, through a carbon tax and cap-and-trade schemes, is crucial for reducing carbon emissions, decreasing carbon intensity and stimulating green growth and should be the cornerstone of any low-carbon development strategy. In addition, the promotion of eco-efficient infrastructure development to reduce the carbon intensity of economic growth patterns and active engagement of the public to pursue low carbon lifestyles should be an integral part of the strategy.

Lastly, low carbon development strategies will require engagement across ministries and sectors, backed by political commitment at the highest level.

Means of implementation: Mobilizing finance, technology and capacity building

Changing market prices to reflect the social and environmental cost of resource consumption, coupled with supportive regulation, will allow private investment and technologies to flow into eco-efficient solutions. Introducing the system change required for low carbon green growth and pursuing the five tracks presented in this Roadmap will require, however, the mobilizing of needed financial resources, putting in place policies to stimulate R&D and ensuring that needed capacities are developed.

Financing

Public financing will be instrumental in jump-starting green growth. It is important that a sufficient amount of public funds be directed to catalyse the transition. Government funds also can be used to leverage private funds. Public financing mechanisms can tilt the balance in favour of profitability where the returns on investment for environmentally sustainable projects are currently low.

Carbon finance and mechanisms for payment for ecosystem services (PES) also have a place in financing low-carbon development and investments in natural capital.

Overseas development assistance (ODA), however, remains a critical source of funding for countries with special needs, such as least developed countries, landlocked developing countries and small island developing states, and its role in the transition to a green economy cannot be stressed enough.

Technology

Achieving environmental sustainability will require changes in public policy, business strategies and personal behaviours. It will also require better technologies. Green technologies will not just improve the economic, social and ecological qualities of economic growth – they will help drive growth.

Although most technology transfer is currently the domain of the private sector, the public sector will need to presume a more proactive influence with green growth. Publicly funded research leads to considerable economic benefits, both direct and indirect – as the green revolution can attest. At present, however, R&D on green technologies in many countries in the Asia-Pacific region is still at relatively low levels. If the region is to make faster progress the more industrialized countries will need to increase their investment.

Many countries in the region will also require assistance in the diffusion of clean energy technologies and should be able to rely on greater bilateral, regional and international cooperation.

Capacity building

The transition to a green and low-carbon economy will also need to be accompanied with policies and programmes for building up the required capacities at different levels. First is the need to build the institutional skills and other capacities at different levels of government to generate and enforce the required policies. Second is the need to build the capacity of enterprises, especially small and medium-sized enterprises, to use new and existing knowledge to green their operations and to take advantage of business opportunities in a green economy. And third is the need to build up the skills of the workforce to engage in green and low-carbon economic activities.

Bilateral, regional and international cooperation is required to support capacity building in developing countries, especially those with special needs.

PART I
GREEN GROWTH: A NEW GROWTH STRATEGY FOR ASIA AND THE PACIFIC











1.1 The challenge: Resource constraints and climate crisis

Developing countries in the Asia-Pacific region have experienced rapid economic growth in recent years, taking advantage of the opportunities brought about by globalization and the export-led growth model. High economic growth rates have helped lift millions out of poverty and achieved significant development gains. The high growth rates that the region is proud of, however, can only be sustained when resource constraints and climate change are adequately addressed.

The resource crunch and the need for a new growth strategy that is based on resource efficiency

Resource constraints and looming ecological crises, including climate change, have made business-as-usual practices no longer acceptable. They require a re-examination of the region's growth strategies.

Unprecedented economic growth in the past century was fuelled by increasingly cheaper resources, including fossil fuels. But the turn of the twenty-first century has ushered in a new era.

The days of abundant resources and falling prices are over. As highlighted by various studies, including a recent report by McKinsey, a consultancy company, a 100-year decline in resource prices has reversed over the past decade, hitting an all-time high.[1] The world is entering an era of high and volatile resource prices. Jeremy Grantham, an investor and founder of Grantham, Mayo, Van Otterloo & Co., one of the largest asset management firms in the world, recently warned investors worldwide that the days of abundant resources and falling prices are over and countries need to urgently develop serious resource plans, particularly energy policies.[2]

The International Energy Agency (IEA) predicts that, in spite of uncertainties over the prospects of short-term economic growth, demand for energy will increase by more than 30 per cent from 2010 to 2035.[3] The World Economic Forum emphasizes that business as usual is no longer an option and warns that unless we break the present link between growth and consumption of resources, some US$2 trillion of global economic output could be lost by 2030.[4] The International Panel for Sustainable Resource Management has shown that global demand for metals, such as copper and aluminium, has doubled in the past 20 years and cautions that unless future end-of-life recycling rates are dramatically stepped up, critical, specialty and rare earth metals (such as lithium, neodymium and gallium) will become unavailable for use in modern technology.[5]

These influential perspectives, backed by research, reflect a growing understanding that resource and environmental risks are intimately linked to economic risk.

The resource-intensive growth pattern of the region cannot be sustained. The report *Green Growth, Resources and Resilience*, jointly prepared by ESCAP, the United Nations Environment Programme (UNEP) and the Asian Development Bank (ADB) and released in February 2012, underscores that the resource, environmental and economic risks are perhaps higher in the Asia-Pacific region than elsewhere.[6] This region uses three times the resources as the rest of the world to create one unit of gross domestic product (GDP). Between 2000 and 2005, the resource intensity of the regional economy increased rather than decreased, in contrast to trends in the rest of the world (figures 1 and 2).[7] These trends have resulted in dramatic increases of resource use by the regional economy.

Although the regional economy is highly resource intensive, the per capita use of resources is still relatively low compared with the global rate (figure 3). Low per capita use of resources reflects persistent poverty and unmet needs in relation to access to basic services and infrastructure.

Due to the deepening resource constraints, the huge situation of unmet basic needs within the region cannot be turned around simply by pursuing economic growth – particularly, increasing production based on the current resource-intensive growth strategy.

Countries in the region need to break the link between economic activity and resource use and environmental impact. Developing countries, where per capita resource consumption is low, have to pursue a relative decoupling (when the growth rate of resource use and environmental impact is lower than the economic growth rate) to sustain the economic growth necessary to reduce poverty. Industrialized economies, with high per capita resource consumption, need instead to realize absolute decoupling (when resource use and environmental impact are stable or decrease while economic growth increases) to improve the ecological sustainability of their growth patterns and to create jobs and stimulate economic growth.

Deepening resource intensity and vulnerability to resource price volatility within the region

Despite the significant unmet needs, economic growth trends have resulted in dramatic increases of resource use by the regional economy. Between 1970 and 2005, domestic material consumption in the region more than tripled – compared with an approximately 50 per cent increase in the rest of the world – to an annual use of some 35.3 billion tonnes of biomass, fossil fuels, metal ores and industrial and construction minerals (figure 1). Growth rates of domestic material consumption were particularly high for the Asia-Pacific region between 2000 and 2005 (table 1).

The increase in resource use has been mirrored with a change in material use profiles; most poignantly, economies that were primarily biomass dependent have become dependent on substantially larger inputs of fossil fuel and other resources (figure 4).

The increase in resource use has enabled both the rapid economic growth of the region's economies and the growth in capacity of economies to meet the needs of their people. But the economic trends for the Asian region now show that each unit of GDP growth results in less impact on poverty reduction over time.[8] Additionally, the

Table 1: Average annual growth rate of material use

	Average annual growth rate of 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 the world	1.9	0.5	1.3	0.8
World	2.5	1.8	1.8	3.7

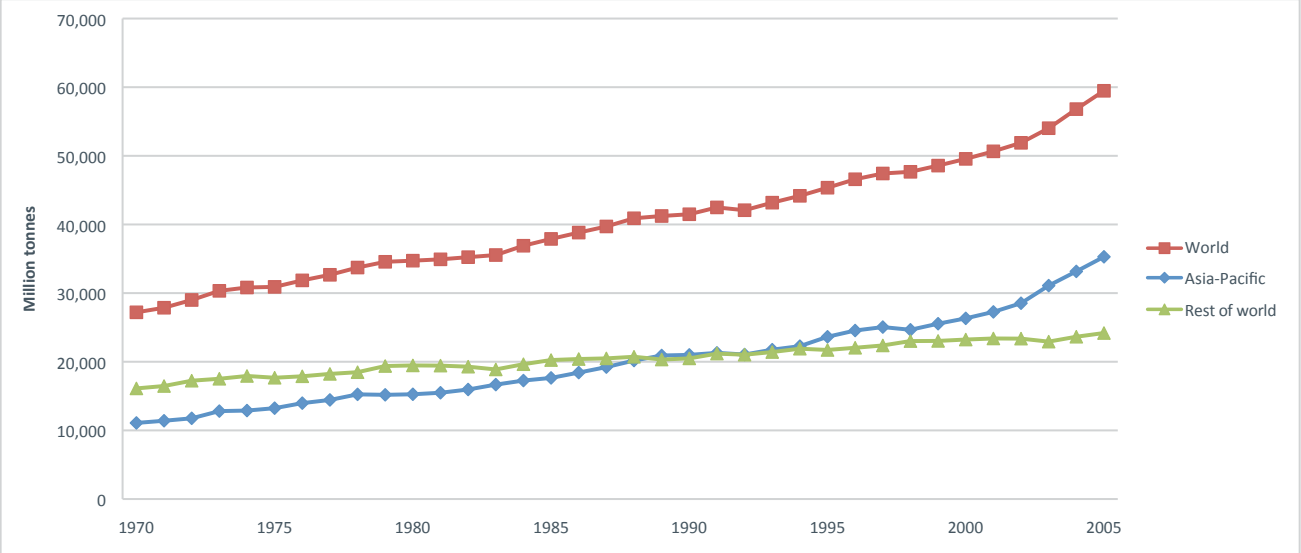
Source: CSIRO and UNEP Asia-Pacific Material Flow Database. Available from www.csiro.au/AsiaPacificMaterialFlows (accessed on 11 July 2010).

capital-intensive growth strategies that have relied on increasing inputs of energy and materials have had devastating impacts on the environment's resources. They have also, to a large extent, underpinned the "jobless growth" trends occurring in some of the largest and most dynamic of the region's economies.[9]

It is developing countries that are most vulnerable to global resource price volatility and are the ones that suffer the most from unsustainable economic growth patterns. The food, fuel and financial crises of late 2008 resulted in recession, job losses, hunger and social conflict that still lingers. If not contained, these crises could aggravate economic uncertainty and send prices rising again. According to ESCAP estimates, 42 million people were pushed back into poverty in the Asia-Pacific region in 2011 as a result of increases in oil and food prices, in addition to the 19 million people still ensnared in the poverty trap in 2010.[10] The region is now exposed to growing risks linked to resource price volatility.

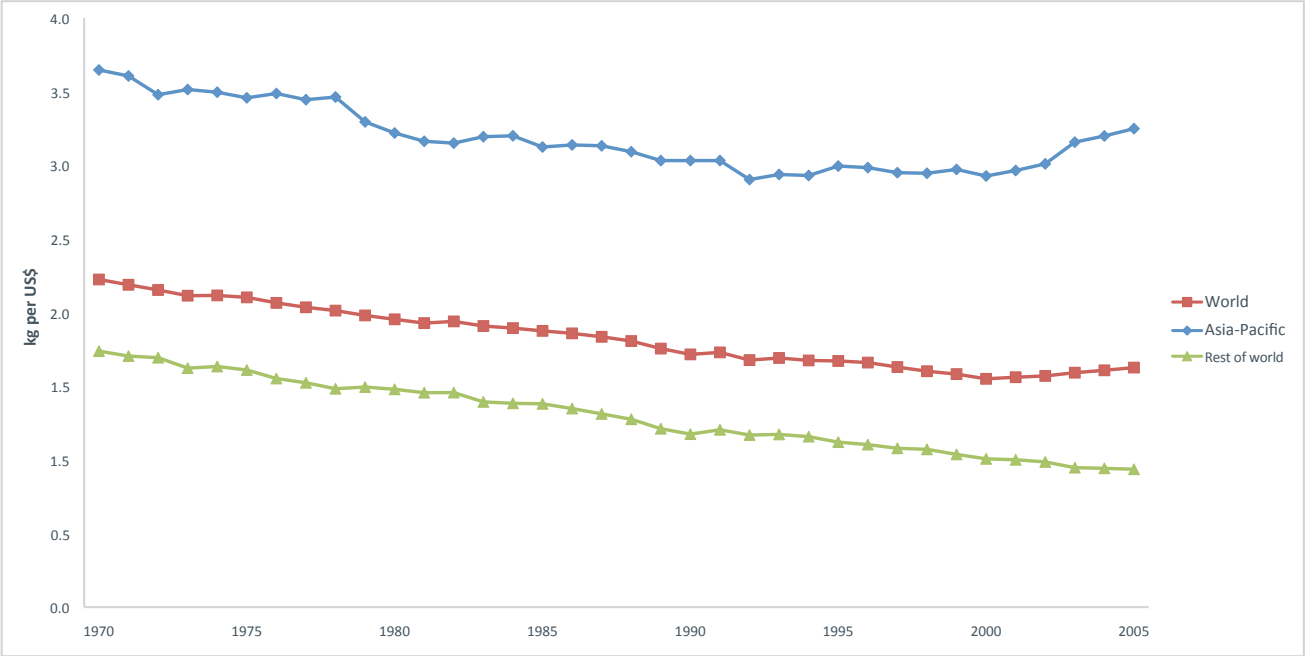
The region needs now to urgently shift away from business-as-usual resource-intensive strategies and embrace a growth strategy that is based on resource efficiency.

Figure 1: Total domestic material consumption in the world, in the Asia-Pacific region and in the rest of the world, 1970–2005



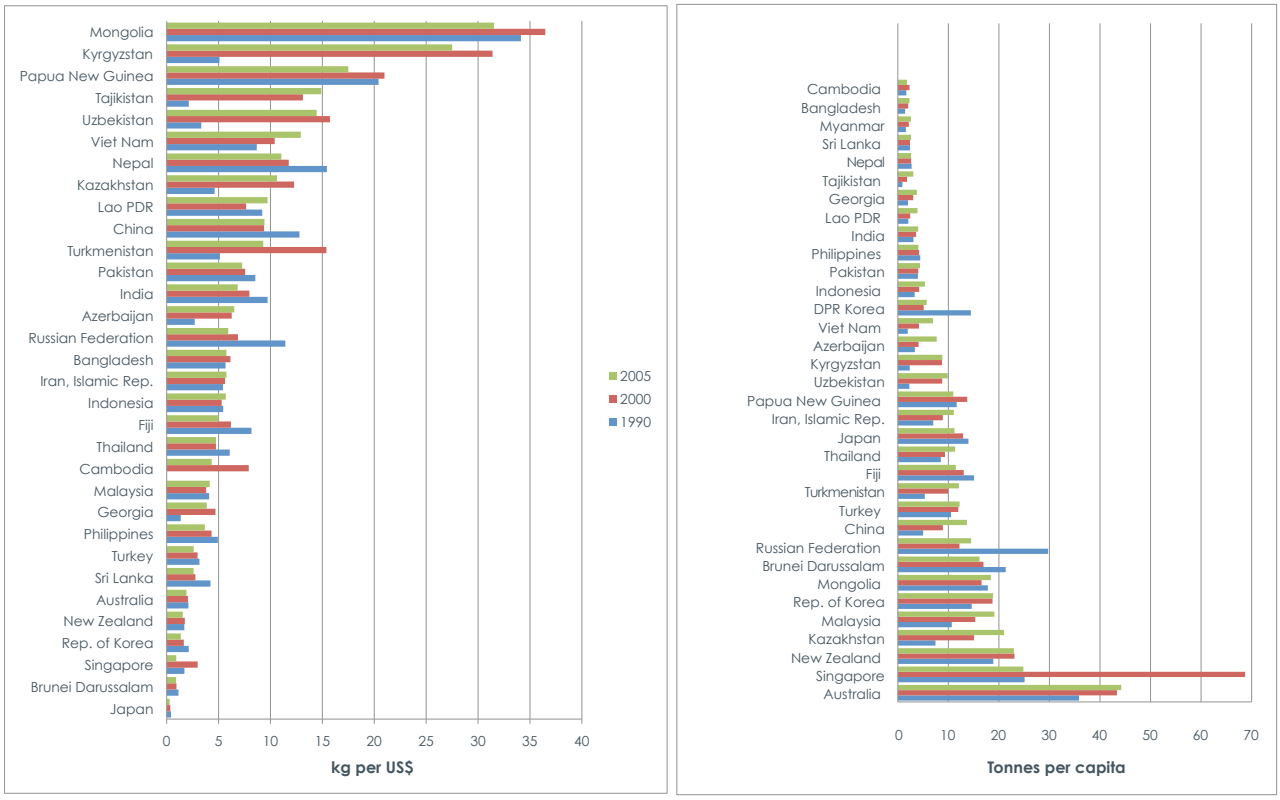
Source: CSIRO and UNEP Online Asia-Pacific Material Flows Database, as of March 2011. Available from www.cse.csiro.au/forms/form-mf-start.aspx

Figure 2: Domestic material consumption per unit of GDP in the world, the Asia-Pacific region and the rest of the world, 1970–2005



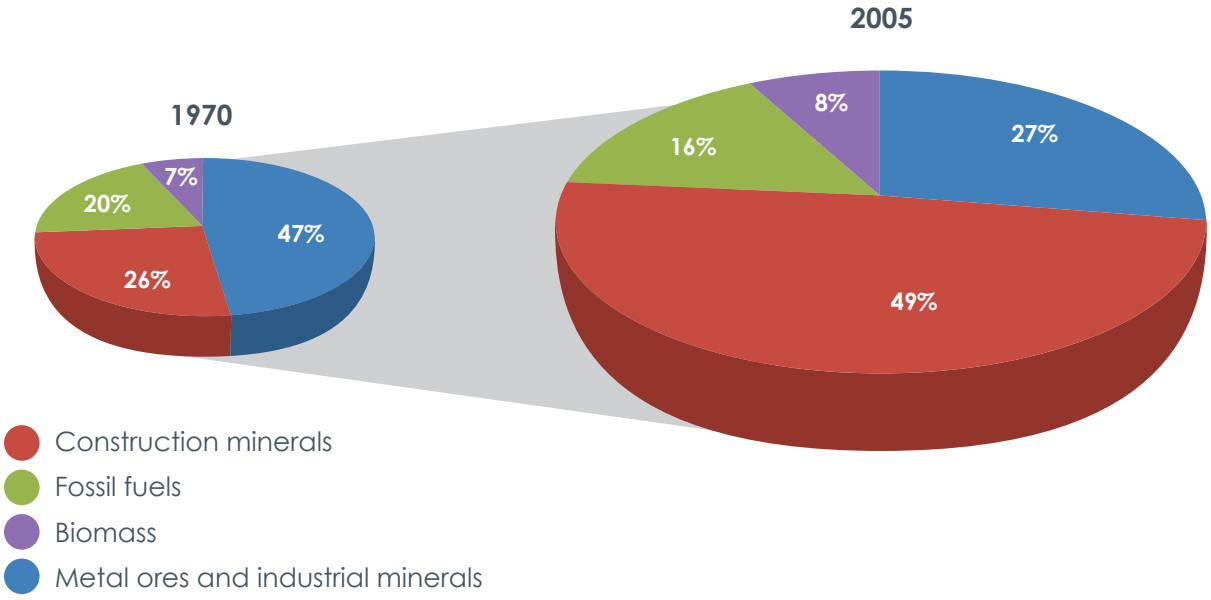
Source: CSIRO and UNEP Online Asia-Pacific Material Flows Database, as of March 2011. Available from www.cse.csiro.au/forms/form-mf-start.aspx

Figure 3: Domestic material consumption per unit of GDP and per capita, Asian and Pacific countries



Source: CSIRO and UNEP Online Asia-Pacific Material Flows Database, as of March 2011. Available from www.cse.csiro.au/forms/form-mf-start.aspx

Figure 4: Material use profiles in the Asia-Pacific region, 1970 and 2005



Source: CSIRO and UNEP Online Asia-Pacific Material Flows Database, as of March 2011. Available from www.cse.csiro.au/forms/form-mf-start.aspx

The environmental threat: An overstretched ecological carrying capacity and deepening climate crisis

The hidden costs of resource-intensive growth strategies increase the long-term risks confronting the region. Analysis of the fast-declining natural capital, climate impacts and climate-related disasters reveals how pervasive the impacts are among Asian and Pacific countries.

There is increasing pressure on the limited ecological carrying capacity that underpins socio-economic systems. There have been some achievements relating to the expansion of overall forest cover and protected areas. But these mask worrying trends related to the losses of primary forest cover and biodiversity (figure 5).

The depletion of the natural capital links to increasing demand for agricultural products as inputs to industrial production and for energy. The growing demand means that land is expected to provide a broader array of ecosystem services while excessive exploitation is undermining its ability to do so.

Worrying signs that the carrying capacity is stretching to its limit are the food insecurity and agricultural production trends. Asia's production of non-food crops is growing at the expense of food crops (figure 6). Production of feedstocks for biofuels is a particular source of competition for food production. Non-food production is concentrated in several large countries, including those in which the proportion of hungry people is increasing or where food deprivation is deepening.

Another worrying sign relates to water resource use. Just as the growing demand for energy has impacted on food production, the growing demand for water may also do the same if trends continue. While the region has access to the lowest per capita supply of water, it withdraws the world's largest proportion from the available renewable supply (figure 7).

Increasing vulnerabilities to climate-related disasters

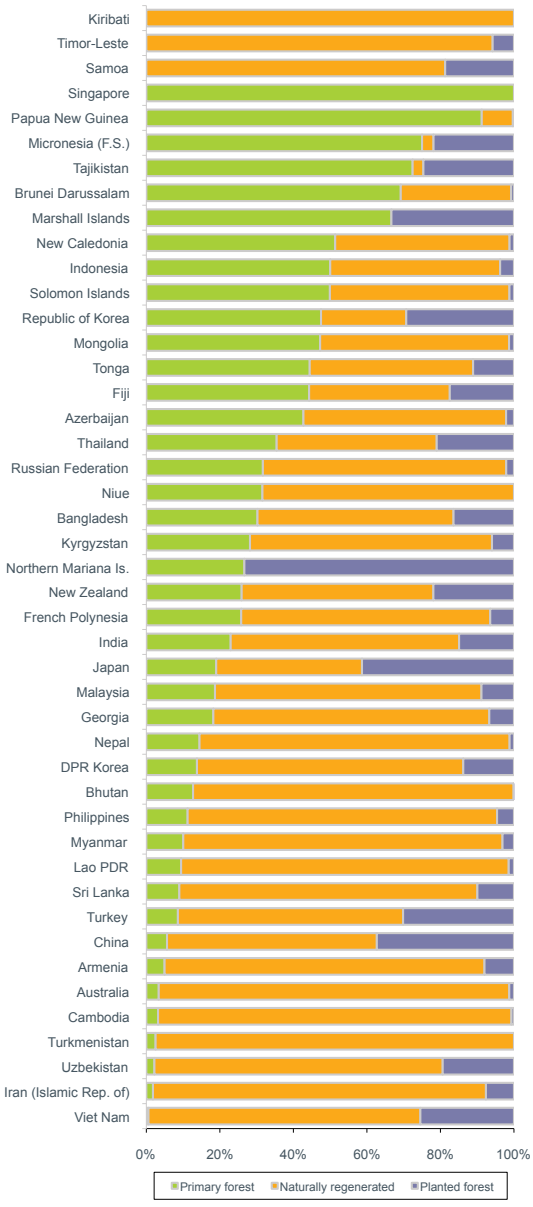
The Asia-Pacific region is also among the most vulnerable to climate-related disasters (figure 8). The 2010 *Asia-Pacific Disaster Report* from ESCAP and the United Nations International Strategy for Disaster Reduction stresses that people of this region are four times more likely to be affected by climate-related disasters than those living in Africa. It also highlights that 85 per cent of deaths and 38 per cent of global economic losses due to disaster originated in this region from 1980 to 2009.[11]

In a recent study by the NGO Germanwatch, researchers analysed the weather-related losses by country for the period 1990–2009 and ranked each country in a Climate Risk Index. The study found that the top-ten nations most at risk of extreme weather events are all in the developing world. Of them, six are in the Asia-Pacific region: Bangladesh, Mongolia, Myanmar, the Philippines, Tajikistan and Viet Nam.[12]

Vulnerability to climate-related disasters is expected to increase as people move into higher-risk areas in larger numbers, pushed by urbanization, migration, population growth and land use changes. The most common disasters are floods and storms. Recent climate-related disasters, such as Cyclone Nargis in Myanmar in 2008 and the floods in Pakistan in 2010 and in Thailand in 2011, have been among the worst ever to be recorded in those countries. The Asian Development Bank estimates that in South-East Asia the economic cost of climate change could be equivalent to a loss of 6.7 per cent of GDP per year by 2100 – more than twice the world average.[13] Climate change is emerging as a critical issue for the region.

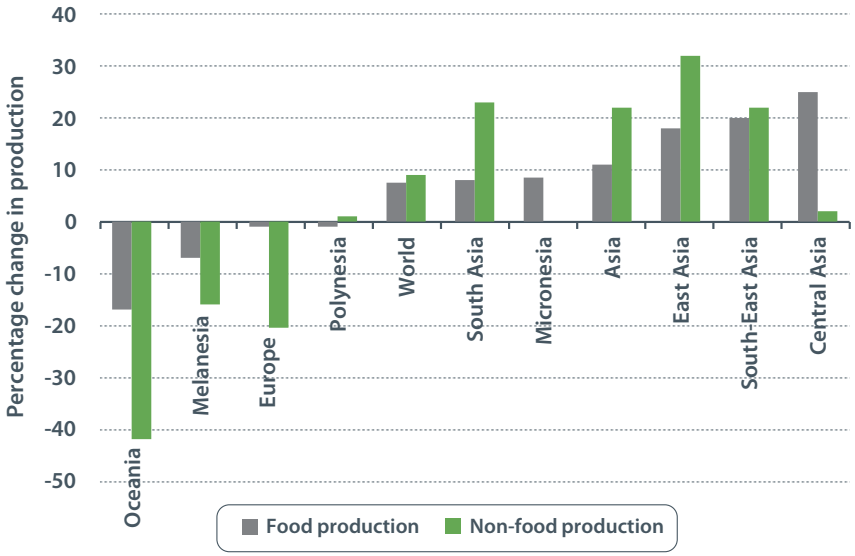
The Asia-Pacific region, while emitting relatively low levels of greenhouse gases on a per capita basis, is one of the fastest-growing sources of climate-impacting emissions (figure 9). Greenhouse gas (GHG) emissions that contribute to climate change are important indicators of unsustainable growth patterns. These trends define the importance of low-carbon growth as a fundamental dimension of the greening of economic growth and growing eco-efficiently.

Figure 5: Proportion of primary, modified and plantation forest in Asian and Pacific countries, 2010



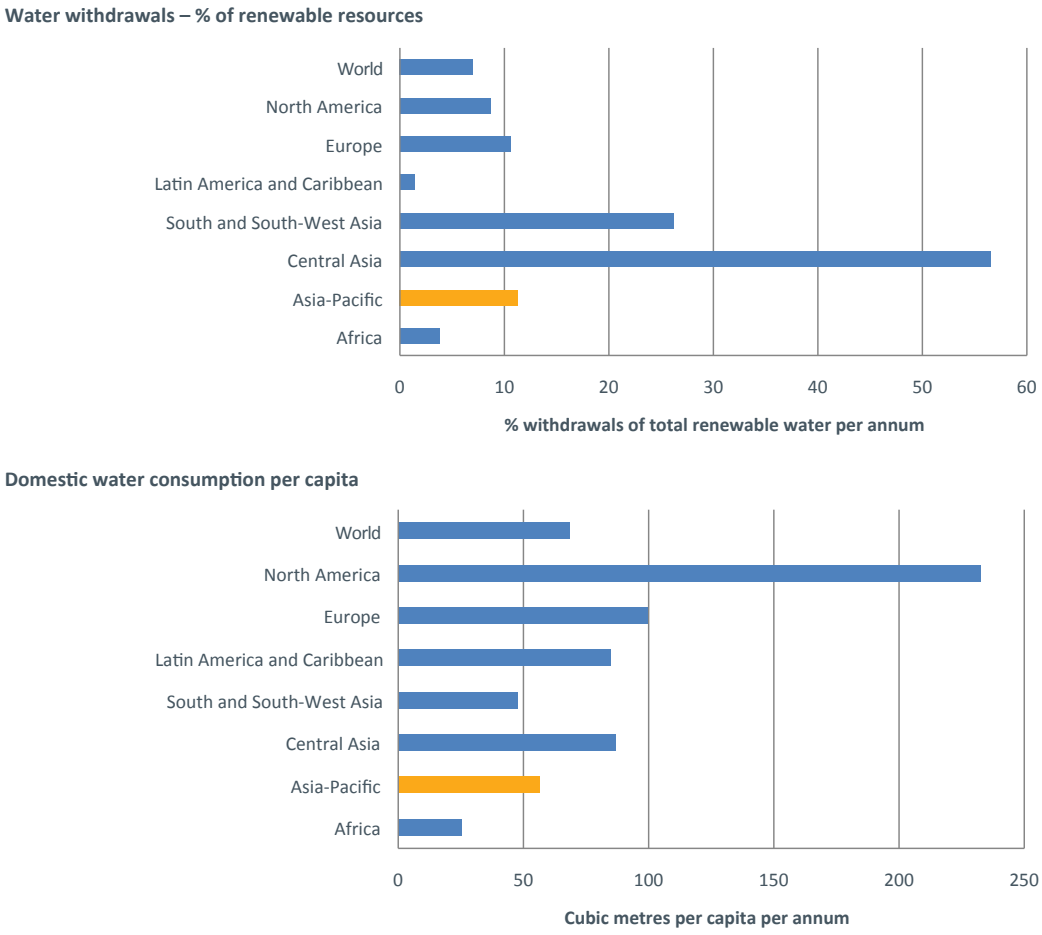
Source: ESCAP Statistical Database http://www.unescap.org/stat/data/swweb_syb2011/DataExplorer.aspx based on data from the Food and Agriculture Organization of the United Nations, FAO Global Forest Resources Assessment.

Figure 6: Changes in food and non-food production, indexed 1999–2001 to 2007



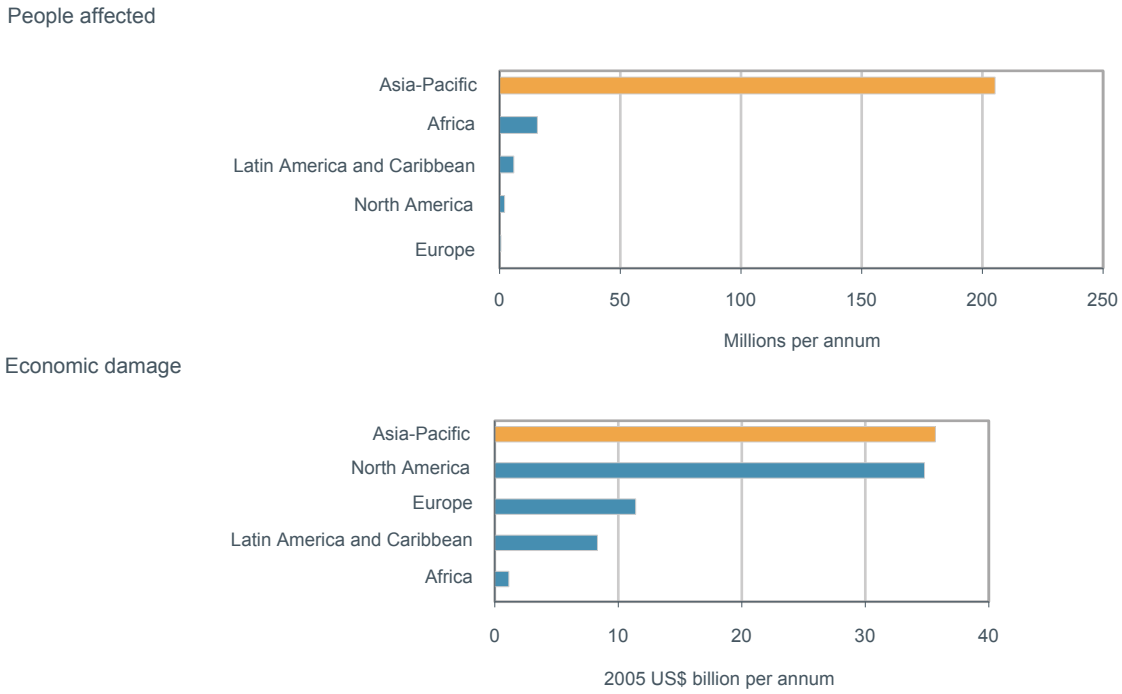
Source: ESCAP Statistical Database, based on data from the Food and Agriculture Organization of the United Nations FAOSTAT database (2011). Available from http://faostat.fao.org

Figure 7: Comparing water withdrawals and access to water in the Asia-Pacific and other regions



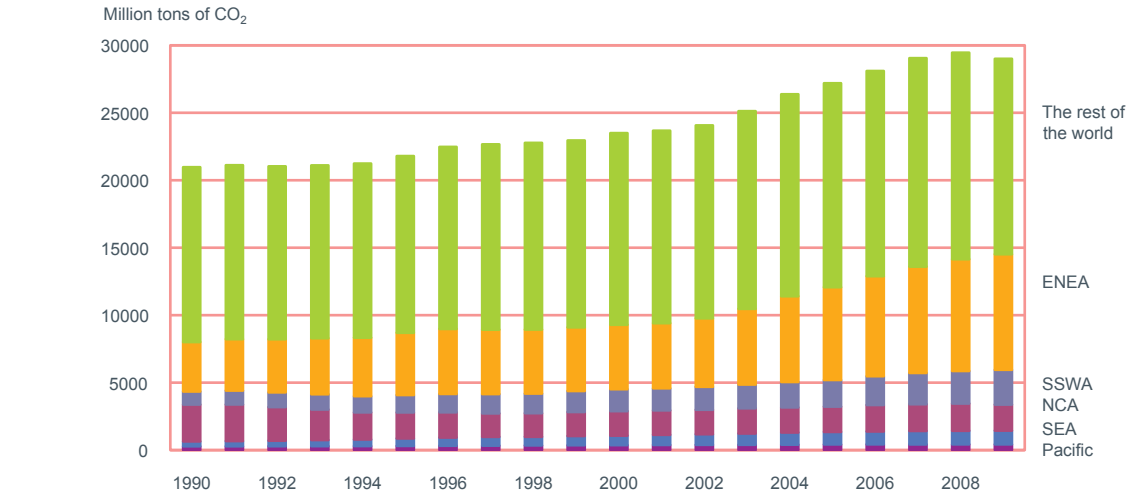
Source: ESCAP Statistical Database www.unescap.org/stat/data/swweb_syb2011/DataExplorer.aspx based on data from the Food and Agriculture Organization of the United Nations, FAOSTAT database. Available from http://faostat.fao.org

Figure 8: Average annual population affected and economic damage by natural disasters in global regions, 2001–2010



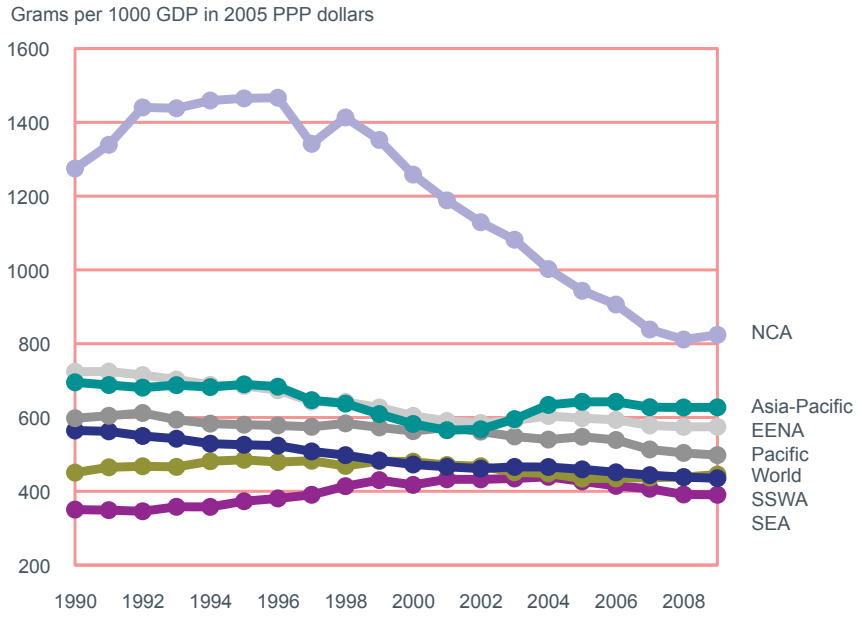
Source: ESCAP, Statistical Database based on data from the Emergency Events Database (EM-DAT).

Figure 9: CO_2 emissions in Asian and Pacific subregions and the rest of the world, 1980–2008



Legend:
ENEA – East and North-East Asia
SSWA – South and South-West Asia
SEA – South-East Asia
NCA – North and Central Asia

Emissions intensity



Legend:
ENEA – East and North-East Asia
SSWA – South and South-West Asia
SEA – South-East Asia
NCA – North and Central Asia

Source: ESCAP Statistical Database www.unescap.org/stat/data/swweb_syb2011/DataExplorer.aspx based on data from the International Energy Agency.

The need for improved eco-efficiency

Energy and resource efficiency need to be drastically improved if growth is to be sustained and sustainable. The new economic reality – characterized by growing resource constraints and ecological threats – requires a re-examination of the region's growth strategies. Sustainable development is still very far away. This was emphasized in the 2012 report of the United Nations Secretary-General's High-Level Panel on Global Sustainability declaring that although progress has been made, it has been neither fast nor deep enough, and there is an urgent need for further-reaching action.[14] The report also warned that by 2030 the world will need at least 50 per cent more food, 45 per cent more energy and 30 per cent more water.

We have been very inefficient in using resources, including such renewable resources as forests and fisheries, and in capturing energy sources. If we are to raise the standards of living of a growing world population, we need to drastically improve the efficiency of our economies in using resources.

Collectively, if we are to keep the increase in global temperature to less than 2° C by 2050 in order to avoid dangerous climate change, as acknowledged by the parties of the United Nations Framework Convention on Climate Change, our energy efficiency has to improve by a factor of 6. Global emissions have to reduce by half by 2050 – even though the world economy is expected to grow three times.[15]

We need to dramatically improve both the economic and ecological efficiency of the economy and re-orient growth strategies towards eco-efficiency. To sustain economic growth in the face of deepening resource constraints and climate crisis, the economic efficiency of energy and resource use has to improve together with the ecological efficiency of reducing carbon and greenhouse gas emissions.

This requires a fundamental transformation of our economic and social structures. A formidable hurdle in climate negotiations is the deep-rooted perception that carbon emission reduction will result in slower economic growth. Until businesses, investors, policymakers and even the public realize that improving the efficiency of resource use and reducing carbon emissions are actually new sources of growth, the world community will not make meaningful progress. The resource and environmental challenge for the Asia-Pacific region is to generate a new era of economic growth that is driven by the improved productivity of energy, other resources and carbon. And therein waits the opportunity.


Crisis
Growth

1.2 The opportunity: Resource efficiency to sustain growth

Addressing the challenges and pursuing a low carbon green growth path will help develop an inclusive, resilient and prosperous Asia-Pacific region in terms of resource security, environmental resilience, ecosystem productivity and sustainable economic growth.

Energy, water and food security

Several countries in the region spend a considerable portion of their GDP to import energy. By improving the overall efficiency of the energy supply and consumption, countries can save on the net import costs of fossil fuel, which are projected to more than double by 2030.[16]

To meet food and nutrition needs, countries will need to increase arable land, improve irrigation infrastructure and use even more water. If they cannot increase productivity, farmers in South Asia by 2050 will need to divert up to 57 per cent more water to agriculture and in East Asia up to 70 per cent.[17] By improving water-use efficiency, the region can also greatly contribute to its food security.

Meeting and sustaining the MDGs

Environmental sustainability is not an isolated objective; it also underpins progress in reaching the other Millennium Development Goals (MDGs) – providing the basis for livelihoods, health and security, particularly for the poor. Within the region, as many as 466 million people lack access to improved water sources, 1.87 billion people lack access to improved sanitation, and 675 million people do not have access to modern energy services, while 30 per cent of urban dwellers live in slums.[18] Shifting to a low-carbon and green economy will provide an opportunity to close these development gaps and ensure that the gains are sustained.

In addition, shifting away from current resource- and carbon-intensive growth practices would reduce local pollution and lead to substantial savings related to health services and productivity. For example, the cost of pollution on current trends will be an estimated US$133 billion in China and US$617 billion globally in 2035. Relying on low-carbon technologies now will likely reduce these figures to an estimated US$86 billion for China and US$428 billion globally, a saving of US$47 billion and US$189 billion, respectively, in 2035.[19]

Latecomer advantage and leapfrogging strategy: Avoiding the "grow first, clean up later" path

Low carbon green growth can be a "leap-frogging" strategy for developing countries to pursue economic development without going down the conventional "grow first, clean up later" path. A large degree of the infrastructure required in the region still needs to be developed; this provides a unique opportunity to avoid the high-carbon, environmentally destructive dependency of industrialized countries. Developing countries in the region have the opportunity to move away from the resource- and pollution-intensive growth pattern – known as "brown growth" – to a resource-efficient growth pattern – what we call "green growth".

Developing countries may have a latecomer advantage in exploiting eco-innovation and green solutions. China, for example, has rapidly become the world's leading manufacturer of solar photovoltaic cells, increasing its global market share in only eight years from 1 to 35 per cent.[20]

Closing the gap between economic and ecological efficiencies

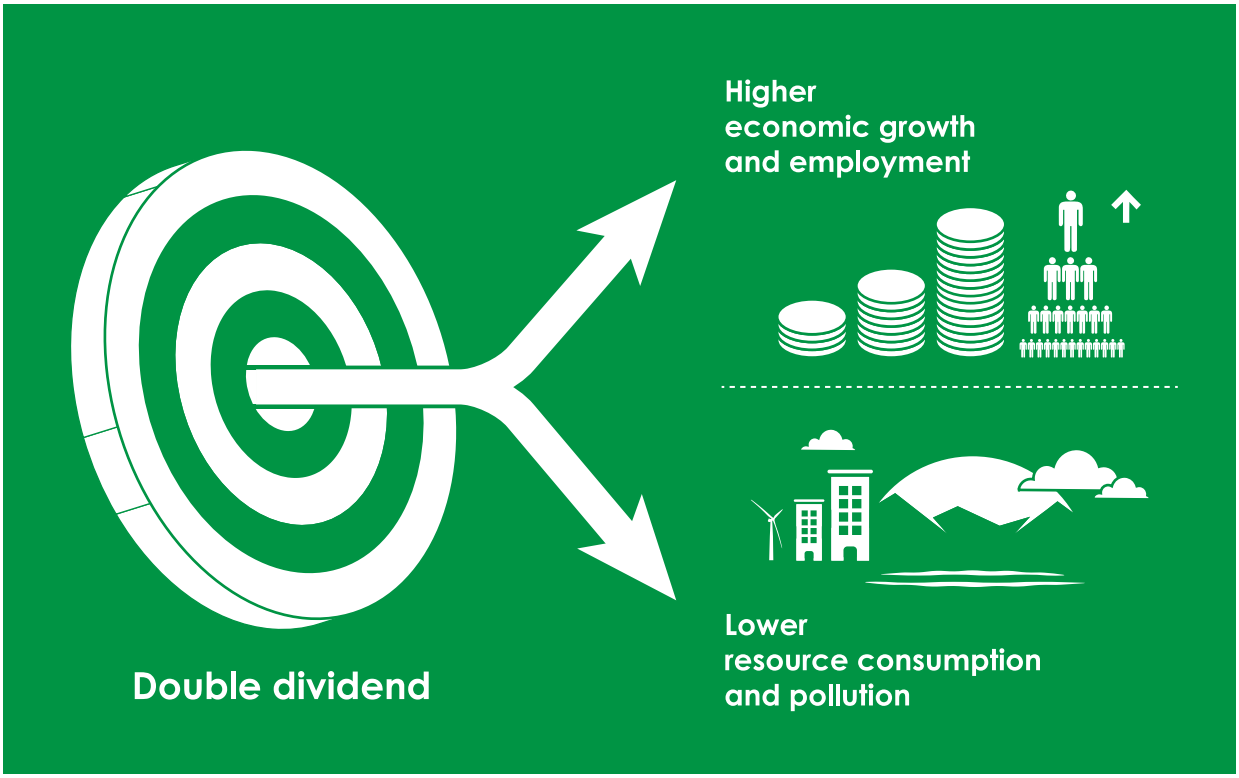
Under the current economic systems in which economic efficiency is based on a market price that does not internalize the cost of ecological degradation and resource depletion, there is a widening gap between economic and ecological efficiencies. Renewable energy technologies are a case in point. Under the current distorted market prices, renewable energy technologies are less cost-efficient than those based on fossil fuels, although their ecological efficiency is much higher.

Eco-efficiency has to mean both economic and ecological efficiencies. If the region is to continue its economic growth in the face of looming resource constraints and climate crisis, the gap between the economic and ecological efficiencies has to be closed. Eco-efficiency should manifest as both economic and ecological efficiencies. This will require a fundamental economic system change and transformation of both the "visible" structure of the economy (physical infrastructure) and the "invisible" structure (prices, governance and lifestyles).

The system change required can be pursued in a way that brings a double dividend: (figure 10) more growth and employment and less environmental impact. Low carbon green growth can turn the crises we are now experiencing into opportunities. Improving the eco-efficiency of the economy will generate in the long run higher economic growth than the conventional brown growth while reducing environmental impacts.

But this cannot happen under business-as-usual scenarios. It requires an economic system change. This Roadmap is a guide for pursuing the required system change and choosing a development path to build a win-win synergy between the economy and the environment.

Figure 10: The double dividend concept



Green growth and green economy: Concepts and perspectives

The idea of green growth emerged within the Ministerial Declaration adopted at the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED-5) convened by ESCAP in 2005 in the Republic of Korea.

Since then, the concepts of green growth and green economy have gained considerable attention within the international community, with several international bodies analysing and discussing them and many governments already pursuing or considering such approaches. The Republic of Korea was the first country whose government realized the potential of green growth – even before the financial crisis – by announcing "low carbon green growth" as its national vision and development strategy in August 2008. The financial crisis that broke out in late September 2008 triggered many governments to incorporate provisions for green jobs, a Green New Deal and a green economy in their stimulus packages.

The relevance of the concepts of green growth and a green economy is underscored by the adoption of "A green economy in the context of sustainable development and poverty eradication" as one of the two themes for the 2012 United Nations Conference on Sustainable Development (Rio+20).

Different definitions and perspectives on these concepts exist. The Organisation for Economic Co-operation and Development (OECD), for example, characterizes green growth as "maximizing economic growth and development while avoiding unsustainable pressure on the quality and quantity of natural assets. It is also about harnessing the growth potential that arises from transiting towards a green economy".[21]

The United Nations Environment Programme (UNEP) defines a green economy as one that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities".[22]

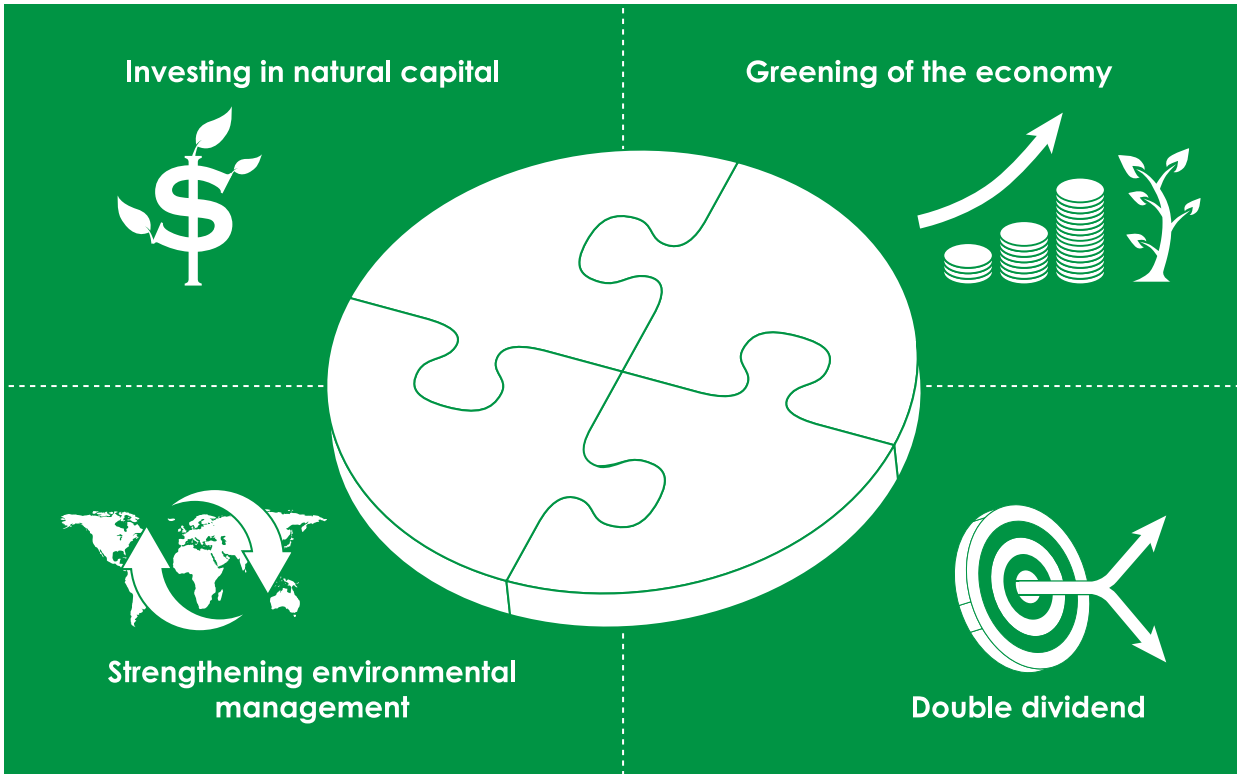
Green growth should not be understood as a replacement for sustainable development – but as a vital component of it. The concept of sustainable development provides us with the vision and framework. At the same time, there is an urgent need to translate this vision into implementing strategies and to find a positive agenda for pursuing the integration of the three pillars of sustainable development – economic growth, environment protection and social inclusiveness – by seeking to develop synergies instead of focusing on the current trade-offs and trying to balance them.

ESCAP understands green growth in this light; it is an implementing strategy to achieve sustainable development that focuses on improving the eco-efficiency of production and consumption and promoting a green economy, in which economic prosperity flourishes with ecological sustainability. In practical terms in a green economy, investing in natural capital and in improving the consumption efficiency of natural resources is an opportunity for profit, employment and growth rather than a cost and a burden on the economy.

Green growth as understood by ESCAP has four main features: i) investing in natural capital, ii) greening of the economy by improving the efficiency of using natural resources and ecosystem services, iii) strengthening environmental management and promoting environmental goods and services and iv) generating a double dividend for the economy and the environment (figure 11).

Rather than imposing an environmental conditionality on development or attempting to commercialize nature, green growth is a

Figure 11: The four main features of green growth



way to generate and sustain development gains, achieve higher and better growth in the medium term and conserve nature by making the economy and the environment compatible.

Investing in natural capital and realizing the contributions of agriculture, forestry and biodiversity conservation as drivers of the economy is the essence of building a green economy. And yet, it is not sufficient. Both the economic and ecological efficiencies of production and consumption must improve. Actions necessary for investing in natural capital are well covered in other reports, such as the UNEP *Green Economy Report*.[23] This Roadmap focuses on the policy options and strategies for greening the economy and realizing the double dividend.

Green New Deal: Governments recognize that green can stimulate growth

The potential of "green" to drive growth and create new employment was first acknowledged by heads of State across the world in the aftermath of the 2008 financial crisis. For the first time, many economic stimulus packages included green components (table 2), with investments channelled towards such sectors as renewable energy, energy efficiency, sustainable transport, waste management and recycling. Through the Green New Deal (as the policy packages that built around green investments were called in response to the financial crisis, in comparison to the New Deal stimulus programme of the Great Depression era), governments recognized the potential of the double dividend: environmental sustainability as a new investment opportunity and source of economic growth and employment.

Among the region's many stimulus packages, the Republic of Korea committed the largest share of its stimulus response to green components, as the following table points out.

Table 2: Green components of selected national stimulus packages

	Australia	China	Japan	Republic of Korea
Total green stimulus for announced period (US$ billions)	5.8	51	12	36.28
Share of green components in total package (%)	21.48	8.7	1.62	81
Share of green stimulus in GDP (%)	0.73	1.18	0.28	3
Total green jobs expected to be created (thousands)	160	1500	1000	960
Total amount of green tax cuts (US$ billions)			3.1	10.17
Total investments in green infrastructure (US$ billions)	5.8	30.07		24.21

Source: Based on International Labour Organization fact sheets compiled from different sources.

However, the Green New Deal was a temporary measure to stimulate a global economy suffering from the impacts of the financial crisis and entailed mobilizing public funds to invest in green projects without introducing any systemic changes. Thus its financial sustainability remains a challenge because governments cannot afford to finance it forever from their budget, especially when fiscal deficits are already running high. What was significant about the Green New Deal, though, is the link policymakers made between growth and environmental protection. For the first time, policymakers realized the potential synergy among the two – rather than the trade-off.

Beyond the Green New Deal towards green growth

As announced during the Group of Twenty (G20) Summit[24] in Seoul in November 2010, now is the time to move on beyond the Green New Deal to promote green growth. In the G20 Seoul Summit Leaders' Declaration, the G20 committed to "support country-led green growth policies that promote environmentally sustainable global growth along with employment creation while ensuring energy access for the poor." The leaders also recognized that "sustainable green growth, because it is inherently a part of sustainable development, is a strategy of quality development, enabling countries to leapfrog old technologies in many sectors, including through the use of energy efficiency and clean technology." The leaders committed to stimulate investment for green growth by "establishing clear and consistent targets, developing long-term energy policies, supporting education, enterprise and R&D."[25] At the November 2011 Asia-Pacific Economic Cooperation (APEC) summit, leaders there also agreed to stimulate green growth through the liberalization of trade in environmental goods and services.[26]

Is higher growth under a green economy (double dividend) really possible? Because green growth is a fairly new concept, it does not have decades of empirical evidence to support it; so far, there are limited examples and mainly from industrialized countries. Several economic models have shown that in the long run a green economy can deliver higher growth than the business-as-usual economy. A study in the United Kingdom by The Climate Group and the Office of Tony Blair found that under a global climate agreement, global GDP could increase 0.8 per cent by 2020 relative to projected GDP growth without climate action.[27] A study conducted by Cambridge Econometrics (a UK-based independent consultancy known for its economic modelling) showed that climate change mitigation policies can accelerate higher growth.[28] Economic analysis by State of California researchers in the United States found that climate action would result in increased economic production worth US$33 billion, increased per capita income of US$200 and 100,000 more jobs.[29] The UNEP *Green Economy Report* showed that investing 2 per cent of global GDP in greening certain sectors of the economy (such as energy, manufacturing, transport, buildings, waste, agriculture, fisheries, water and forests) would deliver in the long run even higher growth than the business-as-usual economy.[30]

Some policy options have been linked with the double dividend effect. The theory and practice behind the concept of environmental tax reform – shifting the tax base from income to resource consumption and pollution while maintaining revenue neutrality – suggest that it can bring about increased employment and growth while reducing negative environmental impact. European countries where environmental tax reform was introduced have experienced positive GDP gains of up 0.5 per cent as a direct result while their fuel demand fell by 2.6 per cent

on average and CO_2 emissions decreased by 2–6 per cent.[31] For instance, the reforms in Germany led to a 2.5 per cent reduction in CO_2 emissions and 250,000 new jobs in 2003 alone.[32]

ESCAP analysis finds that even greater gains could be achieved through properly designed environmental tax reform in the Asia-Pacific region (see section 2.2.2). More research is urgently needed on the enabling conditions for maximizing the double dividend, especially in developing countries.

Low carbon green growth: Countries in the region are already taking action

As noted, Asian and Pacific countries adopted green growth as one of the strategies for the region to pursue sustainable development during the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific in 2005. Since then, many governments have recognized the potential of green growth and are taking important steps towards greening their economies. Examples of country initiatives include the following:

Australia: A number of programmes at the national and state levels to expand the use of renewable energy have been in place for several years. But one of the more recent initiatives is the Clean Energy Future, which is a plan to cut polluting emissions, particularly greenhouse gases, while driving investment and working towards sustainable growth. The Clean Energy Legislative Package covers a range of legislation to support the plan and its programmes, such as a carbon pricing scheme. The scheme will introduce a carbon tax, and revenue will be used to support job creation and investment in clean energy and climate change programmes.

Cambodia: In 2010, Cambodia became the first least developed country in the region to draft a National Green Growth Roadmap, with technical assistance from ESCAP. This roadmap is now the basis for a holistic approach to development – helping to reduce poverty and decrease vulnerability to climate change. Priority areas include agriculture, forestry, water resource management, transport and waste management and a scheme to promote eco-villages.

China: Beginning in 2005, the Government has taken huge steps towards green growth: Resource and energy efficiency were featured prominently in both the Eleventh and Twelfth Five-Year Plan for National Economic and Social Development. In particular, the concept of a "resource-efficient and environment-friendly society" was proposed and a composite indicator, the Resource and Environmental Performance Index (REPI) was developed, to monitor the impact of the new policies. The major initiatives include improvements in energy consumption, scientific research for energy efficiency and recycling technologies, and systems of labelling and certification to provide consumers with choices for sustainable consumption. As a result, between 2005 and 2008, energy consumption per unit of GDP fell by 10 per cent, while sulphur dioxide emissions decreased by 9 per cent.

Fiji: In 2009 the Government adopted a National Employment Centre Decree to link enterprise development, green productivity and green jobs. The Government is also increasingly promoting renewable energy sources as a way to boost energy security and meet development demands.

India: In June 2008, India adopted a National Action Plan on Climate Change that encompasses a very broad and extensive range of measures, including eight national missions focusing on renewable energy, energy efficiency, clean technologies,

public transport, resource efficiency, tax incentives, research and other changes. The ambitious National Mission for a Green India plans to restore 10 million hectares of forests by 2020.

Indonesia: In November 2007, the Government announced its National Action Plan Addressing Climate Change, which focuses on both mitigation and adaptation. In 2009, the president announced a voluntary target of reducing greenhouse gas emissions by 26 per cent by 2020, which could become 41 per cent with international funding. In 2010, the Government introduced the Indonesia Climate Change Sectoral Roadmap to guide the central and local governments in planning and expediting low-carbon development plans for the next 20 years. At the local level, the Aceh provincial government adopted a Green Economic Development and Investment Strategy to rebuild its economy in the aftermath of the 2004 tsunami and a 30-year armed conflict.

Japan: In 2008, the Government announced its Low-Carbon Society vision. Supported by an action plan, the vision sets a long-term (2050) target of 60–80 per cent CO_2 emissions reduction from the then-current level and outlined specific policy mechanisms, such as emissions trading, tax reform and green technology innovation. The Japanese cabinet approved the Basic Act on Global Warming Countermeasures in 2010. After the financial crisis hit, the Government embraced the shift to a green economy as a driver for achieving further growth. In the aftermath of the devastating earthquake of March 2011 and the environmental disaster of the Fukushima nuclear plant, the country is now looking at a shift to greener energy sources and technologies as part of the recovery strategy.

Kazakhstan: In 2007, the Government introduced elements of green growth into the National Sustainable Development Strategy and in 2010 adopted the Zhasyl Damu – Green Development Strategy 2030. The Government also has been promoting regional cooperation by hosting the Sixth Ministerial Conference on Environment and Development in Asia and the Pacific (MCED-6) and launched the Astana Green Bridge Initiative: Europe-Asia-Pacific Partnership Programme for Green Growth.

Republic of Korea: In August 2008, President Lee Myung-bak became the first political leader to declare low carbon green growth as a national vision and strategy and subsequently set up a comprehensive institutional and legal framework to implement it (box 1).

Malaysia: The Government has declared three main areas of green growth: i) decoupling GDP growth from energy consumption through energy efficiency and increased productivity; ii) promoting knowledge and innovation industries; and iii) developing renewable energy for energy security. Policies in these areas aim to reduce poverty, for example by promoting renewable energy for rural development. A Green Technology Council, headed by the prime minister, was formed, and a green technology financing scheme was launched to spur innovation, manufacturing and consumer adoption of a range of new environment-friendly technologies and services.

Maldives: As one of the most threatened countries by the impacts of climate change, the Government announced in 2009 its plan to go carbon neutral by 2020. The Government developed a new electricity plan, committing to reducing emissions from the sector by 80 per cent without increasing prices to consumers and setting a target of 60 per cent of electricity via solar power by 2020. The plan includes a pledge to spend 2 per cent of national income on renewable energy development and support for the increased use of electric cars.

BOX 1: Low carbon green growth in the Republic of Korea

On the 60th anniversary of the country's founding in 2008, the president of the Republic of Korea presented a low carbon green growth development vision for the next 60 years, which involves a fundamental paradigm shift from quantitative to qualitative growth. Green growth in the Republic of Korea is now the overarching national priority supported by the top political leadership.

To follow through on the vision, the top-down, long-term National Strategy for Green Growth provides a comprehensive policy framework to: i) mitigate climate change and promote energy independence, ii) create new engines for economic growth and iii) improve the quality of life and enhance the country's international standing. To expedite the national strategy, the Five-Year Plan for Green Growth was announced in July 2009 with an investment component representing 2 per cent of the country's annual GDP. A Green New Deal programme announced in early 2009 is incorporated in the Five-Year Plan and contains specific budget and detailed tasks assigned to line ministries and local governments.

The Presidential Committee on Green Growth was established in 2009 as an inter-ministerial institution for better coordinating multisector policymaking. Composed of senior public officials and experts, the Committee deliberates on the Government's green growth policies and coordinates the central administrative agencies as well as local governments. The Framework Act on Low Carbon, Green Growth was enacted in January 2010, along with its enforcement decree, to provide the legal basis for the Republic of Korea's green growth strategy. Based on this act, the Government set a 30 per cent carbon emissions reduction target by 2020.

Timeline of green growth initiatives in the Republic of Korea	
August 2008	President's announcement of low carbon green growth as a national vision
January 2009	Launch of Green New Deal
February 2009	Establishment of Presidential Committee on Green Growth
July 2009	Development of National Strategy for Green Growth and Five-Year Plan
January 2010	Enactment of Framework Act on Low Carbon, Green Growth
July 2011	Development of 2020 Roadmap for Greenhouse Gas Emissions Reduction

New Zealand – In early 2011, the Government established an independent Green Growth Advisory Group to analyse challenges and opportunities related to green growth, in particular in terms of innovation and the role of small and medium-sized enterprises, and inform on future policy in this area. The report of the advisory group, *Greening New Zealand's Growth*, was released in March 2012 and recommendations included, among others, developing green growth indicators, greater focus on energy efficiency and promoting green public procurement.

Philippines: The Government latched on to green growth as a way of addressing the financial crisis and climate change. As part of the strategy, lawmakers passed a Renewable Energy Act. Renewable energy already accounts for 33 per cent of the energy supply, but with the country's great potential in geothermal energy, the Government is seeking to increase that share. The Philippine National Development Plan 2011–2016 integrates climate change adaptation and disaster risk management. As well, the Government launched a green procurement programme and is promoting green businesses. To encourage green growth at the regional level, the Government convened the International Conference on Green Industry in Asia in 2009 in Manila.

Singapore: The Government developed a Sustainable Development Blueprint for the city-state that contains the strategies and initiatives needed to achieve both economic growth and a good living environment by 2030. Prepared by an Inter-Ministerial Committee on Sustainable Development, the blueprint highlights the need to boost resource efficiency, with targets for energy efficiency, recycling rates and water use. It also aims to increase liveability by reducing pollution, increasing green spaces and access to waterways for recreational purposes and promoting sustainable mobility. The blueprint emphasizes the need to invest in building up capacities, testing new technologies and fostering community action.

Thailand: Several government projects and programmes have been implemented that are based on the concepts of the "sufficiency economy", which was introduced by the King of Thailand and called for a more diversified and balanced development strategy. The Government has implemented several consumption and production policies, including the Green Government Procurement Programme and guidelines to promote green industry. The Government aims to transform all industrial estates in Thailand into eco-industrial parks by 2019.

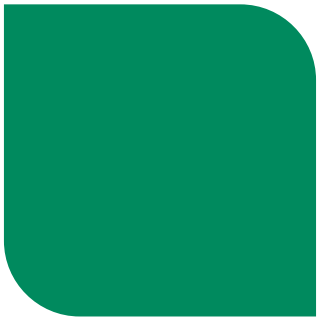
Viet Nam: Among other initiatives, the Government recently adopted an Environment Protection Tax Law framework that introduces an environmental tax targeting fossil fuels and other polluting items, including plastic bags. The tax revenues will be recycled into environmental programmes.

Realizing the green growth opportunity in the Asia-Pacific region depends on governments changing the economic system. All these country initiatives are important steps in a necessary direction. Realizing the promise of green growth, however, will require institutionalizing a system change that can systematically transform the current economic structure and create synergies between the economy and the environment. System change (reforming governance, fiscal policies and infrastructure) is required to close the gap between economic efficiency and ecological efficiency and to achieve the double dividend. To move to a green economy, we need to build on these initiatives – these "green shoots" – and step up the momentum towards changing the economic system and thus changing the way the world grows.







TIME FOR CHANGE





1.3 System change for low carbon green growth

A green economy will not materialize through incremental changes. The shift towards green growth requires a fundamental system change, restructuring both the visible as well as the invisible structures of the economy. A green economy will also not happen automatically through the markets – it needs to be driven by governments.

Changing the visible and invisible structures of the economy

The way an economy operates is defined by the way we design the built environment – the physical infrastructure – as well as the way we manage the market, regulations, institutions, innovations and lifestyles. System change for green growth requires a restructuring and redesigning of the visible and invisible structures of the economy.

The ***visible structure*** is the built environment that affects the way we produce and consume, such as urban design and planning, buildings, transport, energy, water and waste systems – the physical infrastructure of our societies. These need to be restructured and redesigned, based on energy, resource and ecological efficiencies.

The ***invisible structure*** consists of the intangible patterns that affect the way we produce and consume, such as market prices, fiscal policy, financial systems, regulations, social values, lifestyles, know-how and technologies. These need to be re-aligned, based on ecological efficiency.

As important as lifestyles, regulations and technological as well as institutional capacities are in defining the way an economy operates, market price is perhaps the single most critical factor in resource allocations and resource efficiency of an economy. Changing market price signals to reflect the full cost of ecological impact and resource depletion caused by production and consumption will be the most important intervention to close the gap between ecological and economic efficiencies and improve resource sustainability.

Although price signal is critical and effective, the impact of price changes on infrastructure choices will only materialize in the long run due to the long life span of infrastructure assets. Thus price structure change needs to be coupled with supportive changes in the way physical infrastructure is planned and designed as well as in lifestyles.

Low carbon green growth is often regarded

as investment in green technologies and thus relevant mainly for industrialized countries. But when accepted as a new growth strategy, green growth offers the greatest opportunity for developing countries because the economic system change allows them to leapfrog to a new development stage where they can compete with industrialized countries on more equal terms.

Likewise, discussions on climate change action have focused mainly on financing and technology as the elements required to de-carbonize the economy. Although technological advancements and investments are indeed crucial, they are not sufficient without the right policy frameworks in place. Without the right price signals, the required climate-friendly technologies cannot substitute for the old technologies, and it will not be possible to leverage private investment. In fact, several crucial interventions (such as changing consumer behaviour or city design) do not require new technologies but the right policies.

Role of government: Green growth will not happen automatically through the market

The process of greening the economy will not take place automatically through the markets and laissez-faire approaches. Although the market has an important role, only governments can usher in the necessary changes. The current playing field is skewed due to two main gaps, which is why governments must lead on the system change.

Gaps inhibiting system change: Time and price

First, there is a **time gap** between short-term costs and long-term benefits. Gains from the system change necessary for green growth take time to manifest; they appear mainly in the medium to long run. However, the short-term economic and social costs of such system change can be quite substantial, making it politically difficult for them to be accepted by the public and the business sector.

Second, there is a **price gap** between current market prices and the real cost of natural resource use and ecosystem services. To close the gap between economic growth and ecological sustainability, markets need to recognize proper prices for the ecosystem services and the natural resources.

Only government policies can bridge these gaps and jump-start the green growth. In the longer run, when we have arrived at a green economy, green growth will be driven by the private sector and by markets. In the short and medium terms, however, green growth requires government to drive the process and manage the transition.

Green growth requires strong government leadership and political commitment. Governments can lead the process of system change through green fiscal packages, similar to the stimulus packages issued by many governments in the wake of the financial crisis. But governments cannot pump investment into fiscal packages forever. Thus greening the economy needs to be made commercially viable and profitable through measures that internalize the ecological costs in the market prices. Renewable energies, for example, will not be commercially viable as long as fossil fuels are subsidized or their prices fail to reflect their ecological costs.

The need to close the time and price gaps without damaging the economy and affecting the poor

We have to explore policy options that can change the price structure without damaging the economy and affecting the poor (section 2.2.2 on reforming fiscal policies presents policy options). So far the measures that internalize the ecological costs have not been taken up to the necessary degree out of fear that they will represent an extra cost and burden on the economy. A properly designed environmental tax reform (ETR) that changes the tax base from labour and income to resource consumption and pollution while maintaining revenue neutrality can close the price gap between economic and ecological efficiency and deliver a double dividend without damaging the economy and affecting the poor. By allocating public funds based on ecological efficiency, an environmental fiscal reform (EFR) can close the time gap.

Role of private sector and the public: Virtuous cycle of partnership for system change

Considerable business opportunities will emerge with green growth, and the private sector should seize such opportunities rather than resisting or blocking the transformation towards a green economy. The point that it is only governments that can jump-start green growth does not mean that they alone can bring about green growth. Governments need to lead the process, but the private sector still has a vital role. Green growth focuses on creating an enabling environment for businesses by providing positive price signals and reducing the uncertainty and risk of investment.

At the same time, the public will need to support the paradigm shift by responding with positive acceptance. People's conscience must shift to a preference for the benefits of lifestyles changes that centre more on the quality of life rather than on the quantity of consumption.

A shift towards a green economy requires changes in a variety of areas, ranging from policies, production processes, technologies and infrastructure to lifestyles and behaviours. Knowledge and educational institutions will need to reorient their focus and curricula to produce the information, the skills, the intellectual capacities and awareness required for a society to fully engage in the system change towards green growth.

Without such a virtuous cycle of partnership among the various parties, the fundamental transformation towards a green economy will be fragmented. Strong government leadership and political commitment are required to bring businesses and the populace on board. This is the challenge of green growth for the Asia-Pacific region. Part II of this Roadmap suggests how it can be started.

The need for an inclusive social policy to complement green growth

In the long run, a green economy can have great impact on poverty reduction because it increases growth prospects and reduces the vulnerability of socio-economic systems to external shocks and crises. It also sustainably manages the natural resources that underpin such systems. There is no guarantee, however, that the costs and benefits of the transition will be evenly distributed.

It is absolutely critical that system change towards green growth is supplemented by

inclusive social policies that ensure the fair distribution of the costs and benefits of the system change. It is also essential that green growth policies are designed to minimize the trade-offs and maximize the synergies with other developmental objectives, such as poverty reduction.

While it is true that green growth does not automatically alleviate poverty and address equity, the same can be said for conventional economic growth strategies. Economic growth policies, whether brown or green, need to be complemented by policy measures directly aimed at improving equity and reducing poverty. Policies for greening economic growth cannot be – and will never be – a substitute for sound social policies. Green growth and a green economy still require an additional set of specifically designed social policy initiatives to fairly share the gains and losses arising from economic system change.

Relevance of green growth for developing countries in the Asia-Pacific region

Depending on the definition of green growth, ranging from investing in natural capital, greening of the economy by improving resource efficiency, strengthening environmental management or harmonizing growth with the environment (or ideally, all of these), the concept holds relevance for developing countries in the region to varying degrees.

If green growth is regarded only as investing in advanced green technologies, there will be limited relevance for developing countries. But if green growth is regarded as improving resource efficiency to cope with the deepening resource constraints and climate crisis to sustain the economic growth necessary to reduce poverty, then green growth is a critical economic strategy for developing countries in the region because they are the most vulnerable to resource price hikes and climate-related disasters.

Green growth is particularly relevant for developing countries when it is regarded as an alternative growth pattern that can propel them into a higher development stage without repeating the "grow first, clean up later" trajectory. By the very definition of their status, developing countries are already in the process of institutionalizing a new economic system one way or another. Green growth presents them with a more efficient direction.

Relevance of green growth for industrialized countries in the Asia-Pacific region

Green growth can provide industrialized countries with a way out of the current economic downturn. For industrialized countries, green growth is a viable strategy to reduce their per capita resource consumption and decouple their economic growth from environmental impacts. At the same time, green growth offers them an opportunity to reverse the current economic downturn by generating jobs and stimulating growth.

The need for enhanced regional cooperation and a global partnership

Fully realizing the potential of green growth will require collective action. System change entails risks and uncertainties, and some countries may be reluctant to be the first movers. Collective action and partnership can reduce the risk and uncertainty any one party takes on.

Moving to a green economy requires a global partnership that enables developing countries to adopt green growth policies for system change by mobilizing financing,

transferring green technologies and providing technical assistance and capacity building. ***The 2012 United Nations Conference on Sustainable Development (Rio+20) offers a unique opportunity to develop such a global partnership.***

The region can drive the discussions and shape the global agenda on the green economy and green growth. This will require enhancing a coordinated Asian and Pacific "voice" and leadership. The region can also spearhead the global partnership at the regional level.

To move to a global green economy, we need to build on country initiatives and quickly step up regional and international cooperation efforts to create a bigger momentum and a critical mass for system change.

A number of important regional initiatives have emerged in recent years, including the Seoul Initiative on Green Growth adopted at the MCED-5 in March 2005 and the Astana Initiative for Green Bridge adopted at MCED-6 in September 2010, to link Europe, Asia and the Pacific through green growth.

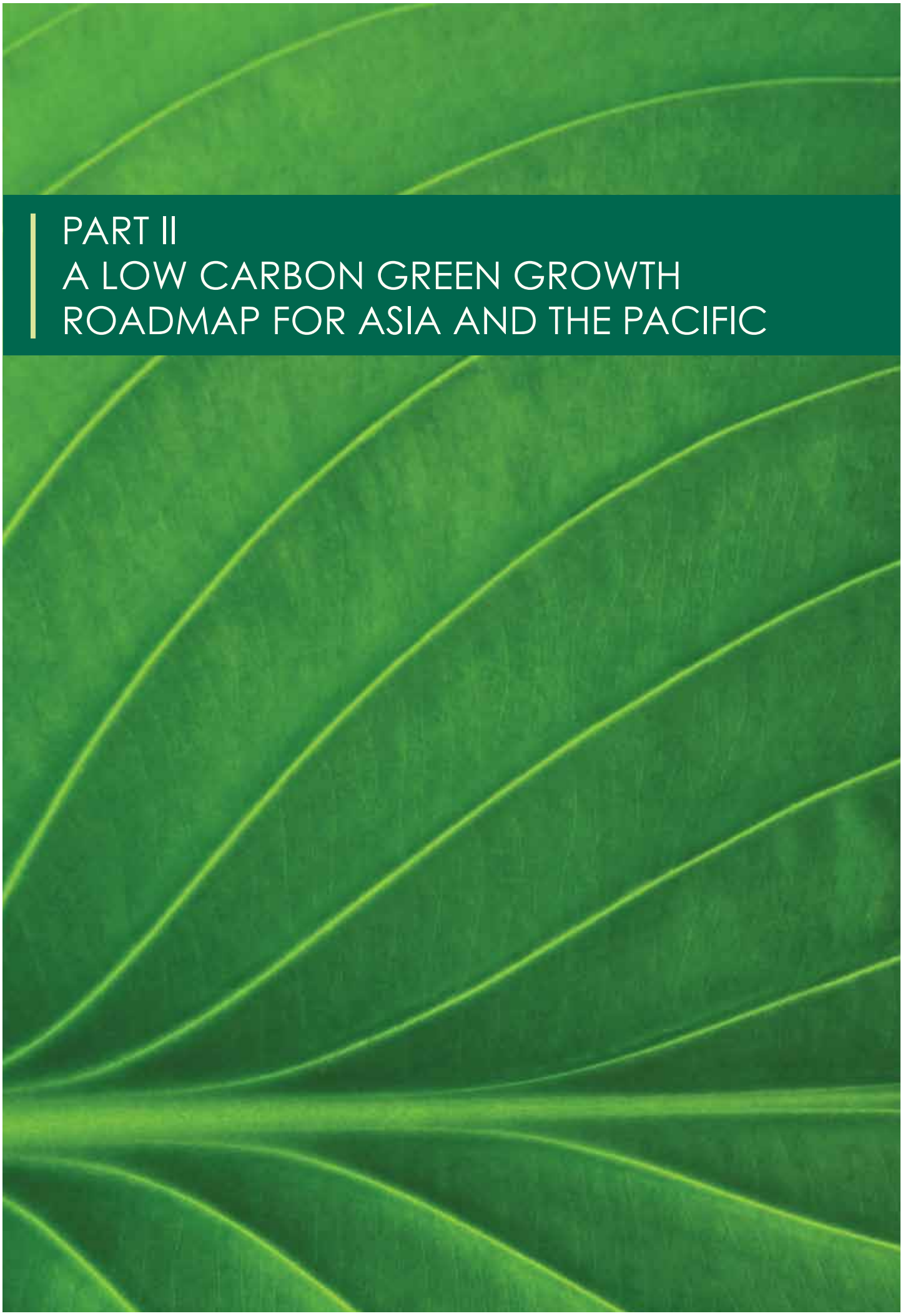
In particular, the Government of the Republic of Korea has been at the forefront of efforts to promote green growth as a global strategy for sustainable development. Among the many initiatives, the two worth mentioning here are the East Asia Climate Partnership initiative as well as the establishment of the Global Green Growth Institute.

Promoting collective action for system change requires strengthening such regional initiatives.

A roadmap for low carbon green growth

Introducing the system change for low carbon green growth requires a roadmap. The concept of green growth is not based on economic theory. Rather, it is a vision put forward by policymakers in an attempt to find solutions for reconciling economic growth and environmental sustainability. Although many countries in the region see the necessity of green growth and have constructed various policies, none of them are yet on the green growth path. This may partly be for the lack of a comprehensive conceptual framework and blueprint to guide the implementation of green growth initiatives.

This Roadmap aims to fill this gap by providing policymakers in the region with a comprehensive set of policy options and implementing strategies necessary for low carbon green growth.



PART II
A LOW CARBON GREEN GROWTH ROADMAP FOR ASIA AND THE PACIFIC

Roadmap directions

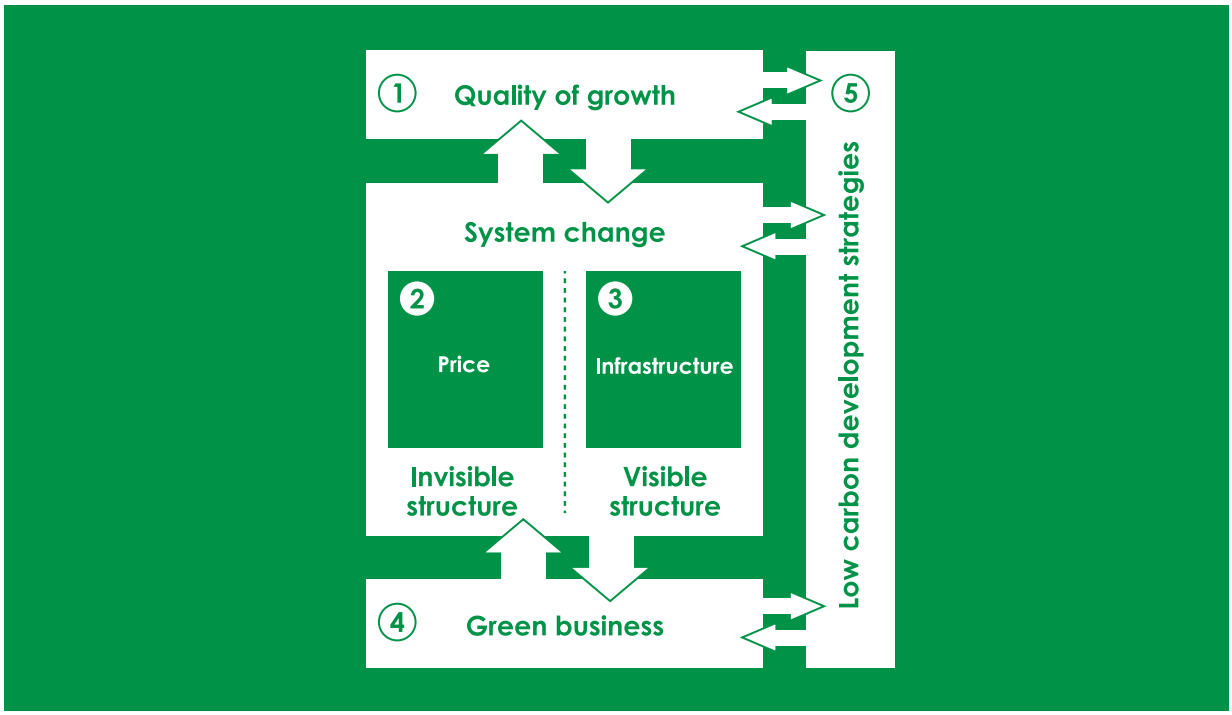
This Roadmap does not promote a one-size-fits-all approach to low carbon green growth. Socio-economic circumstances and political priorities differ from country to country and so should green growth strategies. There are, however, some pivotal areas of policy intervention, or "tracks" on which to drive the system change for low carbon green growth. This Roadmap presents the following five tracks as the key action areas to introduce the system change necessary for low carbon green growth:

1. Improving quality of growth and maximizing net growth
2. Changing the invisible structure of the economy: Closing the gap between economic and ecological efficiencies
3. Changing the visible structure of the economy: Planning and designing eco-efficient infrastructure
4. Turning green into a business opportunity
5. Formulating and implementing low-carbon development strategies

Sections 2.1 to 2.4 cover improving the quality of growth, changing the invisible and the visible structures of the economy and turning green into a business opportunity. Sections 2.2 and 2.3 are further broken down into specific subsections regarding institutions and fiscal policies and the various types of infrastructure (urban planning, transport, buildings, energy, water and waste management). Given the importance of climate change and the interest from countries in the region to contribute to climate action while pursuing socio-economic development goals, section 2.5 offers insights on how specific policies can support a low-carbon development strategy. Section 2.6 then elaborates on the means of implementation and in particular on financing, technology and capacity building.

This Roadmap provides a comprehensive list of policy options and practical implementing strategies that countries may consider for low carbon green growth. It is a compilation of many examples of successful policies and initiatives from the region and beyond. Policy options presented are not likely to fit all

Figure 12: Five tracks for low carbon green growth



development contexts; policymakers need to adapt them to their national circumstances and priorities.

Accompanying the overview of challenges and the detailing of policy options, 63 fact sheets and 51 case studies are presented in Part III in the CD-ROM enclosed in this publication and at the Roadmap website (www.unescap.org/esd/environment/lcgg/)

The following icons are used to indicate where more information about a topic or an example is available in a fact sheet or a case study:

Further information can be found in a fact sheet

Further information can be found in a case study

At the end of each track (and subsection), the reader will find a list of the relevant fact sheets and case studies, as well as policy papers, which provide comprehensive analysis on specific topics.

Crucial caveat: Political leadership and commitment from the top

As the first part of this Roadmap emphasized, public policy needs to steer the transition to a green economy – it will not happen automatically. Low carbon green growth requires long-term planning and policy integration and coherence in order to realize the multiple objectives. Political leadership and commitment are essential for moving beyond ad hoc decision-making and sector-specific policies. To foster the system change, the political leadership will have to push themselves and others beyond the comfort zone of existing policies.

Low carbon green growth requires collective action and collaboration among different parties, including different segments of government, the private sector and civil society. By promoting strong public values and a sense of common purpose, the political leadership can influence and mobilize the different actors to support the change.

Political leadership facilitates the achievement of collective commitment by inspiring institutional change as well as changes in behaviour. Political commitment is also essential to direct sufficient resources for properly implementing the new policies. The high-level commitment is critical to diffuse and maintain the value of the new policy paradigm. It provides incentives to private sector investment and facilitates public acceptance.

In the Republic of Korea, for example, President Lee Myung-bak announced in August 2008 that the country was to follow a low carbon green growth national vision for the next 60 years. To coordinate the strategy aligned with that vision, the Presidential Committee on Green Growth was established in early 2009 and a number of framework policies and initiatives were adopted.

While this Roadmap presents many choices, doing nothing to change the status quo is no longer an option. Countries in the region can no longer simply repeat the "grow first, clean-up later" path. Resources are running out – "later" has arrived. It is not only time for some countries to clean up but for other countries to make difficult but necessary decisions to embark on a different development path. The needed change can only begin with political leadership and commitment.


Opportunity
NEXT EXIT

2.1 TRACK 1
Improving quality of growth and maximizing net growth

The transition to a green economy needs to start with a shift in the way we think about economic growth, from a quantitative to a qualitative perspective. Focusing only on maximizing the quantity of growth generates hidden costs that lead to a reduced "net growth" and eventually undermine the prospects of sustaining growth.

Key points

The focus needs to shift from quantity of growth to quality of growth. Green growth strategies can generate a double dividend by turning resource constraints and climate crisis into economic growth opportunities, but they require, as the previous chapter outlined, a fundamental system change in the way we operate our economy and design our cities and infrastructure. This, in turn, requires a fundamental shift in the way we think about economic growth, from a quantitative to a qualitative perspective. As stressed throughout this Roadmap, such a shift needs to start at the top of leadership.

Focusing only on maximizing the quantity of growth will eventually undermine the prospects of sustaining it. Countries in the Asia-Pacific region, both industrialized and still developing, need to shift away from the conventional economic paradigm of maximizing production (as measured by GDP) towards a new development paradigm of improving the quality of growth. In particular, they need to look at the economic, social and ecological qualities of their growth patterns by focusing on employment generation, economic resilience, social inclusiveness and ecological sustainability.

GDP has its limitations. Gross domestic product (GDP) – a measure of the size of an economy – has been given a dominant position in macroeconomic policy as the single most important indicator of overall economic performance. GDP as an objective measurement of the quantity of production in the formal economy continues to have validity and utility. However, it is often misused as a proxy to appraise overall social progress. GDP is a very poor measure of welfare or sustainability. It does not take into account the non-market production of goods and services or the environmental and social costs. It does not take into account the distribution of income and wealth.

The Millennium Development Goals were a welcome broadening of development objectives. Despite the MDG influence on

public policy, GDP growth is still seen as the primary objective rather than a means to an end and continues to be the main driver of socio-economic development strategies. In the past few decades, Asian and Pacific economies have successfully pursued rapid economic growth by focusing on maximizing GDP expansion through resource-intensive growth strategies. This economic expansion, with remarkably high growth rates, has helped to achieve progress on many development fronts. The number of people living on less than US$1.25 per day fell from 1.5 billion in 1990 to 947 million in 2008, while the total population grew by approximately 0.8 billion people.[33]

However, the focus on high growth rates also has resulted in great environmental and social externalities, leading to real economic costs. Among the most widespread difficulties are jobless growth, inflation, income disparities, energy and food insecurity, growing congestion costs and the growth of inner city slums. Alarmingly, inequality has been rising in many countries in the region.

The mismatch between conventional economic growth strategies and the challenges confronting the Asia-Pacific region is increasingly evident. Although economic expansion has successfully lifted many millions out of absolute poverty, it is not sufficient. Asian and Pacific economies need now to improve the quality of their growth patterns to deal with the challenges of resource constraints, a climate crisis and the implications of both for people.

This does not imply that economic growth is no longer necessary. The concept of quality of growth not only acknowledges the necessity for the economy to continue to expand but also advocates for the establishment of qualitatively defined objectives for the economy, such as reducing income inequality and ensuring sustainable use of resources.

Misleading market price signals result in hidden costs that reduce GDP growth to a lower "net growth". Current market prices do not capture the social and ecological values of consumption and production and this leads to hidden losses not reflected in the GDP statistics of economic growth. Thus real growth is less than what is officially recognized.

The price gap between market prices and the real social and ecological costs of resource consumption as well as the value of many public goods provided by the natural environment (such as a crop pollination, stable climate and biodiversity), leads to inefficient economic choices that increase the hidden GDP losses. The time gap that separates the immediate costs from the long-term benefits of sustainable options creates a distortion in favour of short-term capital investment in resource-intensive infrastructure – at the expense of human and natural capital. Building highways that generate returns from toll revenues by encouraging the driving of private cars rather than expanding mass transit networks is a typical example of such a mismatch.

If left to the market, the provision of public goods will never receive sufficient investment. At the sector level, investments often are directed towards sectors that do not contribute sufficiently to better development outcomes (capital-intensive investments with low-impact in terms of employment, for example in the mining sector). But then lack of investment in, say, agriculture has led to a decline in agricultural productivity in several countries (and one of the causes of the increasing rural-urban disparities).

The misleading market incentives lead to high social and environmental costs, such as those related to pollution and environmental degradation, or lost economic opportunity costs, such as traffic congestion (box 2).

BOX 2: Hidden costs not captured in GDP

Cost related to pollution and environmental degradation: Environmental factors have a direct impact on human health. One out of four deaths globally is attributable to environmental causes, such as polluted air, contaminated water and lack of adequate sanitation.[34] According to a World Bank estimate, China is losing about 5.8 per cent of its GDP due to air and water pollution.[35] In India, 2.6 million premature deaths a year are related to air pollution, contaminated drinking water and other environmental risks.[36]

Cost of traffic congestion: Traffic congestion has become a common feature in most Asian cities, but its costs can be as high as percentage points of GDP. Indonesia is losing about 1.2 per cent of its GDP yearly due to severe traffic jams,[37] while traffic congestion in Bangkok is responsible for a loss of 2.1 per cent of Thailand's GDP.[38] In 2008, the annual road congestion costs in the Republic of Korea reached 26.9 trillion won (approximately US$23.8 billion), more than 2.6 per cent of the country's GDP.[39]

Costs of climate change and natural disasters: Countries in the Asia-Pacific region are the most vulnerable to climate-related disasters and stand to be among the hardest hit by changing climate. While the region generates 25 per cent of the world's GDP, it has suffered 42 per cent of the global economic losses due to natural disasters.[40] The cost of the 2011 floods in Thailand, for example, was estimated at US$45 billion, and recovery and reconstruction at US$25 billion,[41] while GDP declined by 9 per cent in the last quarter of 2011 compared with the previous year.[42] The Asian Development Bank estimates that in South-East Asia, the economic cost of climate change could be equivalent to a loss of 6.7 per cent of GDP per year by 2100 – more than twice the world average.[43]

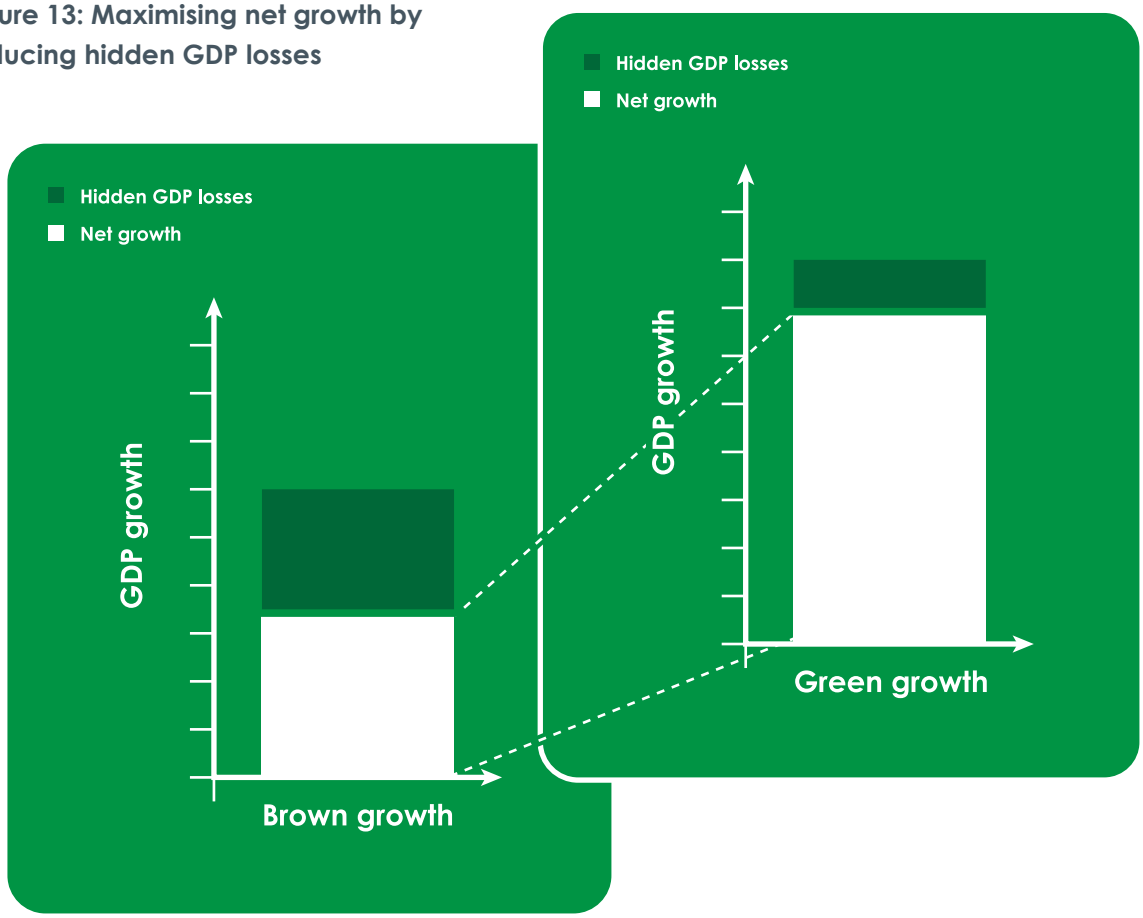
It is important to stress that it is the poor who are the most affected by environmental degradation and who bear most of the costs of these externalities.

Actual net growth is often much lower than the registered GDP growth. The environmental and social costs incurred through resource- and pollution-intensive growth (brown growth) strategies reduce the benefits to society from economic expansion but are not recorded in the GDP measurements. For example, increased energy consumption due to traffic congestion is recorded as an increase in economic activity, while traffic-congestion reduces the welfare of society by causing costs, such as pollution (and associated ill health) and lost time, which the GDP measure does not factor in. If it did, then GDP would reflect a decrease in labour productivity and net income as a result.

In many countries the actual growth of the economy (net growth), after taking account of largely externalized (and thus unaccounted) ecological, social and economic costs, is likely to be much lower than the GDP growth recorded.

Green growth can maximize net growth by minimizing the hidden GDP losses and ultimately deliver higher growth (figure 13).

Figure 13: Maximising net growth by reducing hidden GDP losses



Four types of capital underpin growth

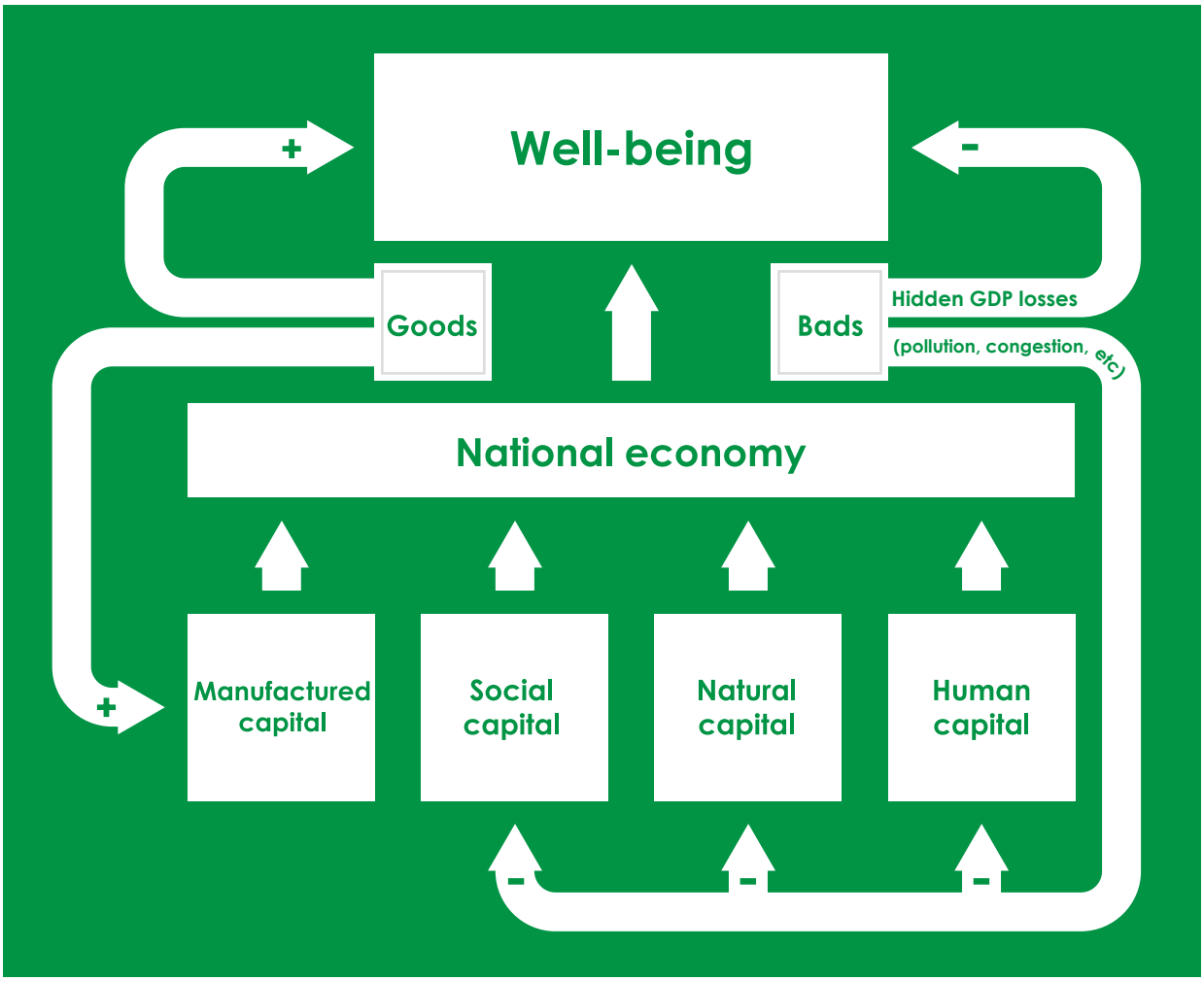
To sustain economic growth, we need to better understand what it is actually based on. Growth derives from capital stocks, which provide a flow of goods and services that contribute to human well-being. Manufactured capital (machines, tools, buildings and infrastructure) is what traditionally is considered as "capital". But growth is sustained by other forms of capital as well. Ekins, for example, identifies four main types of capital: manufactured capital, human capital (knowledge, skills and health), social capital (economically productive relationships and institutions) and natural capital (natural resources, biodiversity and ecosystem services).[44]

Current economic growth strategies are biased towards manufactured capital, resulting in hidden GDP losses that decrease the other three types of capital (figure 14)**.** These four types of capital are substitutable only to a limited extent. By destroying capital from which growth comes, we are undermining future growth prospects. To sustain economic growth, we need to reduce the costs to the human, social and natural capital by investing in making them stronger.

Improving three qualities of growth: Economic, social and ecological

Different economic growth patterns exist, with different effects (both positive and negative) on the stock value of the four types of capital. Growth patterns of the countries in the region show different economic, social

Figure 14: The four capitals that underpin growth



and ecological qualities. Countries at a similar level of per capita income exhibit different ecological footprints, levels of social cohesion and economic resilience.

It is not the purpose of this Roadmap to give a comprehensive definition of the quality of growth, which is bound to differ by country. Rather, the point is to direct the attention of policymakers in Asia and the Pacific to the need to move beyond strategies aiming only at increasing the quantity of growth.

Towards that goal, though, it is useful to understand the different qualitative dimensions that could be ascribed to economic growth strategies. This Roadmap focuses on the impact of GDP growth on three main qualities:

- **Economic quality** includes the capacity of the economy to develop and progressively move towards higher value-added production. Recent ESCAP analysis of the productive capacity of countries in the Asia-Pacific region found that, at an early stage of development, diversification of goods with a wide range of complexity is as important, if not more, as specialization.[45] Another important aspect of economic quality is the resilience of the economy to external shocks, such as financial crises or spikes in commodity prices. The triple crises of 2008 (food-fuel-financial) proved a harsh testing ground. Although most economies in the

region proved relatively resilient to the financial crisis (having learned from the 1997/1998 Asian financial crisis and having put in place necessary reforms and measures), the increases in food and fuel prices hit countries hard, pushing millions back into poverty. Thus, economic growth heavily relying on external financial resources exacerbates vulnerability against external financial shocks. In addition, energy- and resource-intensive growth aggravates the impacts from energy and resource price hikes.

- **Social quality** refers to a more inclusive and equitable growth and includes such aspects as equitable wealth distribution and low income disparity. Inequalities have risen in most countries, especially between urban and rural areas, diminishing the poverty reduction impact of growth. Another important aspect is the ability of growth strategies to generate employment. Countries are already experiencing serious unemployment problems, and with a growing population, the challenge is to create enough jobs for everyone, especially youth. Other aspects may include the presence of adequate social safety nets or equal opportunities for both men and women.

- **Ecological quality** includes such aspects as maintaining environmental impacts within the Earth's carrying capacity and sustainably managing the natural resources. With the current brown economic growth strategies, increases in economic activity lead to higher environmental impacts and resource depletion. Given the challenges explained in the previous section, it is imperative for countries in the region to decouple GDP growth from the environmental impacts. This requires improving the ecological efficiency of production and consumption. Another important aspect of ecological quality is the investment in natural capital.

Green growth specifically aims at improving the ecological quality of growth. While green growth cannot solve the root causes of poverty, improving the ecological quality of growth also improves several aspects of the economic and social qualities, given that economies and societies both depend on the goods and services provided by the natural environment. For instance, a report by the World Bank and the Development Research Centre of the State Council of China underlined that increasing resource efficiency is expected not only to address China's manifold environmental challenges but also improve the level of well-being and sustain the rapid growth and recommended that China follow a green growth path as part of a new development strategy, along with specific social and economic policies.[46] However, specific policies to address social and economic qualities need to be put in place in parallel with green growth policies.

Looking for a better measure of progress

The need to move beyond GDP as a measure of progress has long drawn the attention of economists, policymakers, academics and other analysts. Research in the past two decades has produced encouraging results in identifying alternative indicators of progress. The Human Development Index (HDI) has become one of the most widely known measurements of human progress, encompassing education, health and life expectancy as key components of human development. Normative work by the OECD and the United Nations has helped standardize a large number of indicators useful to inform policymaking. Work by the World Bank has opened the way to a better understanding

of the concept of quality of growth. Recently, the Stiglitz-Sen-Fitoussi Commission conducted a comprehensive review of the limitations of GDP as a measure of economic performance and social progress and assessed the feasibility of alternative measurement tools.

Despite such an extensive body of research on the subject, we are still far from developing and using better measures of progress. In addition to data and methodological issues, the lack of political leadership and a deep-rooted perception that "GDP growth equals progress" have hampered the establishment of better measures of progress.

Moving beyond GDP

Many countries in the region are moving beyond the GDP-only paradigm and taking a more balanced and sustainable perspective to economic growth strategies.

More than a decade ago, **Bhutan's** leadership chose "gross national happiness" (GNH) over GDP to measure progress. The GNH index is constructed from indicators relating to domains ranging from living standards to psychological well-being, community vitality and ecology. The GNH accounts include five types of capital: economic, human, natural, cultural and social. In China, after decades of rapid growth, the quality of growth is now considered more important than its speed. Among other decisions, policymakers adopted bold quantified targets for energy and resource efficiency and air pollution reduction within the Eleventh and Twelfth Five-Year Plans in the context of promoting a circular economy and a resource-saving society. **India's** policymakers are integrating ecological values into the country's national accounts. The government of the **Republic of Korea** adopted "Low carbon, green growth" as the national vision and the long-term **National Green Strategy for Growth** provides a comprehensive policy framework to mitigate climate change and promote energy independence, create new engines for economic growth and improve the quality of life. **Thailand's** policymakers have integrated the "sufficiency economy" philosophy into their socio-economic development plans, with the latest Eleventh Five-Year Plan incorporating also climate change concerns under the vision of a "Happy society with equity, fairness and resilience".

BOX 3: China's eco-efficiency indicators to monitor resources and environmental performance

The Chinese Academy of Sciences, China's leading think tank and scientific research body, developed a **Resource and Environmental Performance Index (REPI**). The index has been used to monitor and compare China's resources and environmental performance in the context of its sustainable development strategy reports since 2006. The index is composed of a number of eco-efficiency indicators related to the consumption of primary energy, freshwater, cement, steel and commonly used non-ferrous metals and other raw materials.

Source: China Sustainable Development Study website. Available from www.china-sds.org

Maximizing net growth and delivering higher growth in the long run by improving the ecological quality of growth

Mainstream economic development approaches have focused on "grow first, clean up later" and "get rich first then think about well-being". But experiences from the industrialized countries sadly illustrate that the pursuit of growth strategies that erode the human, social and natural capital leaves "cleaning up" very difficult and costly to achieve and undermines well-being. Green growth is an alternative growth strategy that improves ecological sustainability while increasing GDP.

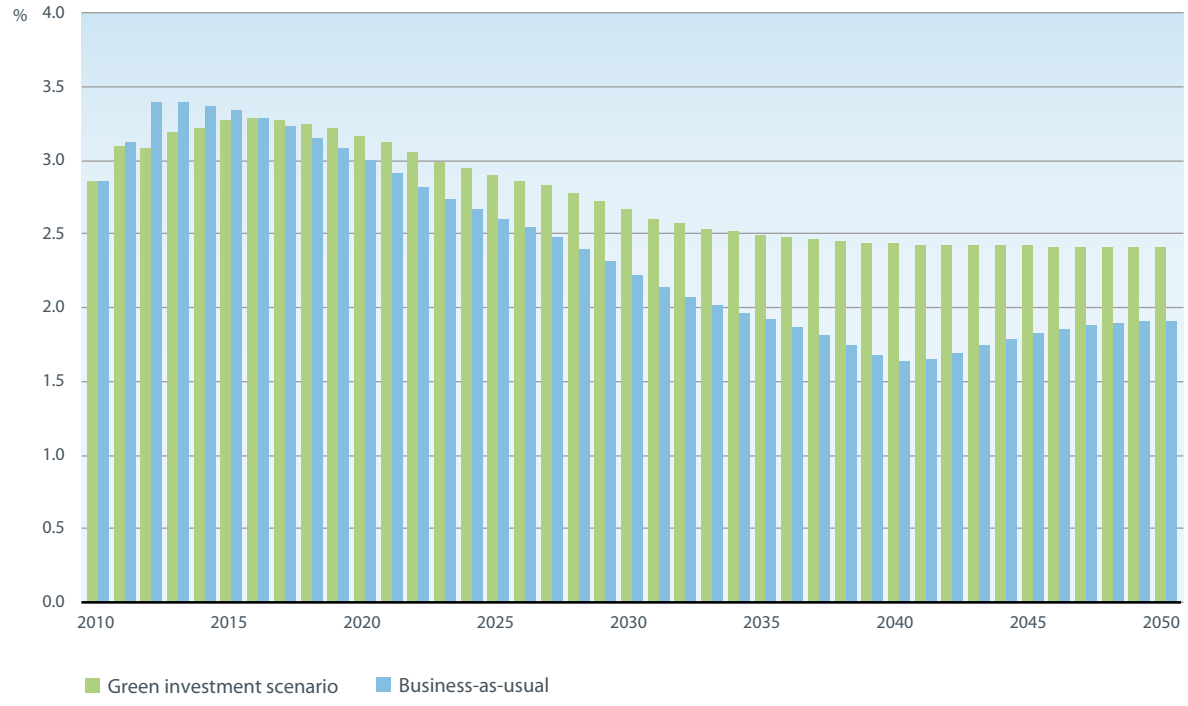
Green growth focuses on improving the ecological quality of growth as a strategy to cope with the impending resource and climate crises confronting the world by highlighting policy options that could improve the overall eco-efficiency of the economy from production to consumption.

Green growth can deliver higher growth ultimately. Green growth strategies can maximize net growth by reducing the hidden costs (GDP losses) that stem from reductions in human, social and natural capital. In doing so, it stimulates greater growth through innovation and efficiency gains triggered by the system change.

As United Nations Environment Programme analysis suggests, a green investment scenario delivers higher growth than a business-as-usual scenario (figure 15).

Minimizing the hidden GDP losses arising from resource depletion and climate impacts is a strong incentive for policymakers to pursue green growth. Green growth needs to be anchored in a broader macroeconomic paradigm that is focused on quality of growth. The pursuit of such a paradigm shift can start with the following actions:

Figure 15: Projected trends in annual GDP growth rates



Source: United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication* (Niarobi, 2011).

- ***Integrate quality of growth into socio-economic development planning.*** Pursuing quality of growth alongside quantity of growth requires expanding the political priority for a more balanced investment in natural, human and social capital. Five-year development plans should integrate programmes to improve the economic, social and ecological qualities of growth.

- ***Identify and measure the hidden GDP losses from worsening economic, social and ecological qualities of growth.*** Introduce policy measures to minimize the hidden losses and maximize the net growth.

- ***Address market failures, thus bridging the price and time gaps.*** This would redirect investments towards projects that improve the quality of growth. This will require changing market signals by allowing prices to reflect the full ecological and social costs of production and consumption, which leads to a level competing field for alternative options that provide long-term solutions (section 2.2.2).

- **Measure what matters.** There is a need for improved accounting systems and a range of indicators that can capture relevant information to assess the qualities of growth and progress towards the greening of the economy. A starting point is the United Nations System of Environmental and Economic Accounts (SEEA). The development of green growth indicators could be considered. There is a need, however, for further research and better statistics. In this regard, one of the strategic goals adopted recently by the ESCAP Committee on Statistics is to ensure "that all countries in the region by 2020 have the capability to provide an agreed basic range of population, economic, social and environmental statistics".[47]

CASE STUDIES

- China's Plan for National Economic and Social Development
- China's Resource and Environmental Performance Index
- Republic of Korea's National Strategy for Green Growth and Five-Year Plan





Tax


CO2
TAX




2.2 TRACK 2

Changing the invisible structure of the economy: Closing the gap between economic and ecological efficiencies

Roadmap directions

System change for green growth requires changing the "invisible" structure of the economy, including market prices, fiscal policy, financial systems, institutional arrangements, regulations, and lifestyles. The enabling conditions for green growth range from institutional arrangements to awareness raising. The most important factor will be allowing prices to reflect the real costs of production and consumption. Properly designed environmental tax reforms and environmental fiscal reforms can achieve this while generating higher growth and new employment opportunities and lower environmental impact.

This track is divided by function: section 2.2.1 elaborates on what is required for policy reform, focusing on long-term plans and targets, regulations and standards, institutional arrangements and lifestyles, followed by section 2.2.2, which features policy options for restructuring market prices and aligning economic efficiency with ecological efficiency and elaborates on the necessary fiscal reform.


Policy
Law

2.2.1 Reforming the legal and institutional frameworks to create the enabling conditions for low carbon green growth

System change for green growth requires certain enabling conditions. Governance, institutional capacity, socio-economic development planning and lifestyles have to be re-oriented to enable the necessary transformative policy reform.

Key points

Long-term plans and targets, institutional mechanisms for inter-ministerial coordination, greater regulation and behavioural change are the building blocks of the policy framework for low carbon green growth. As previously pointed out, there is no one-size-fits-all policy or strategy for pursuing low carbon green growth. Socio-economic circumstances, political priorities and capacities differ from country to country. Consequently, the planning, designing and implementing of green growth policies and strategies have to consider the local context and socio-economic development stage along with the different challenges and opportunities within a country.

Long-term plans and targets as enabling governance for green growth

Long-term plans and targets decrease uncertainty for businesses and encourage investment. In the case of solar photovoltaic panels, for example, the International Energy Agency estimates that its share in global electricity generation could grow to account for up to 25 per cent of electricity generation in 2050 (as compared with 0.03 per cent in 2007) if climate policy is favourable, in contrast to the 1.96 per cent under the current policy framework.[48]

A long-term vision and strategy is particularly important for promoting technological innovations and the deployment of low-carbon technologies, which require considerable lead time for both R&D and commercialization. It is also important for sustainable infrastructure development, which requires long-term planning, sizable volumes of upfront capital and innovative public-private partnerships. The Republic of Korea, for example, is relying on a **five-year green growth plan** to stimulate its needed investment and innovations.

Setting medium- to long-term national renewable energy targets (standards or quotas for renewable energy generation), with accompanying economic instruments

Table 3: National renewable energy targets in selected countries in the Asia-Pacific region

Country	Target year	National renewable energy targets
Australia	2020	20% of generating capacity from renewable sources
Bangladesh	2015	2.5 million units of rural off-grid solar PV systems
Cambodia	2015	15% of rural electricity supply from solar and small hydro sources
China	2020	15% of final energy consumption from renewable sources
Fiji	2013	100% of final energy consumption from renewable sources
India	2022	20 GW of solar energy capacity
Indonesia	2025	17% of primary energy consumption from renewable sources
Japan	2020	10% of primary energy consumption from renewable sources
Malaysia	2020	3,000 MW of renewable energy capacity
Nepal	2013	7% of rural electricity supply from renewable sources
Pakistan	2030	5% of generating capacity from renewable sources
Philippines	2030	10.6 GW of renewable energy capacity
Republic of Korea	2030	11% of primary energy consumption from renewable sources
Singapore	2012	0.035 GW of solar hot water capacity
Sri Lanka	2016	10% of rural off-grid households served from renewable sources
Thailand	2022	20% of primary energy consumption from renewable sources
Tonga	2013	100% of final energy consumption from renewable sources
Viet Nam	2050	11% of primary energy consumption from renewable sources

Source: Extracted from Renewable Energy Policy Network for the 21st Century, *Renewables 2011: Global Status Report* (Paris, 2011). Available from www.ren21.net/Portals/97/documents/GSR/REN21_GSR2011.pdf (accessed 21 March 2012); and India, Jawaharlal Nehru National Solar Mission: Towards Building a Solar India (New Delhi, 2010). Available from http://india.gov.in/allimpfrms/alldocs/15657.pdf (accessed 21 March 2012).

(feed-in tariffs, renewable energy obligations) has proven to be a powerful driver of fuel switching. Such targets and policies can be highlighted as a part of low-carbon development strategies, national climate change action plans or national energy frameworks. Table 3 provides an overview of such targets in selected countries in the region.

In its **Twelfth Five-Year Plan**, the Chinese Government committed to reducing its energy intensity by 16 per cent between 2011 and 2015, building on the previous target of 20 per cent between 2006 and 2010.[49] Such a long-term vision and target setting are among the success factors behind the rise of China as a world leader in renewable energy technology production. India aims at saving about 10,000 MW of electricity by 2012, as indicated in its National Mission on Enhanced Energy Efficiency.[50] The Indian Government also launched the **National Solar Mission**, with the goal of generating 20 GW of solar energy by 2022.

Many countries in the region have set voluntary targets for greenhouse gas emissions reductions, followed by low-carbon development strategies. The Republic of Korea voluntarily pledged to reduce its greenhouse gas emissions by 30 per cent from its

business-as-usual levels by 2020.[51] China announced a 40–45 per cent reduction in emissions intensity from its 2005 levels by 2020.[52]

Institutional arrangements and governance to coordinate sectoral policies

Low carbon green growth needs to be driven by the top level of government. Leaders in the highest positions of government need to create the appropriate legal and institutional platforms that will steer the system change to low carbon green growth. Framework legislation and an institutional platform chaired by the head of the government are required.

System change for low carbon green growth requires inter-ministerial coordination that focuses on cross-sector policymaking. The low carbon green growth agenda cuts across sectors and disciplines, and involves many parties. This requires an integrated approach to policymaking, along with the appropriate institutional arrangements and coordinating mechanisms. The system change cannot be handled by the conventional government structure, with line ministries focusing on sector-specific issues. Climate change policies, for example, cannot be developed in isolation from energy policies. For this reason, a number of countries (such as the United Kingdom and Denmark) merged the two policy agendas under one ministry.

China's National Development Reform Commission, Indonesia's State Ministry of National Development Planning (BAPPENAS) and the **Korean Presidential Committee on Green Growth** are good examples of institutional arrangements for coordinating various levels and areas of government. Effective integration requires mature institutions and strong capacities. Governments can start by putting in place appropriate coordinating mechanisms and a framework for institutional capacity building. Cambodia, for example, set up a Green Growth Inter-Ministerial Working Group, chaired by the prime minister.

Expediting low carbon green growth policies requires strong coordination among central, regional and local governments. Many actions will take place at the local level, and this requires close interaction with other levels of government and equitable distribution of roles, responsibilities and resources. This is best done by following the principle of subsidiarity – a central authority performs only those tasks that cannot be performed more efficiently at a local level. Although there has been a decentralizing trend within the region, most notably in India and Philippines, in many instances the responsibilities have not been adequately matched with the decentralization of authority, financial resources and capacities.

Regulations and standards

To support low carbon green growth, governments can adopt a range of regulatory instruments. These typically encompass mandatory technical regulations, voluntary standards and information-based instruments. Regulatory approaches provide enabling conditions and incentives, invoke the needed market signals to bolster confidence among business owners to deploy green technologies, accelerate green innovation and push clean technology development and diffusion.[53]

Governments can set standards in a range of fields, such as: emissions, energy efficiency, fuel efficiency, minimum energy performance and green building codes. For example, to increase the energy-efficiency

level of its commercial building stock, the Indian Government issued the Energy Conservation Building Code, which set a minimum standard for energy performance.

Setting the right level of standards can be a challenge and requires thorough assessment by experts and consultations with the affected industries. Mandatory standards set minimum standards that raise the bar for low performers, while voluntary standards and incentives (such as labels and awards) are required to encourage high performers. Standards should be regularly and predictably revised to continue providing stimulus to improvements and innovation as businesses adapt and adjust to existing ones. **Japan's Top Runner programme**, for example, sets mandatory energy efficiency standards based on the most efficient product on the market and has been very effective at improving energy efficiency of a wide range of consumer products, such as air conditioners and passenger vehicles.

An alternative to command-and-control measures are market-based instruments, such as emissions trading. Cap-and-trade schemes combine the effectiveness of standards with the flexibility and cost-efficiency of market-based instruments. After a cap has been set by the government, individual enterprises can choose the most efficient way of reducing their emissions. But the operation of such schemes is very complex and needs to be carefully considered. Additionally, price fluctuations create uncertainty and are not conducive to long-term investment. A carbon tax provides a much more cost-effective solution and can complement a cap-and-trade scheme.

Changing lifestyles and leveraging public support

Improving the eco-efficiency of production is not enough to make the shift fully to green growth. We have to also shift towards sustainable consumption. This requires changes in consumer behaviours and public support for policies that push for greener consumption patterns.

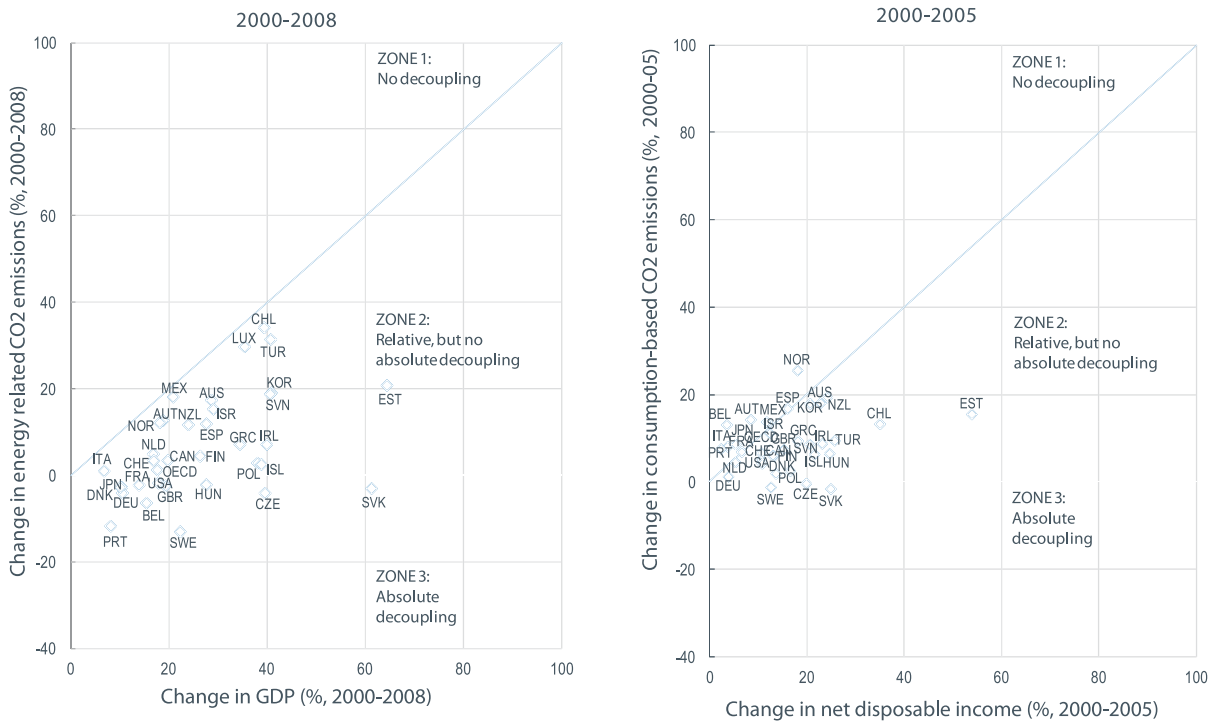
Unsustainable consumption spreads rapidly in developing countries as income goes up, and once entrenched, is difficult to reverse. As shown in figure 16, several OECD countries have to a large extent decoupled their growth from CO_2 emissions (thanks partly to structural changes and to the relocation of manufacturing overseas). But decoupling consumption-based CO_2 emissions from economic growth has proven to be a much more difficult task.

This highlights the urgency for developing countries in the Asia-Pacific region to avoid the trap of energy- and resource-intensive lifestyles by making sustainable choices in the early stages of development. Singapore is a case in point. The Government introduced a strict control on private cars as early as the 1970s and is now showing low levels of traffic congestion compared with other cities in the region.

Prices are one of the main factors influencing consumer behaviour. Pricing policies supported by regulatory measures can have a huge impact on consumption patterns (discussed in the next section). At the same time, promoting sustainable consumption requires specific tools and instruments, such as standards, incentives, education, communication campaigns and labelling.

Financial incentives can be useful instruments to engage consumers and households to make more sustainable choices. These

Figure 16: Change in production-based CO_2 emissions compared with GDP and change in consumption-based CO_2 emissions compared with disposable income



Source: Organisation for Economic Co-operation and Development (OECD), *Towards Green Growth: Monitoring Progress* - OECD Indicators (Paris 2011).

can include grants or tax reductions. They can be particularly effective in the adopting of new greener technologies. Schemes to encourage the purchase of cleaner vehicles, for example, exist in many countries. In the Republic of Korea, the 2010 Green Car Industry Development Plan includes tax reductions on the purchase of hybrid and electric cars. Additionally, the Korean Government is providing low-interest loans and tax exemptions for the installation of energy-efficient lighting in private buildings as part of its LED Lighting 2060 Plan. The **Korean** Government also introduced a **green credit card** scheme in July 2011, to encourage consumers to adopt more sustainable lifestyles.

Governments need to invest in long-term education for sustainable development programmes. Public communications campaigns should expand awareness among the general public on a number of issues, such as waste, energy efficiency and sustainable mobility. Beyond mere awareness, though, there is a need to promote education for sustainable development. In the Republic of Korea, the Government introduced green growth content into the national elementary and secondary education curricula and established training courses for teachers on green growth. Other measures include customized green growth educational programmes for youth, an environmental education certification system and the Experience Green Growth Centre in downtown Seoul for the general public.

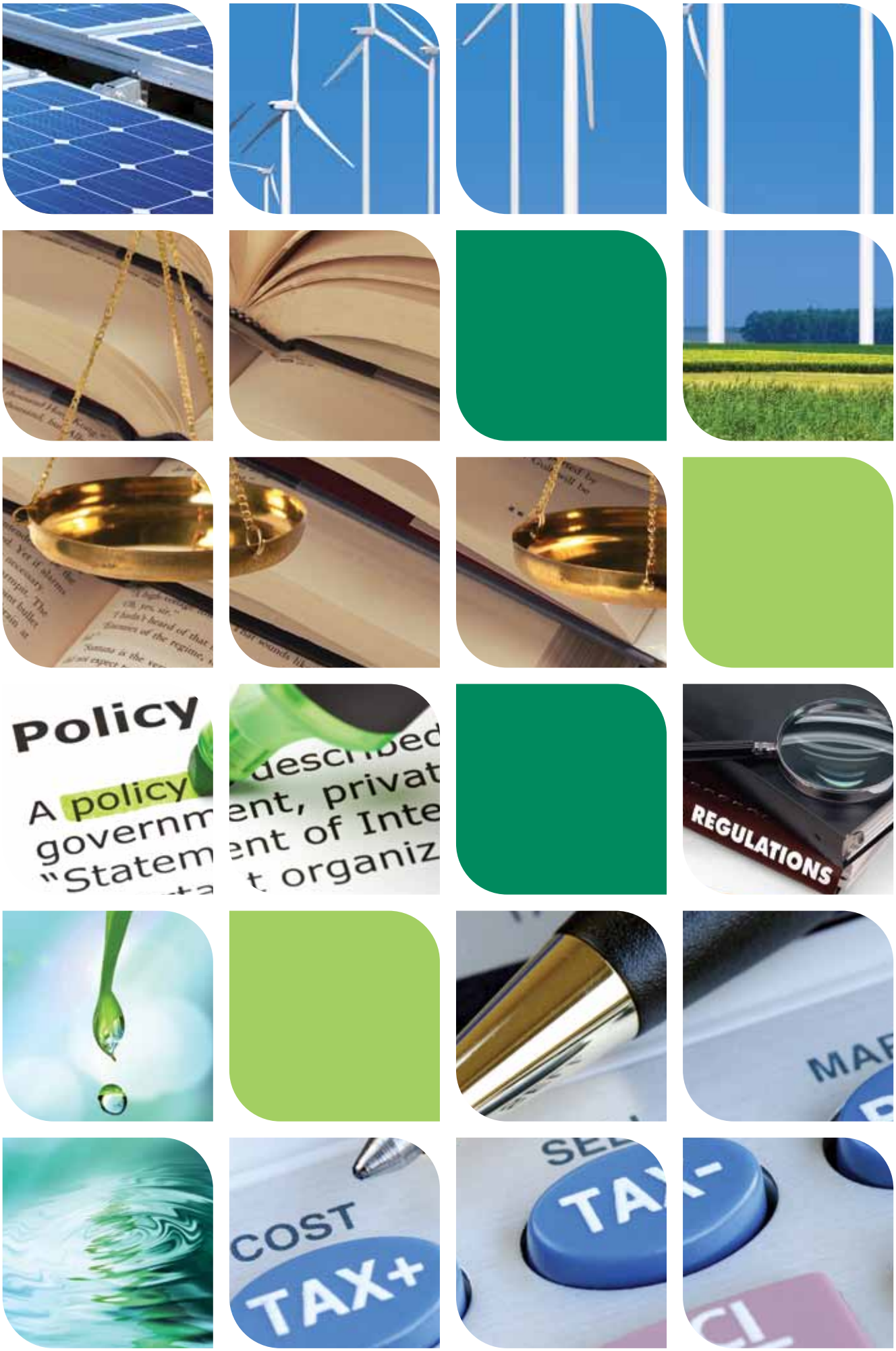
Labelling is very useful in guiding consumer choices by providing relevant information regarding the environmental and social impact of products (see section 2.4 on **eco-labelling**).

FACT SHEETS

- Carbon pricing
- Cap-and-trade scheme
- Eco-labelling
- Extended producer responsibility
- Low-carbon development plan
- Restricting licence plates

CASE STUDIES

- Beijing, China's traffic policy package
- Brazil's National Plan on Climate Change and Law
- China's mitigation targets
- China's National Development and Reform Commission
- China's Plan for National Economic and Social Development
- European Union's Emissions Trading System
- India's Solar Mission
- Indonesia's National Development Planning Agency
- Japan's Top Runner Programme
- Republic of Korea's Emissions Target Management Scheme
- Republic of Korea's Framework Act on Low Carbon, Green Growth
- Republic of Korea's green credit card
- Republic of Korea's investment plan for low carbon green growth
- Republic of Korea's National Strategy for Green Growth and Five-Year Plan
- Republic of Korea's Presidential Committee on Green Growth
- Singapore's traffic policy package


Policy
A policy
REGULATIONS
COST
TAX+

2.2.2 Reforming fiscal policies to close the gap between economic and ecological efficiencies

To use market forces to drive green growth, prices need to reflect the full ecological and social costs of production and consumption. This requires the use of fiscal tools, such as taxes and subsidies, in a way that does not affect the poor or reduce competitiveness and is politically acceptable. Properly designed environmental tax reforms and environmental fiscal reforms can be powerful drivers for green growth and achieve the double dividend of higher economic growth and lower environmental impact.

Key points

Prices have a powerful effect on people's behaviour and affect their decisions on what goods and services to consume and how much. Underpriced resources stimulate excessive and wasteful consumption and inefficiency. Placing a price on environmental damage thus reflects the real cost of production of goods and services and provides an incentive for companies to reduce it.

Full-cost pricing can provide significant incentive for private-sector innovation, especially for market-ready innovation, while longer-term improvements need to be supported by targeted R&D and innovation policies. Harnessing the power of markets and strategically reforming prices to reflect the full cost of resource consumption creates enormous opportunities to activate the fundamental economic system change required for green growth, while engaging investors, producers and consumers in the whole process.

Putting a price on carbon, for example, is crucial for reducing carbon emissions, decreasing carbon intensity and stimulating green growth. It should be the cornerstone of any low-carbon development strategy. The most cost-efficient way to do this is by introducing a carbon tax. If a carbon tax is imposed while reducing income and labour taxes (and thus maintain revenue neutrality), there will be no increase to the overall tax burden. Another way of placing a **price on carbon** is through a **cap-and-trade scheme**, which generates an equivalent price by creating a market for trading emissions permits.

The uptake of such pricing policies to restructure market prices so far, however, has been limited, mainly due to fears related to

competitiveness, the social impact on the poor and political resistance. In some situations, it has had limited impact due to poor design and implementation. But pricing policies remain the central element in the transition to a green economy.

The challenge is to design pricing policies in a way that ensures their environmental effectiveness, their political feasibility and their contribution to growth, employment and poverty reduction – but without negative impact on the poor or on competiveness. This Roadmap argues that well-designed and gradually introduced environmental tax and fiscal reforms offer the best promise for developing countries in the Asia-Pacific region to achieve green growth for sustainable development.

Concept, principles and benefits of environmental tax and fiscal reforms

Environmental tax reform (ETR) based on revenue neutrality and the double dividend is a powerful tool for green growth. According to the European Environment Agency, environmental tax reform is a "reform of the national tax system where there is a shift of the burden of taxes from conventional taxes, such as those on labour, to environmentally damaging activities, such as resource use or pollution".[54]

The defining features of ETR are revenue neutrality and double dividend. Shifting the tax base to resource consumption while maintaining revenue neutrality ensures that the overall tax burden does not increase. ETR can stimulate economic growth and employment by lowering the cost of labour while reducing resource consumption or carbon emissions. A properly designed ETR can then generate a double dividend, which is the main aim of green growth.

ETR is an important mechanism for closing the price gap between market and ecological prices. ETR raises the prices of resource use and pollution by taxing the relevant emissions or resource use. Environmental taxes include all those taxes that are applied to something that has a proven and specific negative impact on the environment, regardless of the purpose. This may include taxes on:

- **Natural resource** extraction and consumption, such as raw materials, forests or water
- **Energy** products, such as fossil fuels or electricity
- **Pollutants**, such as polluting emissions to air and water, management of solid waste or noise
- **Transport**, such as ownership and use of motor vehicles

The ETR approach recommends that the revenues are mainly used to reduce other taxes, especially those on the productive factors of labour and capital. Reducing such distortionary taxes may increase employment and output.[55]

The concept of ETR is not a new idea and has been adopted by numerous countries in Europe since the early 1990s to address issues related to the environment, resource productivity and economic progress. However, it is largely underused; its potential for application in developing countries in the Asia-Pacific region remains overlooked.

While environmental tax reform can greatly help governments to internalize social and environmental costs not reflected in market prices, it doesn't address the problem of environmentally harmful subsidies that can also distort prices.

Environmental fiscal reform (EFR) can remedy that shortfall. EFR refers to a range of

taxation and pricing measures that raise fiscal revenues in pursuit of environmental goals.[56] While ETR focuses on shifting the tax base and raising tax revenue, EFR covers tax revenue spending. EFR extends beyond ETR by including **subsidy reforms**, which entail phasing out subsidies on environmentally harmful activities and products, such as fossil fuels or pesticides, and redirecting public spending towards more socially and environmentally beneficial activities.

Subsidies are an important fiscal mechanism that governments use to stimulate certain vital sectors of the economy. However, when such subsidies stimulate production with increased and unabated environmentally harmful consequences, they have a negative impact on the economy because the net result is the promotion of unsustainable production and consumption patterns. The costs for abatement are not internalized into the production costs and remain unaccounted. The higher costs of the environmental damages are eventually paid by society.

Some subsidies are explicit and transparent: the government pays directly to producers or consumers of the products and the payments appear in the budget as expenditure. Other subsidies are hidden, taking the form of tax concessions, regulatory exemptions, grants or loans at below-market interest rates, price-support measures or preferential depreciation allowances.[57] The International Energy Agency estimates that fossil fuel subsidies amounted to US$409 billion in 2010.[58] Several countries in the Asia-Pacific region still heavily subsidize fossil fuels. Some of them, notably China, India, Indonesia and the Russian Federation, have started to reduce such subsidies. This trend should continue.

EFR can also be used to recycle the revenue from the environmental tax reform to long-term investments in sustainable infrastructure, green industries or projects that increase social welfare. These fiscal measures can bridge the time gap between long-term gains and short-term costs by providing public funding for investments that may have significant financial hurdles but serve as long-term price signals in the evolving process towards a green economy. EFR can also contribute to poverty reduction by freeing up resources necessary for pro-poor programmes and investments in areas such as health and education.

Closing the gap between economic and ecological efficiencies

By closing the price and time gaps through the tax and fiscal reforms, economic efficiency can be aligned with ecological efficiency. This closing will lead to environmental, economic, social as well as fiscal benefits. Taxes on resource consumption will make any investment in resource efficiency economically viable and will lead to profit, employment and growth.

Benefits

If properly designed, ETR and EFR can bring about a number of benefits:

- **Environmental benefits:** Decreases pollution and natural resource use. Both reforms have proven to be very effective environmental policy mechanisms, particularly in reducing energy use and CO_2 emissions.

- **Economic benefits:** Generates economic activity and employment. Both reforms *directly* increase output by reducing distortionary taxes on labour and capital as well as *indirectly* by stimulating green innovation and environmental industries.

- **Social benefits:** Contributes to poverty reduction. Environmental fiscal reform can reduce poverty by generating or freeing up resources for pro-poor programmes and investments in health and education.

- **Fiscal benefits:** Raises revenues and consolidates budgets. Environmental fiscal reform can help generate revenues to finance public services, which is a challenge in many developing countries. It can also help more advanced economies with budget consolidation in a time of fiscal hardship and economic downturn.

Core principles

There are three core principles behind the design and use of ETR and EFR as policy mechanisms for green growth:

- **Tax "bads" not "goods":** The basic principle behind both reforms is to shift the tax burden from those things that are better increased (the goods), such as labour and capital, to those that are better reduced (the bads), such as pollution and natural resource consumption.

- **Revenue neutrality:** Both reforms not only involve levying new environmental taxes and raising the tax burden but also using the revenues to lower other taxes – thus keeping the overall tax burden on the economy unchanged. A wide range of taxes can be reduced to achieve revenue neutrality, including social security or health care contributions, personal income tax, corporate income tax, corporate profits tax, business income tax, capital gains tax or even value-added tax, depending on the revenue structure in each country. Strict revenue neutrality can be considered in those cases in which it is essential for securing political support. But if raising revenues is required for fiscal consolidation, then revenue neutrality is less important.

- **Double dividend:** Both reforms are powerful green growth mechanisms because they produce the double dividend of reducing environmental impacts and increasing economic activity and employment while reducing poverty. Experiences with the environmental tax reform show that it can be beneficial or, at worst, neutral to the economy. The extent to which the double dividend can be achieved depends on many factors, including the design of the reform as well as the use of complementary policies.

Potential for environmental tax and fiscal reforms in the Asia-Pacific region

Environmental tax and fiscal reforms have been implemented with varying degrees of success in several countries in Europe, such as Denmark, Germany, Sweden and the United Kingdom. Although these experiences provide useful insights, the relevance and potential of these policy mechanisms are distinctive in the context of developing countries in the Asia-Pacific region.

Several countries in the region have introduced environmental taxes:

- In April 2010, lawmakers in **Viet Nam** adopted an Environmental Protection Tax Law framework that is scheduled to enter into force in 2012. The law mainly targets fossil fuels but also other polluting items, such as plastic bags and some harmful chemical substances used in agriculture and forestry. Revenues generated by the taxes are to be directed towards environmental programmes,

although the details have not been specified.

- Policymakers in **Thailand** prepared a draft Act on Economic Instruments for Environmental Management. The Act considers a range of economic instruments, including environmental taxes, user fees and charges for pollution management, product surcharge, performance bonds, tradable permits, subsidies and other support mechanisms and allows product prices to include end-of-life management fees. Part of the revenues will go into an environmental fund to invest in green technologies.

- Similarly, lawmakers in **India** in 2010 imposed a carbon tax on both domestically mined and imported coal at the rate of 50 rupees (around US$1) per ton of CO_2. Revenues generated from the tax go into a National Clean Energy Fund.[59]

- Policymakers in **China** are planning to implement resource tax reforms and change the electricity, refined oil and water pricing mechanisms.[60]

Other countries have started phasing out harmful subsidies:

- Policymakers in **Indonesia** started a reform of the fossil fuel subsidies; in 2005, concern over the increasing pressure that fuel subsidies were placing on the state budget led the Government to increase fuel prices in March and then again in October by an average of 29 per cent and 114 per cent, respectively. This reduced the state budget deficit by US$4.5 billion in 2005 and US$10 billion in 2006.[61] The potential negative impact of the reform on the poor was mitigated through a **direct cash transfer programme**, which reached 19.2 million households and cost around US$2.3 billion, less than a quarter of the savings in 2006 alone.[62]

- Similarly, lawmakers in the **Islamic Republic of Iran** introduced in 2010 the Targeted Subsidy Reform Act, which resulted in a twenty-fold increase in domestic energy and agricultural prices. The reform resulted in savings of US$50-$60 billion in one year. Half of this amount was redistributed to households, while US$10–$15 billion was advanced to enterprises to finance investment in restructuring aimed at reducing energy intensity.[63]

Economic modelling of the double dividend potential from environmental tax reform in the Asia-Pacific region

The various country tax changes are very good steps in the right direction, but their scope and depth are still limited. To assess the scope and potential impact of comprehensive environmental tax reform in countries in the Asia-Pacific region, ESCAP conducted a simulation analysis through a computable general equilibrium (CGE) model. The model analysed the effect of the introduction of a carbon tax of US$10 per tonne of CO_2 equivalent on GDP, employment and utility by 2020 under different scenarios and depending on how the revenues from the tax were allocated. The model compared the case in which revenues would not be used to lower other taxes (but given back to citizens as a cash transfer) with a reduction in taxes on labour, corporate income or consumption (VAT). Table 4 illustrates the result of the simulation for selected countries in the region.

The model found that a carbon tax would be effective in reducing CO_2 emissions in all

Table 4: Impact of a unilateral ETR in selected countries in the Asia-Pacific region

	CO_2 reduction (%)	GDP impacts (%)	Employment (%)	Suggested tax to be cut		
				GDP	employment	utility
Cambodia	-10.86, -8.60	-0.39, +1.01	-0.27, +0.26	CPR	LAB	LAB or CON
China	-21.11, -15.59	-1.85, +1.90	-0.44, +0.67	CPR	CON	CPR
India	-17.77, -15.04	-0.94, +0.62	-0.32, +0.32	CPR	CON	CON
Japan	-3.01, -2.78	+0.03, +0.21	-0.03, +0.04	CPR	LAB	LAB or CON
Republic of Korea	-8.64, -7.30	-0.22, +0.73	-0.13, +0.08	CPR	LAB or CON	CON
Malaysia	-9.36, -7.24	-0.82, +1.45	-0.52, +0.42	CPR	CON	LAB
Thailand	-6.79, -3.81	-0.81, +1.57	-0.37, +0.54	CPR	LAB	LAB

CPR= corporate taxation; LAB=taxation on labour; CON=taxation on consumption (value-added tax, VAT)
Note: Values range from worst case scenario to best case scenario (except for CO_2 emissions reductions where the inverse is presented), based on how the revenues from the tax are used. For more details, refer to the background policy paper *Environmental Tax Reform: Major Findings and Policy Implications from a Multi-Regional Economic Simulation Analysis for Low Carbon Green Growth*.

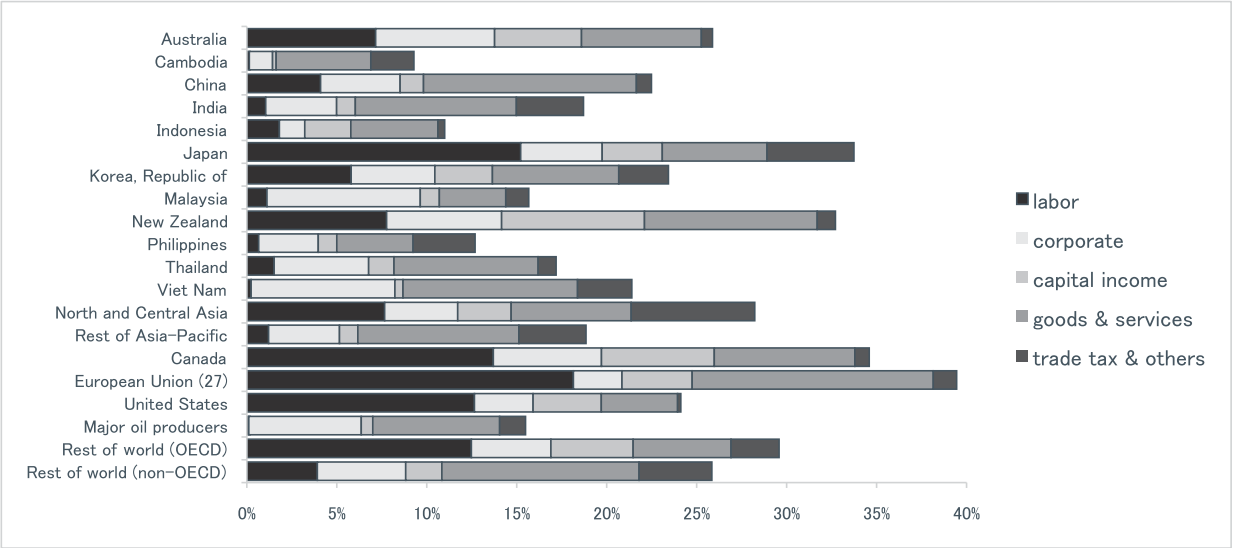
countries, with the biggest reductions in developing countries and in particular China and India. In the worst case scenario, it would result in a slight contraction of GDP if revenues were not used to reduce other taxes. The effect on the economy appears positive if the revenue is used to reduce taxes on labour, corporate income or consumption. China, for example, could increase its GDP by 1.9 per cent if the revenues are properly used.[64]

The effects on GDP, employment and utility vary according to which taxes are reduced. The reduction of corporate taxation (CPR) would be the best option for raising GDP but would not necessarily lead to a strong double dividend in terms of employment, utility or consumption because a part of the value added may accrue to foreign capital holders, depending on the country-specific context, such as dependency on foreign capital or regulation of it. Another way of revenue recycling, such as reducing tax on labour (LAB) or consumption (CON), may have better impact on those indicators. The impact and priority of each option for using the revenues of the taxes would differ for each country, especially depending on the tax structure in place. Figure 17 provides a comparison of the tax structure in different countries in the Asia-Pacific region as well as elsewhere in the world.

It is important to emphasize that developing countries with a tax system still under development do not need to follow the income-based tax system of industrialized countries. Income taxes are inefficient because they are highly distortive. Rather, developing countries in Asia and the Pacific have an opportunity to develop their tax system based on resources and pollution, thereby directing their economies onto a more resource-efficient development path.

The effectiveness of environmental tax reform would be much higher if countries cooperated through collective action. Global CO_2 emissions could be reduced by 11 per cent if all countries introduced a similar carbon tax. Regional cooperation

Figure 17: Comparison of tax structures in various countries and regions, as % of GDP



Source: IMF Government Finance Statistics, CD-ROM, March 2011
* Taxes on goods and services include energy taxes.

would also be extremely beneficial: global CO_2 emissions could be reduced by 7.86 per cent if countries in the Asia-Pacific region alone implemented environmental tax reform.[65]

Regional cooperation can start with a knowledge network. Cooperation among the countries in the region on a carbon tax may take time to materialize, given the sensitivities related to taxation in different countries and fears related to competitiveness. But regional cooperation can start by sharing knowledge and experiences on the introduction of such reform and other economic instruments and pricing policies. A regional knowledge network, bringing together policymakers, academics and other actors, could assist.

This was done in Europe with the establishment of the Green Budget Europe. Similarly, a Green Budget Asia could be established.

Designing environmental tax and fiscal reforms: Issues to consider

ETR and EFR can deliver a double dividend of reducing environmental impacts while increasing growth and employment. This is not automatic, though. There can also be trade-offs between various objectives that need to be addressed explicitly. ETR and EFR require careful design and implementing, taking into account issues relating to: i) equity, ii) competitiveness, iii) political feasibility, iv) administrative feasibility and v) effectiveness. All these issues require coordination among various government departments and are better addressed through dedicated institutional arrangements.

i) Addressing income regressiveness and ensuring equity

Those affected by the introduction of a tax on a specific resource (or the removal of a subsidy on it) are usually the heaviest users of such a resource. These may not be the

poor. Some studies have suggested that in China[66] and in Indonesia,[67] for example, a carbon tax may be progressive because higher-income groups tend to buy more carbon-intensive goods and energy-intensive sectors tend to employ skilled labour rather than low-paid informal workers.

In some situations, however, the poor may be directly affected by the reform measures. This is the case with fossil fuels used by the poor, such as diesel or kerosene. In other instances, the poor may be indirectly affected. It is important to conduct a detailed analysis of the impact and how different social groups may be impacted. If need be, it will also be important to develop interventions that address the income regressiveness of ETR and EFR. These include mitigation measures, such as increasing block tariffs (also known as "lifeline tariffs"), progressive tax rates and compensation. In general, introducing well-targeted, coherent and transparent compensation that support real incomes of the poorest households tends to be more effective in mitigating the immediate negative impacts of the fiscal reform on low-income households than other measures.[68] A good example is the case of **Indonesia's direct cash transfer programme**, previously pointed out. In **Singapore**, the distributive impacts of a water pricing reform were mitigated through tax rebates and targeted subsidies for lower-income households.

ii) Strengthening competitiveness

Empirical evidence from countries that have introduced ETR shows that overall competitiveness was not affected. To the contrary, the ETR had a positive economic effect – increasing GDP and reducing fuel demand.[69] Higher prices of resources can stimulate innovation and efficiency improvements, and results can be enhanced if part of the revenues from the fiscal reform is channelled towards supporting innovation.

The potential negative impacts of increased prices of energy and raw materials on certain industries (in particular, the producers of energy and raw materials and the most intensive users of these products) can be addressed through specific interventions.

First of all, a gradual application of the ETR and EFR policies over a set time period provides a critical long-term planning horizon and gives industry sufficient time to retool production processes to adapt to the new policy scheme. Governments can provide lead-in times and announce the tax levels and implementing dates well in advance.

Using part of the revenues generated through the ETR to reduce corporate taxes may offset increased energy costs to businesses. The effect of revenue recycling on different sectors has to be closely studied, starting from the design stage of the ETR. Different types of tax reductions can have different impacts, depending on a business's energy and labour intensity or the tax and fiscal structure. For example, labour tax cuts may benefit labour-intensive sectors.

More pronounced impacts are expected on sectors that exhibit high energy-intensity (sectors such as aluminium, steel, cement, paper and glass), high trade dependency, a large share of energy costs and a weak ability to pass costs on to consumers.[70] Special arrangements may be considered for these specific sectors, such as tax rebates, sector-based tax exemptions, voluntary agreements, targeted subsidies for R&D, green job training and transition assistance. Compensatory measures, such as tax rebates and exemptions, should be transitory and time-bound in order to avoid reducing the environmental effectiveness of the ETR.

Border tax adjustments (BTAs)[71] can, in

theory, create a level competing field for competition between domestic and foreign producers and reduce potential emissions leakage related to shifts in production. However, the BTAs are a rather sensitive issue due to their potential to be used as a protectionist measure; not enough evidence exists on their effectiveness. Considering the high administrative and monitoring costs, their use should be carefully assessed.

iii) Enhancing political feasibility

ETR and EFR will entail losses for some. This prospect may stir up strong political opposition. To enhance the political feasibility of the measures, it is important to understand who will be affected and how, and then to design interventions that compensate them and mitigate the impacts. It may be necessary to allocate part of the revenue back to those affected, especially if they are the poor or politically influential groups. Regardless of the actual impacts, raising taxes is one of the hardest policies to sell to the public. Thus it is important that ETR and EFR are designed and applied transparently and accompanied by a persuasive campaign to communicate the benefits of the proposed measures to the general public.

iv) Ensuring administrative feasibility and efficiency

Another factor to consider when designing the ETR and EFR is implementing capacity, especially in developing countries, where it may be limited. From an environmental point of view, it is best to target the environmental "bad" directly (such as the pollutant). But given weak environmental monitoring capacity, it may be simpler and ultimately more effective to use a proxy, such as a tax on products that generate the harmful pollutants in the course of their production. For example, a tax on fuel may be the best way to reduce the emissions of a range of harmful pollutants that are difficult and costly to monitor.[72] Revenues from taxes on pollution, in the form of fees and charges, usually channelled to an environmental fund, are administered by the environment ministry and used mainly to support monitoring and enforcement. Other forms of environmental taxes allow for revenues to be channelled to the general budget and used for various purposes. A part of it may still be earmarked to strengthen environmental monitoring, but not necessarily. To be administratively feasible, taxation should apply broadly to a range of sectors in the economy.[73]

v) Adjusting the tax base to maintain effectiveness

Ironically, if the ETR is effective, then the tax base can shrink or even disappear. In case the mechanism leads to a phase out of a highly polluting input, for example, the environmental results will be high but the revenue would be lost. Thus, both the fiscal and environmental effectiveness of the ETR mechanisms need to be carefully considered and continuous adjustment is needed to avoid losing the fiscal effectiveness.

Governance and institutional arrangements

ETR is a cross-cutting issue that will affect many policy areas and government departments. It thus requires specific institutional arrangements to involve the whole range of line ministries. It needs to have the full support and engagement of the finance ministry, which should be the main driver, in coordination with the environment ministry. This was done in European countries, including Norway, where the Government set up a Green Tax Commission with participation of the Ministries for Environment, Economy, Industry and Trade, Energy and Transport

and external experts. To maintain transparency and credibility of the reforms, countries introducing ETR and EFR are advised to establish an independent monitoring and evaluation mechanism of revenue neutrality that involves private and public actors. In the United Kingdom, for example, an independent Green Fiscal Commission consists of commissioners from both houses of parliament, the business sector, universities and other NGOs with expertise in environmental taxation and green fiscal reform.

Need for complementary policies and a country-specific approach

Although market-based instruments may provide powerful and cost-effective policy options for green growth, ETR and EFR should be pursued in conjunction with complementary policies rather than as stand-alone instruments. The effectiveness may be enriched by other instruments, such as regulation, voluntary agreements or information, particularly in developing countries where markets are less developed. Introducing ETR and EFR as part of a more general package may also raise its political feasibility, considering raising prices likely will remain generally unpopular.

The context for ETR and EFR will largely differ among countries, given that fiscal systems are a complex and deeply embedded part of a country's institutional structure. Thus the reforms need to be cognizant of country-specific circumstances and political priorities.

POLICY PAPER

- ***Environmental Tax Reform: Major Findings and Policy Implications from a Multi-Regional Economic Simulation Analysis***

FACT SHEETS

- Carbon pricing
- Double dividend and revenue neutrality
- Environmental tax reform and competitiveness
- Environmental tax rfeform and environmental fiscal reform
- Feed-in tariff
- Subsidy reforms
- Vehicle and fuel taxes plus the removal of car-oriented subsidies

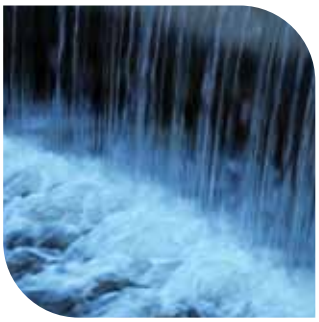
CASE STUDIES

- Australia's carbon pricing scheme
- Europe's environmental tax and fiscal reforms
- Indonesia's Bantuan Langsung Tunai cash transfer programme
- Islamic Republic of Iran's subsidy reform
- Singapore's water pricing policy
- Thailand's initiative on environmental tax reform
- Viet Nam's Environmental Protection Tax Law
- United Kingdom's climate change levy











CANS


2.3 TRACK 3

Changing the visible structure of the economy: Planning and designing eco-efficient infrastructure

The impact of price changes on infrastructure choices will only be realized in the long run due to the long lifespan of infrastructure assets. Thus price structure change needs to go hand in hand with supportive changes in the way physical infrastructure is planned and designed. Urban design and planning, buildings, transport, energy, water and waste systems need to be re-oriented towards eco-efficiency.

Key points

System change for low carbon green growth requires eco-efficient infrastructure design and approaches. As explained in the previous section, a core element of the system change required for low carbon green growth will be allowing market prices to reflect the costs of production and consumption in such a way that resource efficiency is encouraged. But prices alone will not be sufficient to shift production and consumption patterns. Infrastructure assets have a long lifespan, which creates a lock-in effect (if they are fossil fuel dependent, they remain that way a long time) and cannot be changed overnight by pricing policies. Thus, an equally important element of system change will be planning and designing infrastructure based on eco-efficiency.

Infrastructure provides the foundation for our socio-economic systems. It is also a critical determinant of energy consumption, greenhouse gas emissions and environmental impacts in general. The way infrastructure is designed and built has a long-lasting impact on the efficiency of the way we use natural capital and the quality of growth.

Green alternatives to conventional brown infrastructure are available. The carbon intensity and energy efficiency of the future greatly depends on the kind of infrastructure we design and invest in today. Green buildings, renewable energy technologies, public transport, railways, rainwater harvesting and decentralized wastewater treatment are all examples of eco-efficient infrastructure options. Constructing either highways or railways, for instance, will make a great difference on the level of traffic congestion and the amount of energy consumed to cater for mobility demands over time.

Investing in eco-efficient infrastructure will provide great opportunities for economic growth, employment generation and achieving the MDGs. Developing countries in the Asia-Pacific region have a unique and fast-closing window of opportunity to invest in eco-efficient infrastructure, thereby creating growth and employment while avoiding being locked into energy- and carbon-intensive infrastructure.

Infrastructure determines energy consumption and greenhouse gas emissions. Infrastructure is one of the main determinants of resource efficiency and the carbon intensity of economic growth patterns. Buildings, for example, are responsible for 30 per cent of the global annual greenhouse gas emissions and consume up to 40 per cent of all energy;[74] the transport sector accounts for 23 per cent of global energy-related CO_2 emissions, and it is the fastest growing source of emissions in developing countries.[75]

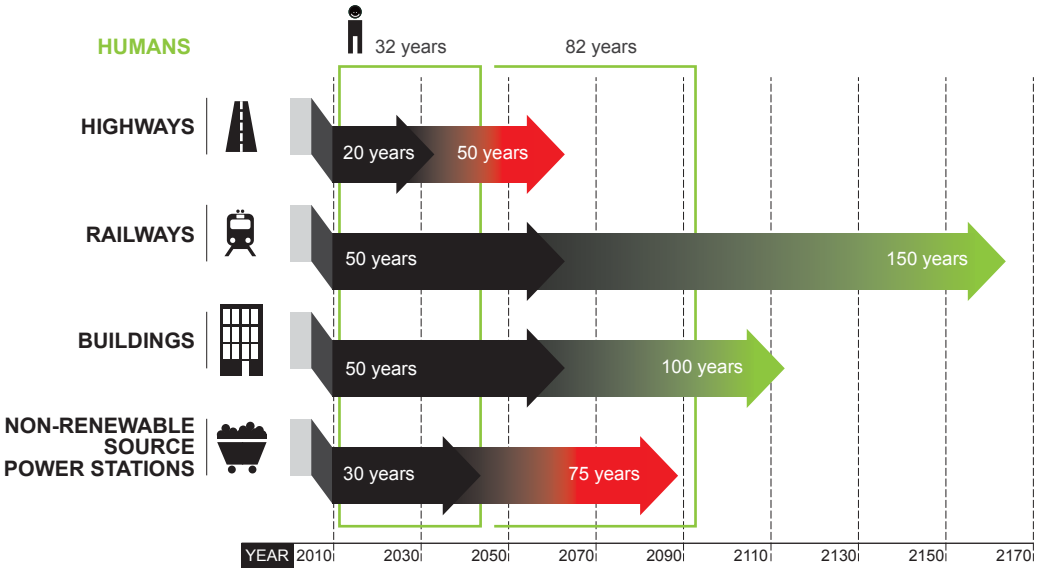
Urban planning and design greatly influences energy consumption and greenhouse gas emissions. Designing cities for cars leads to urban sprawl and car-dependent development and thus higher energy consumption and greenhouse gas emissions. Building the city around public transport networks can help reduce energy consumption and greenhouse gas emissions and creates a more inclusive transportation system. Japan's urban areas are about five time denser than, say, Canada's, and the use of energy per capita in Japan is around 40 per cent that of Canada's.[76]

Infrastructure also affects the quality of growth and liveability. Higher energy consumption, for example, has a negative impact on energy security and economic competitiveness. Most countries in the Asia-Pacific region are net energy importers – relying on fossil fuels – and they stand to be hardest hit by oil price increases and volatility. Infrastructure is also associated with large externalities; unsustainable choices can translate into very high socio-economic costs. Most Asian cities already suffer from severe traffic congestion, which costs them up to 10 per cent of their annual GDP and is one of the main factors reducing their competitiveness. Social costs related to traffic accidents and public health can be equally high. In the Republic of Korea, for example, the social costs of road accidents amounted to about 1.1 per cent of GDP in 2009,[77] while in Beijing the social costs of motorized transportation are as high as an estimated 15 per cent of the city's GDP.[78]

Infrastructure should be designed thinking 30–50 years ahead. Because infrastructure has a long lifespan, as figure 18 illustrates, policymakers and planners should think at least 30–50 years ahead and consider the socio-economic needs and trends, such as population growth, urbanization and development goals, as well as environmental factors, such as projected climate change impacts or water resource availability. In particular, infrastructure development has to think about urbanization trends in the region. The proportion of people living in urban areas has been steadily increasing over the past few decades and is projected to continue expanding. In 2030, some 2.6 billion people will live in cities and towns across the Asia-Pacific region.[79] This is equivalent to adding an entire new city of 3.5 million people, approximately the size of Melbourne, every month for the next 20 years.

Investments in the next five to ten years are critical. Infrastructure investment requirements in the Asia-Pacific region for the next ten years are estimated to be between US$8 trillion[80] and US$10[81] trillion. Such investments will lock Asian and Pacific economies into patterns of energy use and greenhouse gas emissions for decades to come. Transport infrastructure investments in the next five to

Figure 18: Lifespan of selected infrastructure



Source: United Nations Economic and Social Commission for Asia and the Pacific, adapted from World Wildlife Fund, Zoological Society of London and Global Footprint Network, Living Planet Report 2006 (Gland, Switzerland, 2006).

ten years will lock in transport-related CO_2 emission patterns for the coming 20–30 years.[82] If business-as-usual practices continue, greenhouse gas emissions from buildings will more than double in the next 20 years.[83] Choices made today will determine the prospects of competitiveness, quality of life and environmental sustainability of countries in the region for years to come. Developing countries in the Asia-Pacific region have a unique but quickly closing window of opportunity to invest in eco-efficient infrastructure.

Failure to integrate eco-efficiency concepts into infrastructure development now will result in growing externalities and a persistent or growing number of people without access to basic services. Whereas currently those who lack access to basic services live mainly in rural areas, the situation could expand across urban areas, given the rapid urbanization occurring in the region; special attention is required in the planning and development of cities and towns, which become centres for economic growth but also poverty and environmental problems.

Promoting eco-efficient infrastructure includes retrofitting the old. Retrofitting old infrastructure, such as old buildings and transport systems, could create considerable investment opportunities and jobs because it is more labour intensive.

Obstacles

One of the main obstacles to developing eco-efficient infrastructure is the different and often contrasting incentives of landowners, developers, financiers, operators and users for whom eco-efficiency may not be an important objective.

Gap between collective and individual benefits

Although infrastructure is built for the public, there is a gap between individual and social gains and costs. In particular, there is a gap between the gains from building eco-efficient infrastructure options, such as energy savings from public transport, and the individual preference for the comfort

of driving a private car. Driving private vehicles produces many negative impacts on society as a whole, such as air pollution, congestion or safety hazards; but it provides benefit to the individual users who lack incentive to stop driving. Thus eco-efficient infrastructure options are not expected to be favoured and supported by the public as a whole.

Gap between builders and users

Introducing eco-efficiency criteria into the design and construction of infrastructure would save considerable expense during operation. But these benefits are accrued to the users, while developers, who depend on being able to propose competitive prices to ensure that their services are retained, can find it difficult to justify shouldering the added cost of eco-efficient technologies. This gap is clearly manifested in the case of green buildings.

Time and price gaps in choosing eco-efficient infrastructure options

In most cases, the gains from eco-efficient infrastructure choices appear over time. Because the market prices of energy and resources used in buildings and infrastructure remain low without the internalizing of the social and ecological costs, the long-term benefits of eco-efficient infrastructure may be considered not enough to justify the upfront costs and eco-efficient infrastructure may appear to lack commercial viability.

Strategies for change

Government policy intervention is essential for closing the gaps and for making eco-efficient infrastructure choices.

Driving change: Leadership and political commitment

Political commitment and leadership are essential for moving beyond ad hoc decision-making and sector-specific policies, allowing governments to respond to challenges and creating opportunities for the long term. Eco-efficient infrastructure approaches can deliver win-win situations. Politicians who take the lead may encounter initial resistance from those who doubt the benefits or fear they will be worse off. Strong leadership and determination from political leaders, at all levels of government, are required to push the eco-efficient infrastructure agenda forward. Controlling private cars, for example, is not a popular policy, but it is necessary. Long-term political commitment is also necessary to effectively engage the private sector.

Making unpopular decisions for the long-term benefit requires courage. But it can be rewarding as well. Experiences such as in Seoul in the early 2000s (box 4) demonstrate that in spite of initial resistance, eco-efficient infrastructure projects can be very successful, not only in terms of positive environmental outcomes but also in increasing the popularity of the politician pushing the agenda.

Bridging the gap: Long-term vision and transition management

Only governments can bridge the time gap between short-term costs and long-term benefits of eco-efficient infrastructure. This can be done though a vision and proper planning. A shared long-term vision based on eco-efficiency will help prioritize policies and projects that provide long-term solutions. It will also bring together and motivate civil society, businesses and bureaucrats around a common purpose and thereby reduce public resistance.

BOX 4: From a visionary mayor of Seoul to president of the Republic of Korea

Before becoming president of the Republic of Korea, Lee Myung-bak took office as mayor of Seoul in 2002. Two decisions taken to balance environmental imperatives with the development needs of the city were turning points in catapulting him to the presidency: In 2003, the then Mayor Lee pushed first to restore the Cheonggyecheon waterway and then to reform Seoul's public transportation system. Local businesspeople and the general public were volubly against it – at first. Mayor Lee persisted. A controversial decision was made to rethink the expressway that covered the nearly dried up historic Cheonggyecheon stream. In the end, it was torn down, making a way for a public space thoroughfare and restoration of the 5.8 kilometers waterway.

The Cheonggyecheon project initially encountered strong resistance from thousands of shop owners. But a well-managed negotiation process ensued between the government and merchants. The Seoul Development Institute buffeted the talks with evidence from studies that projected the restoration would create 300,000 jobs in construction, real estate and retail industries. In terms of environmental benefits, the waterway would help cool areas overheated by sun-baked asphalt and nourish the green areas that attract wildlife as well as pedestrians. An impact evaluation later showed that ecosystems along the Cheonggyecheon had been greatly enriched. The waterway has become a major tourist attraction, drawing more than 10 million visitors in the first year it opened. Nowadays, the 90,000 people who daily visit the Cheonggyecheon's banks have revitalized the nearby shops and restaurants.

Source: United Nations Economic and Social Commission for Asia and the Pacific, United Nations Economic Commission for Latin America and the Caribbean, United Nations Human Settlements Programme and Urban Design Lab, The Earth Institute, Columbia University, *Are We Building Competitive and Liveable Cities: Guidelines on Developing Eco-Efficient and Sustainable Urban Infrastructure in Asia and Latin America* (Bangkok, 2011).

At the same time, there is a need to shift from current planning practices, led by short-term goals and one planning period after the other, to the adoption of "transition management", with short- term goals linked to long-term goals that are driven by a strong vision. This approach breaks down ambitious long-term projects into deliverables that are workable over a short-term political cycle.

Building the business case: Leveraging financing

Governments need to build the business case for eco-efficient infrastructure. The private sector can be the main driver for the development, but it won't ignite as long as business-as-usual practices are more profitable than eco-efficient operations.

Governments need to tilt the balance in favour of sustainable practices and channel private sector investment into eco-efficient infrastructure projects. This would include wisely using public funding and assets, properly valuing natural resources, internalizing environmental costs, removing harmful subsidies and shifting taxes from labour and production to resource use and pollution, among other policies. As previously highlighted, environmental tax and fiscal

BOX 5: Public-private partnership: Potential and limitations

Public-private partnership (PPP) is a means to leverage private investment by offering a long-term business opportunity in building and operating infrastructure. In a PPP, the private sector invests in infrastructure development and provides related services to the government. There are many forms of PPPs, from build-operate-transfer (BOT) to concessions or joint ventures. PPPs typically entail a combination of responsibilities (such as design, construction and maintenance); whereas traditional tendering is usually for proving only one of these responsibilities. PPPs are governed by long-term contracts that involve only one contractor (such as a consortium with subcontractors and shareholders) and the infrastructure usually remains the property of the public entity. PPP can be applied to large infrastructure projects, such as rail, roads, ports, airports, urban development projects or power plants, to medium-scale projects, such as hospitals, buildings, urban renewal projects, or to services, such as energy, water, telecommunications or mass transit.

Risks and controversies: Although PPPs can increase the efficiency of service delivery, engaging the private sector to deliver public services is a tricky business. Depending on the design of the PPP, there could be a downside to engaging the private sector in the delivery of public services. The risk with PPPs is that the contract may end up being too favourable to private investors, allowing them to obtain a high rate of return while leaving the cost burden on the public sector, and/or that the venture fails to deliver the expected benefits to society. It may result in increased prices (beyond the reach of the poor) or decreased coverage. Particular controversy has been generated by the privatization of the water supply. It is critical that the public sector correctly evaluates the worthiness of a PPP and negotiates favourable contractual arrangements with the private counterparts. Governments should have dedicated PPP units (usually within the finance ministry) that can act as a knowledge hub to support PPP development. Additionally, it is critical that a comprehensive legal framework governing PPPs is in place.

reforms can be powerful mechanisms to galvanize investment in eco-efficient infrastructure.

In cases in which projects are expected to have low commercial viability, public financing is required to fill the gap. It is crucial that governments retain the responsibility of providing certain core services. Public-private partnership schemes (PPP) can be useful for leveraging private financing for infrastructure development projects and to tap into the private sectors' expertise and entrepreneurship. But such schemes need to be carefully designed and supported by an appropriate national regulatory framework in order to be effective (box 5).

Eco-efficient infrastructure options can generate considerable savings in the medium and long terms. These savings then can be invested in other sustainable infrastructure projects or to advance pressing socio-economic priorities, such as poverty reduction, health or education, which increases the political feasibility of eco-efficient infrastructure.

BOX 6: India's Jawaharlal Nehru National Urban Renewal Mission

The Jawaharlal Nehru National Urban Renewal Mission is a comprehensive urban modernizing scheme launched by the Indian Government in 2005 under the Ministry of Urban Development, with an estimated investment of US$20 billion over seven years. The Mission consists of two sub-missions: i) Sub-mission for urban infrastructure and governance, and ii) Sub-mission for basic services for the urban poor. The Mission's objectives include an integrated development of infrastructure in cities, adequate funds to meet deficiencies in urban infrastructure, planned development of specific urban areas to disperse urbanization and the provision of basic services to the poor.

To access funding, cities need a city development plan that encapsulates projects and detailed project reports. Project planning should minimize the life-cycle costs. The funds for projects are provided to local entities as soft loans, grant-cum-loans or grants and are intended to leverage additional funds from other sources, including from the private sector though a PPP. The funds may be used to enhance resource availability, commercial viability or the bankability of a project. Assistance is also provided for capacity building, preparing the city development plans and project reports and community participation. State governments and local authorities are also advised to undergo a series of reforms aimed at improving urban governance.

Source: The Republic of India, Jawaharlal Nehru National Urban Renewal Mission website accessible from: http://jnnurm.nic.in/

Considering that eco-efficient infrastructure projects, such as railways and public transport, have large positive social benefits with low commercial return and may benefit primarily lower-income groups, it is important that core public funding is allocated for such projects. Some strategic projects with low commercial return may be entirely financed through public funds. In some cases, governments may earn back such investment through value capture (taxing beneficiaries on increases in private land value generated by public investment). Even where public funds are limited, governments can use their assets (such as land) to leverage private sector financing.

Reshaping governance: Integration and coordination

Promoting eco-efficient infrastructure requires looking at infrastructure networks as a whole system, adopting a life-cycle approach and prioritizing policies with multiple returns (economic, social and environmental). This requires the integration of policies and financing mechanisms and, thus, changes in governance.

i) Vertical integration: Coordination between central and local governments

A local authority, such as the executive body for city design and planning, can directly influence urban spatial planning and development through a long-term vision, while the national government can incentivize local governments via target setting (share of public transport, green space ratio) or economic/fiscal instruments. For example, a pilot project to develop low-carbon cities initiated by the National Development and Reform Commission in China in July 2010 encouraged local governments

BOX 7: A single transport agency for an integrated solution: Singapore's Land Transport Authority

The Singapore Government, like many others, consisted of numerous public bodies with separate functions within urban transport, including the Registry of Vehicles, Mass Rapid Transit Corporation, Roads and Transportation Division of the Public Works Department and the Land Transport Division of the then Ministry of Communications. In 1995, the Land Transport Authority was developed as a statutory board under the Ministry of Transport, with the mission of "providing an efficient and cost-effective land transport system for different needs." As a result, Singapore now benefits from an integrated transport agency that executes most government functions relevant to land transport, including: policy development on land transport; planning, design, development and management of all land transport infrastructure and services; regulation of the metro, bus and taxi systems; design, building and operation of the metro; vehicle registration and licensing, including the private vehicle quota system.

Source: Land Transport Authority website www.lta.gov.sg/

to improve energy efficiency in their cities, to meet national targets set under the Twelfth Five-Year Plan. In Japan, the Act on Promotion of Global Warming Countermeasures mandated many cities to draft a climate change action plan.[84]

ii) Horizontal integration: Coordination among relevant actors

In addition to coordinating the different levels of government, an institutional arrangement among relevant institutions is critical for coordinating cross-cutting and interlinked issues among an array of functions and expertise (financing and technical). For instance, the *Abu Dhabi Urban Street Design Manual* was developed by the Abu Dhabi Urban Planning Council with assistance from the Department of Transport, the Department of Municipal Affairs, the Traffic Police and other relevant government agencies. The collaboration among those agencies and the private sector was pivotal in pulling together the required diverse expertise, such as urban planning, architecture, landscaping and civil engineering.

Leveraging public support: Public participation

While strong leadership is required to steer cities in an eco-efficient direction, public participation in planning and designing infrastructure is essential to actually move the engine of change. Public participation invokes many benefits, but there are three reasons for considering participatory approaches to urban infrastructure development: [85]

- First, the participation of all parties, including communities, can improve the quality of planning and decision-making and facilitate the execution of action. In fact, without the participation of a wide range of parties, it may not be possible to explore the available options and accomplish difficult policy choices, such as demand-management measures in a transport-development strategy.

- Second, participatory approaches to planning provide a better way of deal-

ing with cross-cutting issues. For example, meeting the basic mobility needs of the poor by promoting informal transport (rickshaws and motorbikes that link to transit systems) should be an important consideration in transport development. However, this needs to be carefully balanced against operational and environmental factors. The response requires a creative integrated plan for the whole transport system and its articulation within the overall development process. Participatory approaches provide the institutional framework for the integrated planning needed to address cross-cutting issues and conflicting development objectives.

- Third, the prime element of any infrastructure system is its users. Broad public participation can help ensure that action taken and services provided reflect the needs of people more adequately and that the benefits of development are shared more equally.

Policy options

Overcoming the challenges and realizing the opportunities will require substantial changes in the way infrastructure is planned, designed, built and operated. Such changes are not confined to new infrastructure alone but also to existing infrastructure, which will require retrofitting. While new and cleaner technologies will indeed have an important hand in improving the eco-efficiency of infrastructure, the turning-point factor will be the policies that governments adopt and the extent to which they are able to enforce them. Governments need to drive eco-efficient infrastructure – it cannot be left to the private sector alone.

Alternative policy options are available, with different degrees of eco-efficiency. This section provides a brief overview of the main action areas for low carbon green growth in the urban planning, transport, construction, energy, water and waste sectors. A comprehensive list of policy options for each sector and information on how to implement them is provided in the ensuing sections:

- **Change the way we design cities: shift to eco-city development.** The region is undergoing rapid urbanization. Urban sprawl and car-centred development are putting the liveability and sustainability of cities at risk and require an urgent shift towards eco-city development. Urban areas need to be planned and designed so as to be compact and walkable, mixing different land uses and enhancing public and green spaces. They also need to promote social inclusiveness.

- **Change the way people move: from private cars to public transport, from road to rail.** The region is experiencing rapid motorization. Car-centred transport systems lead to hidden costs, such as chronic congestion, energy consumption, carbon emissions, air pollution and traffic accidents, which add up to more than 10 per cent of a country's GDP. A shift to sustainable mobility is urgently required.

- **Change the way we design and operate buildings: from energy wasting to energy saving.** The building sector presents one of the clearest win-win opportunities for low carbon green growth. Reducing the energy consumption of buildings can greatly reduce the total energy generation needs of a country and is one of the most cost-effective ways of reducing greenhouse gas emissions. Existing buildings need to be retrofitted to substantially improve their energy efficiency and new building design needs to be based on green building standards.

- **Change the way we produce, transport and consume energy: improve the efficiency of the energy system and diversify to renewable energy sources.** Given that a huge portion of the environmental problems we are experiencing derive from our dependence on fossil fuels as the dominant energy source, energy systems are integral in any low carbon green growth strategy. Countries in the Asia-Pacific region need to meet growing energy demand in support of rapid economic growth and extend access to electricity to the millions still without it while avoiding being locked into unsustainable energy systems. This will require increasing the share of energy generated from renewable sources and promoting decentralized and hybrid generation; but it also will require improving the efficiency of energy generation and transmission from conventional sources. Any energy policy, however, should start with energy efficiency and conservation.

- **Change the way water resources are managed: develop an integrated and decentralized system.** The current centralized approach to water resource management, which entails piping in water from reservoirs to end users and piping out water from end users to central treatment facilities, leads to high inefficiencies. Water infrastructure needs to emphasize water-sensitive and low-impact development, based on decentralized water resource management and rainwater management. If properly managed, a decentralized water resource management system can secure water resources, prevent urban flooding and restore the ecosystem.

- **Change the way solid waste is managed: turn waste from a cost into a resource.** As prices for raw materials rise, the recovery of resources from waste will be crucial. Municipalities spend significant portions of their operating budgets on waste collection; reducing the volume or weight of the waste can save on operating costs, and recovering recyclable materials can generate revenues from their resale. The policy focus for solid waste management has to shift from disposal to the 3R approach (reduce, reuse, recycle).

Making eco-efficient infrastructure choices will also require improving the decision-making instruments. To prioritize eco-efficient solutions, there is a need to integrate the actual costs and benefits of each infrastructure option into the decision-making processes. Externalities, such as the cost of traffic congestion associated with road infrastructure, should be factored into any cost-benefit analysis.

Useful tools and mechanisms for assessing environmental impacts exist, such as the strategic environmental assessment, environmental impact assessment, life-cycle assessment or other integrated assessments; but not all adequately assess the impacts of infrastructure on resource use and they are often not used or misused. Achieving eco-efficient infrastructure requires assigning higher weight to resource efficiency in the use of these tools and mechanisms.

2.3.1 Urban planning and design

Change the way we design cities: Shift to eco-city development

The region is undergoing rapid urbanization. Urban sprawl and car-centred development are putting the liveability and sustainability of cities at risk and require an urgent shift towards eco-city development. Urban areas need to be planned and designed so as to be compact and walkable, mixing different land uses and enhancing public and green spaces. They also need to promote social inclusiveness.

Key points

Over the course of the past century, urban development patterns throughout the world have become increasingly fossil-fuel dependent and unsustainable, both socially and environmentally. Development worldwide has evolved into a cycle of sprawl reinforced in many countries by expanding highways and road capacity to support a car-based transport system. This cycle has created vast suburban regions and urban environments characterized by traffic congestion and a lack of cohesion or community. These practices have failed to establish cities, towns and neighbourhoods capable of sustaining themselves without a damaging dependence on automobiles, freeway systems and fossil fuels – the brown growth. The lack of serious strategic planning, with little consideration given to sustainable development, has resulted in a pattern of land use with negative impacts on environmental quality and social equity.

Today, cities in the Asia-Pacific region face the challenge of escaping the trap of unsustainable urban forms. Many large cities are already suffering from inefficient, sprawling development and the negative environmental and economic consequences.

The region is undergoing very rapid urbanization. The majority of the world's population has been living in urban areas since 2009. This transition is expected to happen in the region in 2025; currently, about 43 per cent of the region's population lives in urban areas and the annual urban population growth rate is 2.3 per cent. What is unique about urbanization in the Asia-Pacific region is its scale and pace – by 2025, the population is expected to be 2.3 billion, an increase of about 700 million people in 15 years.[86]

A unique feature of urban growth in the region is the growth of mega-cities, or cities with a population of more than 10 million. Twelve of the 21 mega-cities in the world

are in the Asia-Pacific region, including six of the world's ten largest cities.[87] These mega-cities are often surrounded by extended urban regions that transcend metropolitan administrative boundaries. Yet, 60 per cent of the urban population of the region lives in cities of a million people or less. Problems and challenges confronting those cities and towns often receive less attention than those of the mega-cities because the bigger urban centres have much greater political capital than secondary cities and small towns.

A very visible aspect of urban poverty in cities in the region is the proliferation of slums and squatter settlements. Around 30–35 per cent of the region's urban population lives in slums and squatter settlements.[88] Land in urban areas is under pressure as a result of economic growth and population increase. High demand for land by private companies for offices or production centres raises the market price. Employment of the poor is concentrated in places with intensive economic activities, but land in such locations is beyond their reach, if housing is at all allowed in those areas.

Cities have a critical role in the fundamental transformation towards a green economy. In Asia, more than 80 per cent of the region's GDP is produced in cities and towns;[89] Bangkok alone accounts for 38 per cent of Thailand's GDP.[90] At the same time, cities have huge ecological footprints: cities occupy 3 per cent of the Earth's land surface, but use 75 per cent of the resources and account for approximately 70 per cent of the CO_2 emissions.[91]

Addressing the resource and climate challenges requires changing the way we plan and design cities by focusing on eco-efficiency and by promoting the development of eco-cities. Several principles and ideas can be associated with **eco-cities** (box 8), but three strategies are highlighted here: i) shifting from urban sprawl to compact city, ii) promoting liveability and iii) promoting inclusive urban development.

Shifting from urban sprawl to compact city

Developing cities in a compact manner makes both economic and ecological sense. Compact cities with a variety of mass transit options and mixed use can save energy in the transport sector. By limiting the sprawl, costly investment in new infrastructure in suburban areas can be avoided. In addition, given the economies of scale, such utilities as water and electricity can be produced and delivered more efficiently in denser urban areas.

BOX 8: Eco-cities

Eco-cities are human settlements that have a healthy relationship with the surrounding ecosystem, without putting undue pressure on its carrying capacity (without consuming more resources that it produces and without producing more waste than it can assimilate). The roots of the eco-city concept hail from urban ecology, which took shape in the 1970s. Since then, many principles and ideas for developing eco-cities have been proposed, including restoring urban environments, supporting local agriculture, promoting sustainable mobility and developing vibrant communities.

Source: Ecocity Builders website, www.ecocitybuilders.org

Cities can be designed compactly so as to reduce the need for motorized transport by concentrating and mixing office, residential and commercial areas and by making the streets well-connected and walkable. In addition, demands for mobility for longer distances should be catered for through a mass transit network by integrating transport and land use planning.[92]

Private car use can be constrained by limiting parking space in downtown areas together with pricing measures. Policy mechanisms, such as congestion charging, alone cannot go very far in managing traffic because they are reactive to a situation – not preventive. Thus, limiting the private car use should be backed up by urban planning and design measures promoting accessibility and mobility in connection with mass transit.

Promoting liveability through walkability and car-free development

Compact city urban planning and smart design can also increase the liveability of cites. Some planning measures, such as those aimed at promoting walkability and preserving green areas not only improve environmental sustainability but also directly affect liveability.

Cities can provide a more favourable environment for pedestrians via walkable streets and car-free development. Streets need to be designed for pedestrians – not for cars. They need improved safety for pedestrians and to provide easy access to the major centres of diverse functions, including green areas. Other forms of non-motorized transport, such as cycling, should also be promoted, by providing cycling lanes and bicycle parking facilities at strategic locations, including public transport stations.

In addition, wetlands, parks, forests and waterways can be conserved and turned into places of leisure with various purposes, including reducing the heat island effect or the potential for flooding. For instance, increased permeable natural areas can capture run-off water, acting as storm water management. In the case of Garland, Texas, tree canopies in the city saved up to US$38 million by avoiding the construction of artificial infrastructure for storm water retention.[93]

Promoting inclusive urban development

On average, urban residents have better living conditions than rural populations. Disaggregated data shows, however, that large numbers of people in Asian and Pacific cities, in particular those living and working in the informal sector, are in poor health due to income poverty, a poor diet, cramped and unhygienic living conditions, unsafe working conditions, polluted air, the use of contaminated water and inadequate sanitation facilities.

There are certain interventions governments can do to improve housing conditions and reduce slums in cities and towns. Policymakers can form, adopt and enforce slum-upgrading policies and mainstream them into the national development policy. As part of their planning process, policymakers can infuse a range of slum-upgrading and innovative options, including tenure security and access to financing. Additionally, major land policy reforms are needed for urban land use, with designated restrictions to certain areas as public goods that are reserved for the urban poor.

Most transport systems in Asian and Pacific cities currently do not take account of the specific needs of the poor. Because many transport services in the region have been

privatized, transport fees need to recover costs rather than to ensure that low-income people can move from one place to another.

Because environmental degradation and poverty are interrelated, there is scope for synergies and win-win solutions. Starting from urban planning and design, for example, a city that is developed for the people and not for private cars and that mixes land uses as well as high- and low-income housing will benefit both inhabitants (especially the poor) and the environment. The poor cannot afford cars and have to rely on (mostly) non-motorized or informal transport options for their commuting; they are forced to live in slums to be close to their source of livelihood. Prioritizing non-motorized transport, affordable public transport and allowing low-income residents to live close to high-income residents can provide livelihood opportunities and definitely benefit the poor.

Win-win solutions exist in all sectors. Water and sanitation and energy are two important sectors. Lack of access to safe water, adequate sanitation and clean energy are among the contributing factors to poverty; people who are poor are affected by the negative health effects stemming from their lack of those services and because they have to rely on informal supplies and thus end up paying more for the services.

Low carbon green growth policies for eco-city development can and should advance the inclusive urban development agenda.

Policy options

A master plan for eco-city development should be based upon the following development concepts, design and planning measures.

Table 5: Policy options for urban planning and design

Policy option	Measures	Supplementary measures
Make cities compact	• Promote infill & brownfill development • Promote vertical development • Institute density standards citywide • Promote cluster development	• Improve access to mass transit use • Discourage private vehicle use • Promote cellular development • Promote walkability • Set urban growth boundaries to limit urban sprawl
Cellular development	• Institute mixed-use zoning • Institute development permits: regulate the location, size and use of buildings for new construction, renovation and business	• Improve access to mass transit use • Discourage private vehicle use • Provide access to social services (quality education, recreation, affordable housing)
Slum upgrading	• Facilitate land sharing • Support incremental infrastructure development • Provide community mortgages	• Provide secure land tenure • Develop partnership with various stakeholders

Integrated land use and transport planning	• Develop an integrated transport and land master plan • Develop mass transit-oriented policies • Promote density along a mass transit corridor	• Institute demand-side management (congestion charges, parking management, etc.)
Promote walkability	• Promote pedestrian-friendly streets • Promote car-free development	• Improve access to mass transit • Discourage private vehicle use • Encourage compact development • Preserve open and green spaces
Manage parking	• Limit parking spaces in city centres • Integrate parking with mass transit • Integrate parking with mixed use	• Increase shared parking • Increase parking fees
Preserve open and green spaces	• Require green zoning • Require urban agriculture • Require green roofs • Turn the natural capital into social amenity (parks, lakes, etc.)	• Promote walkable neighbourhoods • Promote social-economic activities centring on open and green spaces (ecotourism)

Compact development: Increase the urban density via strategic planning

Compact development is essential for implementing smart growth and sustainable planning strategies. It allows cities to accommodate rapidly increasing populations in limited urban areas, without hampering liveability. Compact development increases land use efficiency while promoting walkability and reducing the need for private cars. It includes a variety of strategies, including promoting urban density over decentralization, protecting open spaces, mixing land uses, integrating downtowns and central business districts with a high proportion of residential uses rather than strictly commercial spaces and promoting public transit over automobile use. For instance, the Bangkok Metropolitan Administration announced in 2010 plans to redevelop a 740 square kilometre informal settlement within the city, including residential compact development incorporated with green space.[94] Compact development should be coupled with such infrastructure as affordable housing, streets, public transportation and a utilities system sufficient to serve the daily requirements of people.

Cellular development: Mixed land use development for greater accessibility

Cellular development places houses, offices, retail shops, schools and entertainment centres close together. Separating the places where people live, work and shop via

zoning has resulted in long-distance commuting and the increased number of trips via private vehicles. By reversing the trend in a way that enables different types of uses to locate within a proximate area, people can easily access various needs on a daily basis. In addition, traffic congestion and the amount of fossil fuel consumed on the road can be significantly reduced due to minimized trips. This concept can be applied in both macro and micro development planning. On a large scale, it is important to link the central points to the mass transit. Existing areas can be retrofitted, while new development can supplement the existing core. For example, Kuala Lumpur Sentral is an exclusive urban centre built around Malaysia's largest transit hub. The 72-acre development is designed to be a "city within a city", including numerous office towers, hotels, condominiums and a shopping mall.[95] At the micro level, mixed-use towns and districts can enhance the liveability of people by connecting them via walkable streets.

To promote cellular development, zoning policies prohibiting non-residential uses in residential areas, observed in many countries, need to be relaxed.

Improved housing for the urban poor through slum upgrading

One innovative way in which housing conditions of the urban poor can be significantly improved is through citywide slum upgrading initiatives, which have gained momentum and are spreading to many developing countries in the region. The methodology for upgrading an entire community involves participation of slum dwellers in savings groups, surveying, planning, and collaborating with city authorities to make affordable, available and large-scale citywide slum upgrading possible. There are, however, challenges that must be overcome, such as withstanding urbanization pressures, achieving the critical mass and possessing technical capacity. The slum occupants must also have strong local government support, active participation by each community member, partnerships with different interest groups and a guarantee of land tenure. In Thailand, strong support from the central and local governments have been provided across different cities and townships for successfully completing slum upgrades for more than 90,000 households through the Baan Mankong Programme over the past nine years.

Figure 19: Cellular development

Image courtesy Timothy Haahs & Associates, Inc.

Integrated land use and transport planning: Promote convenient access to mass transit

Cities should integrate transportation and land use planning in a way that promotes public transport while controlling private car use. At the planning and design stage, the routes of various public transport modes can be coordinated to maximize the coverage as well as to fully use the strength of each mode. For instance, rail-based transport can be operated to connect major routes across the city while buses are supplemented for areas that are not accessible by railways. Promoting density along mass transit corridors can be critical for the success of the operation of public transport because it increases the commercial viability thanks to increased ridership. The city government of Tokyo, for instance, delegated the right to develop some metro lines to private companies, leading to commercial and residential projects along the newly established railway corridors.

In addition, city planners can encourage convenient access to mass transit in densely populated areas, such as city centres and business districts, by promoting walkable streets and incorporating parking and cycling facilities into public transit stations.

Parking management: Discourage private vehicle use

If managed properly, parking measures can discourage private car use. Parking space in city centres can be restricted, and districts can be designed to be walkable. The effect will be amplified when coupled with increased parking fees. Vast areas can be freed up by reducing parking space and redeveloped to serve other purposes.

BOX 9: Turning parking space into mixed use in Annapolis, Maryland (USA)

Maryland's Annapolis town centre is a model of redevelopment to increase density while reducing traffic congestion, encouraging walkability and creating more attractive and vibrant communities. The area used to be an expansive surface parking lot with no access to mass transit, resulting in increased vehicle trips from outside the town. The refurbishment project was planned in accordance with the nearby land use, including 350 apartments and condominiums, numerous restaurants, grocery stores and retail shops. Instead of large-scale on-site street parking, which induced inefficient land use, two new parking structures were constructed. The freed-up land was turned into various public places, such as plazas and outdoor cafes, encouraging more street-level vibrancy and economic vitality. By integrating residential properties with substantial mixed use, the Annapolis town centre reduced the need and incentive for residents to drive to other areas for shopping and dining. Along with the redevelopment, local buses embarked on service connecting the town centre to other locations in the region, providing more convenient access to the centre as well as reducing the private vehicle trips.

Source: Timothy Haahs and others, Urban Planning and Design: Policy Recommendations for the Development of Eco-Efficient Infrastructure, Policy paper (Bangkok, United Nations Economic and Social Commission for Asia and the Pacific, 2012).

Instead, parking space can be located in a way that supports mass transit. For instance, many local governments have developed parking facilities for bicycle and cars in connection with mass transit to make the use of public transport more convenient.

Promote walkability: Design streets for pedestrians, not for cars

Cities should be planned and designed to encourage people to walk more rather than using private vehicles. Infrastructure and urban spatial form designed for cars have moved pedestrians away from streets. Pedestrian-friendly streets can be promoted by improving safety, installing clear and direct signage and widening them for people's use. Designing car-free city centres, for example, in central shopping and business districts can be an effective instrument to make cities walkable and to increase land values and profits of nearby businesses.

Preserve open and green spaces: Enhance the quality of life and attractiveness of the city

Preserving green and open spaces greatly enhances the liveability, as well as the attractiveness, of a city. Urban green and open spaces can take a variety of forms, including parks, playgrounds, walkable squares, plazas and natural surroundings, such as wetlands, forests and waterways. Building rooftops can serve as urban green spaces where land available for parks is scarce. Maintaining green areas is vital to cities; they balance out the adverse impacts resulting from human activities, such as air pollution and the heat island effect, as well as climate-related disasters, such as floods. Parks and plazas with attractive landscaping significantly improve the appearance of an urban neighbourhood, serving as gathering places with increased vitality.

BOX 10: Abu Dhabi's urban street manual

Abu Dhabi struggled with staggering traffic congestion and resulting pollution due to the public's reliance on automobiles. The Abu Dhabi Urban Planning Council created the *Abu Dhabi Urban Street Design Manual* to guide designers in creating walkable streets and pedestrian-friendly environments. Sidewalks are required to be designed, placed and sized appropriately for their surroundings. For example, retail corridors must include wider sidewalks with more shade, buffers from traffic lanes and sidewalk cafes and tree linings. Similarly, low-density residential streets must be designed for slow traffic speeds and incorporate safe pedestrian connections to encourage walkability. In addition, street networks are to be designed to increase accessibility to every person. Unobstructed pedestrian walkways are required, and the proper placement of street lights, traffic sign poles, utility boxes, benches and plantings are now mandatory for new or redesigned streets. The manual applies to all streets in the city, including those parts scheduled for urbanization by 2030 as well as streets to be retrofitted. The first application of the manual is underway with a redesign of Khalifa Street in the Abu Dhabi City Centre.

Source: United Arab Emirates, Abu Dhabi Urban Street Design Manual (Abu Dhabi, Abu Dhabi Urban Planning Council, 2009). Available from www.upc.gov.ae/template/upc/pdf/Street%20Design%20Manual%20English%20(small)%20FINAL.pdf

BOX 11: Waterways as a means to improving the quality of life for people and the attractiveness of a city

Singapore's Active, Beautiful and Clean (ABC) Waters Programme shows a remarkable re-orienting of policy and thinking. Moving away from a historically grounded engineering approach that regards infrastructure resources as economic goods, the city-state now embraces many of the principles of eco-efficiency by looking at water as a means to improve the quality of life of Singaporeans and the attractiveness of the city as a whole. Water infrastructure management has been integrated as part of the planning and design of the city so that local communities can enjoy the waterways as engaging features in their urban landscape. The ABC Waters Programme recognizes that waterways and reservoirs can do more than just meet the city's water needs. They can provide recreational opportunities (water sports or resting), a venue for cultural events (festivals, performances) or tranquillity for relaxation and community bonding. They also provide indirect economic value in terms of employment (in landscaping or events management), competitiveness (such as attractiveness to foreign direct investment and tourism) and enhanced property values. In 2009, ABC water design guidelines were issued to provide reference to developers and industry professionals on how to integrate environmentally sustainable green features or ABC Waters features in their developments.

Source: Lai Choo Malone Lee, "Active, Beautiful and Clean" Waters Programme in Singapore, Case study prepared for the Project of Eco-Efficient and Sustainable Urban Infrastructure Development in Asia and Latin America (Bangkok, 2009).

POLICY PAPER

- ***Urban Planning and Design: Policy Recommendations for the Development of Eco-Efficient Infrastructure***

FACT SHEETS

- Cellular development
- Citywide slum upgrading
- Compact development
- Eco-city
- Integrated land use and transport planning
- Preservation of open and green spaces
- Walkability

CASE STUDIES

- Australia's water sensitive urban design
- China's low-carbon city project
- Curitiba, Brazil's transport and zoning policies
- Yokohama, Japan's eco-city initiative


BTS








electric drive










2.3.2 Eco-efficient transport system

Change the way people move: From private cars to public transport, from road to rail

The region is experiencing rapid motorization. Car-centred transport systems leads to hidden costs, such as chronic congestion, energy consumption, carbon emissions, air pollution and traffic accidents, which can add up to more than 10 per cent of a country's GDP. A shift to sustainable mobility is urgently required.

Key points

Transport is a glaring example of the gap between social and individual preferences. Public transport can provide a considerable social benefit, but individuals prefer the comfort of driving private cars. There has to be a clear direction to improve the contribution of transport infrastructure in enhancing the eco-efficiency of the economy.

The road is not free; dependency on private vehicles translates into huge hidden costs. The current trend of urban development, based on the private car, generates many economic, social and economic costs through chronic congestion, energy consumption, carbon emissions, air pollution and traffic accidents. These costs add up in some circumstances to more than 10 per cent of a country's GDP. Nevertheless, many countries and cities across the Asia-Pacific region continue to focus their investments on costly road infrastructure, such as urban highways, ring roads and flyovers. These are, in most cases, provided free of charge at the point of use to the general public, resulting in their overuse, as witnessed in the chronically congested roads of the majority of cities across the region.

The transport sector is the fastest-growing sources of CO_2 emissions in developing countries. Transport currently consumes more than 50 per cent of the world's liquid fossil fuels.[96] This translates into around a quarter of global energy-related CO_2 emissions generated.[97] Land transport accounts for roughly 73 per cent of the sector's total CO_2 emissions. Emissions are projected to increase by 1.7 per cent per annum between 2004 and 2030.[98] More than 80 per cent of the predicted growth is expected to be in the road transport sector in developing countries.[99]

Increasing vehicle ownership, decreasing share of public transport: A trend to reverse. In light of the growing demand for mobility, absolute numbers of both private and public transport users are increasing in the region. However, in terms of the overall modal share, use of public transport and non-motorized transport is decreasing while motorized forms of transport are increasing.[100] The number of motorized vehicles is rapidly expanding, especially in the region's middle-income countries, such as Indonesia, Malaysia, Philippines and Thailand. For example, in Jakarta, the number of motorized vehicles has grown at a pace of roughly 9.5 per cent per annum for the past five years, reaching roughly 5.5 million vehicles.[101]

Although the absolute number of vehicles per unit of population in this region is relatively low compared with the industrialized countries, without timely intervention, developing countries may lose the window of opportunity to avoid being locked into an unsustainable transportation system that is based on private car use. For instance, in China, the level of car ownership grew from 15 to 22 vehicles per 1,000 people between 2005 and 2007.[102] With the business-as-usual scenario, the total number of vehicles in China and India is expected to match or surpass those in North America or Europe by 2035.[103]

From vicious cycle of private cars to virtuous cycle of public transport

Development towards the road-based transport system, coupled with inadequate investment in public transport, leads to the decreased modal share of public transport and, in turn, lowers the financial viability of public transport. As a result, less revenue is channelled into further investment for upgrading services, maintenance and operation of public transport, making it more unattractive.

The vicious cycle centring on the private car-oriented system is not inevitable. Mobility patterns can be shaped in the early stage of development to a large extent by government commitment and long-term planning. This is illustrated by experiences in Singapore, Hong Kong (China) and cities in Japan, which have managed to grow in a compact way and limit congestion by integrating land use and transport planning early on. **Singapore** started introducing measures to control the ownership and use of private cars as early as the 1970s.

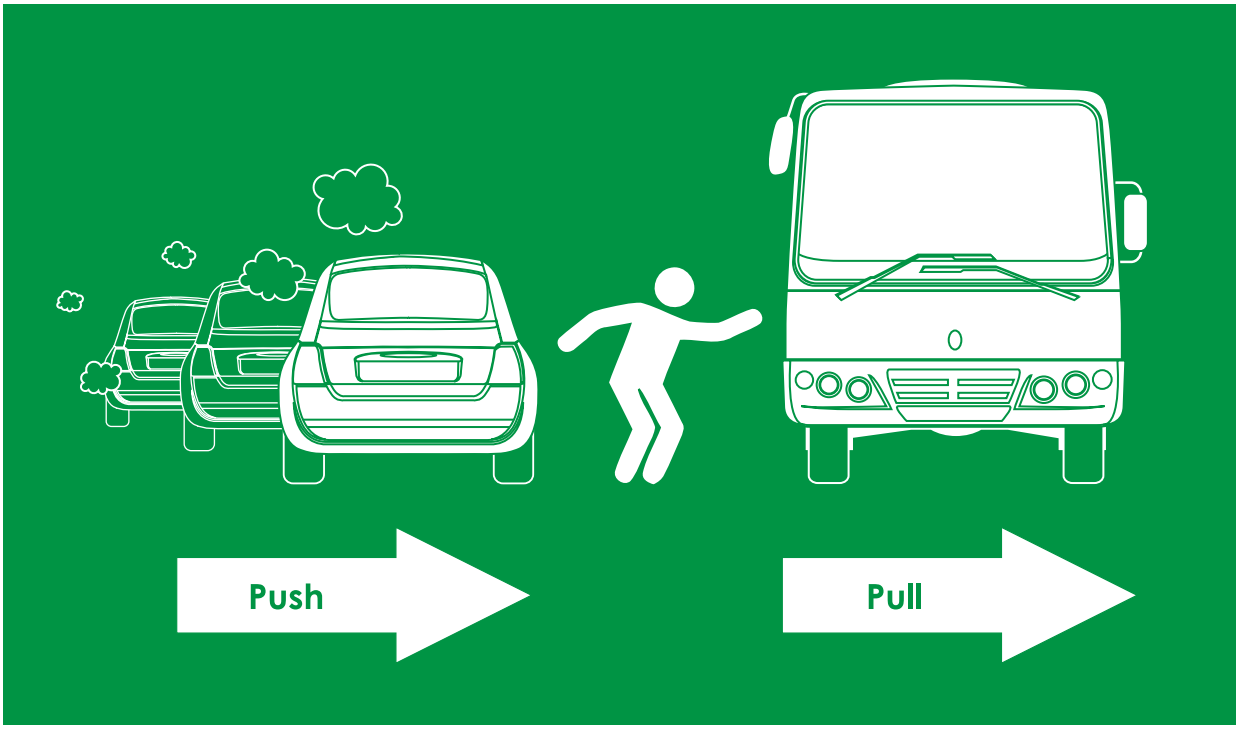
The mobility demand can be met in a sustainable way through public transport and non-motorized transport via integrated transport and land use planning while controlling private vehicle use. Instead of building more roads, limited road space can be used to prioritize public transport, cycling and walking by allocating exclusive bus lanes and expanding the width of sidewalks.

In addition, investment in rail-based transport should be prioritized both nationwide and intra- city with conditions adequate for the size of the population and the level of economic development. The quality of public transport should be highly maintained so as to compete with private cars in terms of speed, comfort and convenience.

In essence, the move towards sustainable transport requires:

- Managing and reducing the reliance on private cars (push)
- Making sustainable forms of transport, including public transport, more attractive (pull)

Figure 20: The push-and-pull approach to sustainable transport



Policy options

Transport is a sector that generates great externalities, both positive and negative, which require government intervention. There is a clear gap between individual and collective costs and benefits. Driving private vehicles creates many negative impacts to society as a whole but provides great benefit to the individual users who thus lack incentive to stop driving. Mass transport provides great societal benefits, such as decreased CO_2 emissions, decreased congestion, increased energy security and lower health care expenditures, which are not captured in narrow cost-benefit analysis of transport projects.

Public policy is required to internalize these externalities and steer transport choices towards those that maximize the collective benefit.

Shift from road to rail

Rail-based transport is safer, creates more jobs and is much more environment-friendly than expanded automobile use. A shift from road to rail can enable countries to avoid the substantial costs of traffic accidents, congestion, fuel consumption and air pollution associated with motorized transport. Given the high capital costs and long lifespan, investment in transport infrastructure should strategically consider the socio-economic changes envisioned in a few decades. Currently, however, the opposite is happening, with priority given to lower short-term investment costs and immediate gains, such as transit time savings. As a result, the investment in road infrastructure, which takes less construction time and has lower capital costs, is often favoured over rail infrastructure. Developing an eco-efficient transport system for low carbon green growth requires reversing this trend.

BOX 12: Road versus rail

Overall, railways incur higher construction costs compared with roads but carry more passengers, create more jobs and have a smaller carbon footprint per kilometre than roads.

- The capital cost per kilometre of railway is US$40 million, whereas the cost per kilometre of an urban two-lane road is US$1 million
- The people-carrying capacity per metre per hour is 3,570 passengers by elevated rail and only 500 persons per hour per metre by urban two-lane road[104]
- Railways are up to 5.5 times as fuel efficient when compared with trucks[105]
- Rail creates more jobs per kilometre than roads. The creation of 100 direct jobs in railways supports 140 indirect jobs, whereas 100 direct jobs in roads create only 48 indirect jobs.[106] Investing in public transport creates twice as many jobs than investing in roads

BOX 13: Benefits from the rail network in Japan

The benefits of the Japanese Shinkansen system of high speed rail include:

- Time savings of around 500 billion yen (approximately US$6.2 billion) every year
- Avoiding 1,800 deaths and 10,000 serious injuries every year
- Reduced annual CO_2 emissions between Tokyo and Osaka by the same amount of the total emissions from industry in and around Tokyo registered in the year 1985.

Source: Roderik A. Smith, "The Japanese Shinkansen: Catalyst for the Renaissance of Rail", Journal of Transport History (2003), vol. 24, No. 2, pp. 222-236. Available from www.manchesteruniversitypress.co.uk/uploads/docs/240222_1.pdf

Many city and country planners are revisiting their approach to infrastructure. For example, the Municipality of Seoul is moving towards demolishing elevated urban highways at as many as 19 locations. It is easy to imagine the money the city could have saved had it not built them in the first place.[107]

One of the ways to balance out the investment practice favouring road infrastructure is to reform the current project appraisal in a way that takes into account the life-cycle impacts of investment on society. If we factor externalities, such as traffic congestion costs, into transport project evaluation, then railways become more economically viable than highways.

High-speed rail brought about considerable benefits for a densely populated and oil-importing country like Japan (box 13) and has received the attention of policymakers in the region, for example in the **Republic of Korea** and more recently in China (box 14), as a viable option for national and regional connectivity.

BOX 14: Investment in high speed rail in China

China has been heavily investing in its railway system, including the development and expansion of its high speed system. Up to 2012, a total of 3.5 trillion yuan (more than US$500 billion) had been set aside for high-speed track construction and train manufacturing, over a period of five years.[108] With these investments, 13,000 kilometres of new high speed rail lines, including a line between Shanghai and Beijing, were scheduled for completion by 2012.[109] Since its opening in 2011, the high-speed rail track between Shanghai and Beijing has reduced travel time from ten hours on an express train to less than five hours.[110]

Control private car use

Given the rapid motorization taking place across the region, countries need to urgently put in place measures to control the ownership and use of private vehicles.

At the national level, policymakers should remove car-oriented fuel subsidies and introduce taxes on vehicle ownership and use. Fiscal reform can lead to the internalizing of the costs of private vehicle use. Policymakers can start with the phasing out of subsidies on cars and fuels, thereby increasing the cost of ownership and use of motorized vehicles. In addition, a tax can be levied on vehicle acquisition and ownership. Differentiated tax on vehicles, according to weight or fuel efficiency, can encourage the purchase of more eco-efficient vehicles.

At the local level, policymakers should introduce demand-side management measures. While nationwide fiscal reform can have a widespread impact in terms of coverage, fiscal reform alone is not sufficient to manage the volume of traffic in local circumstances. A portfolio of planning, regulatory and economic instruments is needed at the local level. The number of private cars can be directly controlled by **restricting license plates**. The use of private cars can be rationalized by letting car users pay for using roads via a **congestion charge** or road pricing. In addition, parking space in the city centre can be limited via land use planning.

In general, demand-side management measures can be applied with very little financial resources, with very short payback periods. In addition, economic instruments, such as congestion charges, parking fees and the auctioning of vehicle licenses, allow for the collection of additional revenue, which can be reallocated for financing public transport. A mixture of policy measures can amplify the effects, delivering multiple objectives, such as eased congestion, improved air quality and walkability. For instance, **Beijing** and **Singapore** have imposed a package of private vehicle control measures. In a broader picture, controlling private vehicle use is in line with the modal shift towards public transport. It is important to design the policy package in a way that keeps the costs for driving private cars higher than costs for using public transport. However, in the actual implementation, such a policy may encounter strong resistance from the public. Dynamic government efforts are required to secure public acceptance by showing strong political commitment and clearly communicating the envisioned benefits.

Table 6 provides an overview of demand-side management policy options for controlling the use of private vehicles.

Table 6: Selected policy options aimed at controlling private vehicle use

Policy option	Type	Aims	Responsibility	Examples
Manage parking	Planning, regulatory and economic instruments	Vehicle use	Local government	Parking policy supports travel-demand management in Seoul
Implement congestion charging or road pricing	Economic instrument	Vehicle use	Local government	Electronic road pricing in Singapore; congestion charges in London
Restrict/auction license plates for cars	Regulatory instrument	Vehicle purchase	Local government	New car licence plate auctioning in Shanghai
Tax vehicle purchase and ownership	Fiscal instrument	Vehicle purchase and use	National government	Differentiated vehicle acquisition and ownership tax for low emission vehicles in Japan
Remove fuel subsidies and tax fuel	Fiscal instrument	Vehicle use	National government	G20 and APEC nations plans to phase out support for fossil fuels
Remove car-oriented subsidies	Fiscal instrument	Vehicle purchase	National government	Higher corporate car tax in the United Kingdom for vehicles emitting greater levels of CO_2 emissions

BOX 15: Distance-based car insurance scheme

Distance-based car insurance is a relatively new concept aimed at changing the insurance premium that is based on the amount of driving that actually takes place rather than charging for a fixed annual fee. Linking the insurance premium to the kilometres driven is a financial incentive for drivers to use their cars less. Because distance-based car insurance schemes are generally a private sector-promoted scheme, government support (such as tax incentives and voluntary agreement with insurance companies) can be critical in scaling up this private sector-led practice. Distance-based or pay-as-you-drive insurance is being introduced in many countries. In the Republic of Korea, for example, a car mileage insurance scheme was introduced under the policy framework promoting green transport by the Ministry of Land, Transport and Maritime Affairs in November 2011. In Japan, the Aioi Insurance Company introduced a Pay As You Drive insurance programme in 2005. Toyota Motor Corporation provides the G-book telematics technology, which is a GPS-based tracking device with Internet and phone connection to the Aioi Insurance Company. The premium is paid by annual charge plus the amount according to distance and time of the day driven. Peak hours are more expensive than off-peak hours, and high-risk groups pay more.

Source: EMB, "Telematics in the Fast Lane?", EMB Briefing (London, 2009)

Table 7: Characteristics of various modes of public transport

Type of public transport	Characteristics				Applicability*****	
	Capacity *	Distance range**	Cost***	Payback period****	City size	Stage of development
Public bicycles	Low	Low	Low	Low	All	All
Paratransit	Low to High	Low to Medium	(Low)	Low	All	Least developed to Developing countries
Conventional buses	Low to High	Medium	(Low)	Low	All	All
BRT and trolley buses	High	Low to High	Medium	Low to Medium	Middle to Large	All
Light rail	High	Low to High	High	Medium to High	Middle to Large	Developing to Developed countries
Heavy rail and metro systems	High	Medium to High	High	High	Large	Developing to Developed countries
Taxis and demand-responsive transport	Low	Low to High	(Low)	Low	All	All
Waterborne transport systems	Low to High	Low to Medium	Low to Medium	Low to Medium	All	All

* Capacity: Low = up to 1.000 people/direction/hour, Medium = up to 10,000 people/direction/hour, High = more than 10,000 people/direction/hour

** Distance range: Low = up to 5 km, Medium = up to 20 km, High = above

*** Unit cost: Low = up to 100,000 US$/km, Medium = up to US$1 million/km, High = more than US$1 million. Figures in parentheses do not include cost of road building.

**** Payback period: Low = within 5 years, Medium = within 10 years, High = more than 10 years

***** City size: Small = up to 500,000 inhabitants, Medium = between 500,000 and 5 million, Large = more than 5 million Level of development least developed, developing, and developed countries

Promote public transport

An urban public transport system should be developed based on the context of cities, with various options of public transport: taxi, paratransit, **bus, bus rapid transit, light and heavy rail-based mass transit** and waterborne transport. Each mode has distinctive features in terms of carrying capacity, investment costs, payback period and distances to be covered (table 7). Based on an understanding of strengths and weakness of the different modes, city planners can optimize the mix of the public transport system, given their city context (population, level of development). For instance, industrialized cities with a large population can invest in high-capacity modes, such as rail-based mass transit or bus rapid transit (BRT). A small city with limited budget can prioritize the development of non-motorized transport as well as less costly modes of public transport. Regardless of the context, buses can be operated cost-effectively and easily mixed with other modes of transport.

Public transport should be able to compete with private cars in terms of comfort, affordability, convenience and speed. Public transport needs to provide good quality of service to attract people in competition with private vehicles. Features of quality public transport are as follows:

- **Connectivity:** One of the irresistible strengths of private cars is the door-to-door service. But the routes of public transport can be planned and coordinated to ensure greater connectivity to various places. For instance, socially desired routes or services, which do not necessarily generate profits, can be operated with government support. The respective routes served by different modes of public transport can be integrated to create an extensive public transport network in a way that maximizes the strengths of each mode.

- **Speed:** Public transport should provide speedy and reliable service. Traffic regulations, such as exclusive bus lanes, can be imposed together with traffic signals that prioritize public transport. Exclusive bus lanes can be enforced in both intracity and intercity areas, thereby encouraging a modal shift from private cars to public buses. In addition, express lines can be introduced between remote areas, for instance, connecting airport and city centres as well as connecting cities.

- **Affordability:** Public transport fares should be set at rates that accommodate all members of society. Conversely, the price of using private cars should be higher than that of using public transport, including the use of roads and parking. Governments can subsidize the fare for disadvantaged groups via a discounted rate.

- **Comfort:** Public transit ridership should be comfortable to passengers. Old and dangerous fleets should be regularly replaced and maintained. The operation of service can be required to meet a certain standard (safe bus driving, installation of heating and cooling equipment, cleanliness and special care for people, such as the elderly and people with disabilities, etc.).

- **Convenience:** Not only the routes but also the fare system and physical infrastructure of different modes of public transport should be coordinated to improve the convenience of the users. Stations or terminals can be designed to be accessible to all users, such as people with disabilities and the elderly, by installing elevators. Vehicles can operate frequently during commuting times to avoid heavy congestion inside the fleets and better protect the pleasantness.

There are a few policies that do not require additional upfront costs, such as the integration of a public transport network, which city planners can do right away. Additional costs for improving public transport can be recovered via increased ridership, which can help increase the financial sustainability of operations by continuously attracting more passengers.

Public transport needs to be supported and promoted as a public service. Government is critical for ensuring sufficient public transport infrastructure and a certain quality of service. Given the nature of public transport as a public good, the scale of investment for public transport required for the whole society is often below the scale of investment in the market. This is because the social benefits resulting from public transport, such as improved air quality, reduced energy import costs and reduced traffic congestion, are bigger than the recouped capital gains directed to the actual investors. Without government intervention, it is likely that unprofitable lines that are socially beneficial are not operating. Even when private sector participation is expected, an efficient mass transport service requires partnership among

transport providers, investors, regulators and government (box 16).

Financing public transport: redirect existing private and public financial resources towards railways, public transport and non-motorized transport. Government capacity is critical in redirecting existing financial resources towards more eco-efficient transportation systems. The development of public transport infrastructure usually requires substantial upfront investment. In most middle-income countries, however, the challenge is not the absolute lack of finance; rather, existing financial resources are being invested into an unsustainable transportation system, such as widening roads and constructing flyovers for private vehicles.

To channel the financial resources into eco-efficient modes of transport, policymakers need to understand the financial requirements in their city or country context. Then they can analyse the potential financial options and mechanisms, ultimately combining them to meet financial requirements.

To manage multiple financial sources appropriately and effectively, an urban transport fund can be designated to collect the financial sources (including user fees, local taxes, transfers from national government, official development assistance and climate finance) into one centralized budget and allocate it to the funding needs of the city. The urban transport fund could be administered by the integrated transport authority.

BOX 16: Governments' role in cultivating the private sector for modern transport

The role of the private sector in sustainable urban transport is manifold, including the provision of infrastructure through public-private partnership arrangements and the operation of public transport through franchising arrangements. However, the contribution to the greater society can only be maximized with governments drafting the right market framework and regulatory regimes. Governments can learn from the mistakes of premature privatizations, uncontrolled market competition and misalignment with social or environmental goals by:

- Ensuring that the planning, fare setting and coordinating of public transport is handled by the public sector so that socially desired routes and services are provided.
- Setting up clauses in contracts so that private companies are required to follow certain social and environmental standards, such as for vehicle emissions and safety procedures.
- Incentivizing property developers to accommodate aspects of sustainable land use and transport practices, such as controlling planning permissions, mandating transport impact assessments and providing public financial support for public transport and non-motorized transport infrastructure.

BOX 17: Potential financial resources for financing public transport

There are diverse financial resources, such as user charges, public sources, private sources, loans, grants and climate finance, that can be mobilized at the local, national and international levels to fund the improvement and operations of public transport.

At the **local level**, such economic instruments as parking fees, congestion charges and land development taxes can be accrued to the public budget and recycled for investment in public transport. Farebox revenues are often not sufficient to cover public transport operations; government subsidies are required to maintain the service level. While other sources of revenue are relatively small, the land development taxes can mobilize a substantial amount of resources for investment in urban railways. In Japan, for instance, the private railway companies, such as Tokyu Corporation, have the right to develop along the railway corridor so that the value of land can be captured and recycled as investment in transport improvements.

At the **national level**, taxes levied on fuel and vehicles can generate large-scale financial resources. Those revenues can be earmarked to the investment of public transport infrastructure. In India, for example, the Government set up the Jawaharlal Nehru National Urban Renewal Mission to support urban infrastructure projects. Financial resources are distributed to local governments in accordance with certain criteria. As a result, a BRT was implemented in several cities and 15,260 old buses were replaced by modern ones.[111]

At the **international level**, multilateral development banks, such as the World Bank and the Asian Development Bank (ADB), provide loans for sustainable transport projects. The ADB Sustainable Transport Initiative, for example, aims to substantially increase lending for urban transport and railway projects.[112] Climate-related funds and mechanisms, such as the Global Environmental Facility (GEF), the Climate Investment Funds (CIF) and the Clean Development Mechanism (CDM), provide support for projects in many developing countries.

POLICY PAPER

- ***Urban Transport: Policy Recommendations for the Development of Eco-Efficient Infrastructure***

FACT SHEETS

- Congestion and road-use charge
- Intercity high-speed railway systems
- Intracity bus rapid transit and trolley buses
- Intracity conventional buses• Intracity heavy rail and metro systems
- Intracity light rail
- Policy options to improve the quality of public transport
- Restricting licence plates
- Vehicle and fuel taxes plus the removal of car-oriented subsidies

CASE STUDIES

- Bangkok, Thailand's mass transit system
- Beijing, China's traffic policy package
- Guangzhou, China's bus rapid transit system
- London, United Kingdom's congestion charge
- Republic of Korea's Train eXpress
- Singapore's traffic policy package


Consommations énergétiques
KWh ep/m².an
Bâtiment économe
KWh ep/m².an
A
B
C
D
E
F
G

2.3.3 Green buildings

Change the way we design and operate buildings: From energy wasting to energy saving

Reducing the energy consumption of buildings can greatly reduce the total energy generation needs of a country and is one of the most cost-effective ways of reducing greenhouse gas emissions. Existing buildings need to be retrofitted to substantially improve their energy efficiency, and new building design needs to be based on green building standards.

Key points

The way we design buildings can be a driver towards a green economy. Globally, buildings consume 40 per cent of energy and 12 per cent of freshwater use; they generate 40 per cent of greenhouse gas emissions and of waste to landfill throughout their life cycle.[113] The corresponding figures in the Asia-Pacific region are relatively lower owing to the large number of people without decent housing and other basic services. If we continue to design and construct buildings as usual in this region, however, the resource consumption, waste generation and CO_2 emissions in the building sector will likely outpace the global trends within a few decades.

Improving the efficiency of buildings has a critical role in reducing the total amount of energy generation. By improving the ecological performance of buildings and installing more energy-efficient equipment and appliances, the total energy generation needs of the region's countries can be reduced significantly. In the current centralized energy system, considerable amount of energy is lost from the point of generation to the end users. With the fossil fuel-based power systems, around 68 per cent of energy is wasted before it reaches the end user.[114] Construction of additional power plants, which require huge upfront costs and longer payback periods, can be avoided by minimizing the energy demand in buildings.

Turning buildings from energy wasting to energy saving requires a two-pronged agenda:

1. Existing buildings should be retrofitted to improve their energy efficiency.
2. New buildings should be designed and operated according to green building standards so as to reduce the long-term demand on such resources as energy and water while generating less waste and greenhouse gas emissions.

Green buildings can save considerable amounts of energy and water consumption compared with standard ones. The actual resource-saving potential varies case by case, given that the concept of green buildings can be translated into various types, such as energy-efficient buildings, **zero-energy buildings** and **passive houses**, with different degrees of eco-efficiency. For instance, passive house dwellings, which are built with airtight insulation that maximizes the use of natural heating systems such as the sun, achieve an average energy savings of 90 per cent when compared with existing houses and more than 75 per cent when compared with average new construction.[115] Although the biggest energy-saving potential lies in the siting, design and envelope (glazed area, insulation), in which total energy loads are mainly fixed, it is important to operate and maintain buildings to be eco-efficient throughout their life cycle.

The payback period of the additional investment costs is relatively short, ranging from two to seven years. CO_2 emissions reduction in the building sector can be accomplished with either negative costs or marginal costs through mature low-carbon technologies aimed at reducing energy consumption and improving energy efficiency. The costs and potential to reduce CO_2 emissions will vary by specific technology used. According to estimates by McKinsey, US$600 billion of energy costs can be saved in developing countries with an additional investment of US$90 billion.[116]

Obstacles

Several obstacles hamper the greater uptake of green buildings, such as lack of awareness, access to financial resources and the unavailability or cost of new technologies. Hidden costs and risks, especially for retrofitting buildings, are often underestimated in the cost-benefit analysis. For instance, building occupants are required to be relocated during the refurbishing periods, which can cause significant transaction costs and administrative complexity among

BOX 18: The whole system approach in greening buildings

Buildings should be treated as a whole system in which each component interacts with the others. Resource consumption of buildings depends on a combination of decisions made throughout the life cycle of buildings, from orientation to design, material selection, construction, operation and maintenance. A portfolio of measures aimed at reducing energy demands and improving efficiency should be considered in a way that maximizes the synergies throughout the entire process. For instance, reducing energy loads via sustainable design and efficient equipment is usually prior consideration to switching to cleaner energy resources. Otherwise, installing renewable energy generation in a poorly insulated building is neither cost-efficient nor eco-efficient because costly renewable energy will need to be heavily channelled into buildings to meet huge energy requirements. The potential for greening a building should be assessed in a holistic way, based on the project level. For instance, installation of a greywater (used) recycling system may encourage using more energy for treating water than reducing the need for piped water. The specific technologies to be used are affected by such various factors as climatic and geographical conditions as well as the level of technology development and market readiness.

the building owners and tenants. A common obstacle, though, is that the developers, architects, landlords, investors, facility managers and tenants have different incentives and their main goal may not be to maximize the eco-efficiency of buildings.

- **Gap between developers and users:** Introducing eco-efficiency criteria into the design and construction of buildings would save considerable costs during its lifetime. But these benefits are accrued to users, providing a disincentive for developers to shoulder the added expense of making buildings green. Instead, developers seek the greatest profits by reducing capital investment and increasing the value of buildings.

- **Gap between landlords and tenants:** As in the case of developers, when the payment of operational costs is the responsibility of tenants, building owners lack incentive to invest in efficient improvements. The additional investment is unlikely made by tenants. If landlords directly pay for utilities, it is the tenants who may lack incentive to use appliances and equipment more efficiently.

Though there are potential benefits of green buildings for each party, these benefits are not directly channelled to the respective party in the current fragmented market structure. Especially, energy-efficiency investment is not as visible as renewable energy investment due to the lack of mechanisms (labels, certification) that differentiate them from the business-as-usual practices. In the absence of market appreciation, any investment in energy efficiency is difficult to value and recover. Thus, additional investment made for building green should be properly compensated and the benefits should be clearly communicated with all parties involved in the process.

Policy options

A number of hurdles hamper the adoption of green building practices, such as those outlined previously. Thus the role of government is critical to ensure the economic feasibility of green buildings so that it makes business sense for the private sector and the hurdles can be overcome. A mix of policy options, such as regulatory, economic and information instruments, can help all parties realize the opportunities and reap the benefits that arise from green buildings.

Information and labelling

Informational measures can bridge the gap between parties by highlighting the key features of green buildings and increase the marketability of green buildings. Voluntary labelling and **certification** can be the basis for promoting green buildings. Because the environmental performance of buildings is invisible, the benefits of green buildings, such as reduced utilities bills, are easily overlooked by consumers. In turn, developers have no incentive to invest in green building because the effort is not appreciated in the market.

Building ratings, certification and appliance labels enable consumers to make informed decisions and provide specifics for developers and architects to follow. Energy audits and energy benchmarks provide more practical guidance on the opportunities to improve the efficiency with building owners or developers. In Singapore, the Green Building Mark Scheme was introduced by the Building and Construction Authority in 2005 to green 80 per cent of the city's buildings by 2030. As of 2008, all new buildings were mandated to comply with the scheme; and as of end 2010, 551 new buildings and 65 existing buildings were certified.[117]

Building audits can be an effective instrument for refurbishing buildings and reducing the knowledge gap of residents. Audits identify the efficiency improvement potential and provide technical assistance from experts, particularly at the time of making capital investments for building retrofits. Governments can support training programmes that upgrade the skills of building professionals and technicians. In the Republic of Korea, the Korea Energy Management Corporation (KEMCO) conducts regular energy audits in large residential and commercial buildings at the request of their owners. Based on the findings of energy audits, KEMCO recommends energy-saving measures along with technical assistance for making the changes, such as thermal insulation or installation of double-glazed windows.[118]

However, informational instruments alone cannot go very far in speeding up the process without regulation, incentives and policies to tackle the upfront costs.

Regulatory measures

Regulatory measures can have an immediate impact on greening buildings in the region due to the huge construction boom ongoing. Building certificate and audit programmes, which were introduced earlier, can be implemented as mandatory tools as well. Building codes, appliance standards and procurement can be upgraded to reflect the eco-efficiency principle. **Building codes** can be implemented either to meet the overall performance level (energy consumption or greenhouse gas emissions) or to achieve the energy-efficiency requirements for each building component (thermal transfer values for walls, roofs and windows or heating and cooling systems, lighting, etc.). Regulatory measures can be successfully enforced when the various parties are aware of the necessity and benefits of green buildings. Many countries introduce the voluntary certificate first and then make it mandatory. Coherent and stringent policies can send encouraging signals to the private sector,

BOX 19: Management of the heating and cooling load through insulation

Thermal insulation can significantly reduce the energy required to cool or heat a building, particularly in locations with very high or low ambient temperatures. The insulation is required for the entire building envelope, including the roof and surrounding walls exposed to solar radiation. But energy savings with additional insulation tend to decrease with increased insulation and will depend heavily on climatic conditions. Thus care should be taken to impose the minimum thermal insulation for buildings for a given climate so that it makes economic sense. In Japan, the Energy Conservation Law contains performance criteria for residential buildings that are both prescriptive and performance-oriented. China has enforced requirements for the cost-effective reduction of heating and cooling loads and new buildings must save 50 per cent on energy use. Cities with the largest construction markets, such as Beijing and Tianjin, have adopted more stringent regulations to further reduce the energy consumption by 30 per cent through the use of more envelope insulation and windows that have lower thermal losses.

Source: Liu Feng, A. S. Meyer and J. F. Hogan, *Mainstreaming Building Energy Efficiency Codes in Developing Countries: Global experiences and lessons from early adopters*, World Bank Working Paper No. 204 (Washington, D.C., The World Bank, 2010).

nurture the green building industry market and lower the additional costs in the long term.

Financial support and incentives

Additional investment costs for greening buildings as well as lack of access to finance are two other major hurdles that require policy intervention.

Fiscal incentives, such as grants, subsidies and tax breaks, can be awarded to residential and commercial buildings applying energy efficiency measures or carrying out audits to cover the additional costs, especially when the market is premature. In addition, non-monetary incentives can be granted, such as permitting increased floor space. Governments can mobilize the financial resources that help lower the upfront financial hurdle by partly redirecting the investment for the eco-efficiency of the energy supply system to the end users. The revenue-neutral option is possible by offsetting costs for the construction of power plants. The important thing in designing the financial schemes is not to hand out free money but to bridge the gap between the short-term upfront costs and the long-term benefits. The incentives should be closely linked to the targeted users so that resources aren't wasted. In **Japan**, the Government has established an **eco-point system for housing**, to encourage the construction and renovation of eco-friendly houses by offering reward points that can be exchanged for gift vouchers and eco-friendly products.

Traditional financial solutions are often inadequate to send sufficient finances flowing into green building projects. This is because they either do not realize the energy-efficiency benefits or the current financial scheme is not aligned with the timeframe of the energy savings, which are incrementally recovered over time. Government intervention is critical for reforming institutions in a way that supports energy-efficient building projects.

There are several innovative ways of financing green buildings that do not necessarily require huge amounts of financial resources, including the following:

- **Preferential loans** provide lower-than-market interest rates for customers wanting to adopt energy-efficiency measures in their buildings via public-private partnership with banks and financial institutions. One such scheme is the German Energy Efficient Refurbishment Programme, formerly known as the CO_2 Building Rehabilitation Programme. Under this scheme, KfW, a government-affiliated bank, offers preferential loans with around a 1 per cent interest rate and grants to support energy-efficiency improvements to private housing companies and landlords. Support is available according to the level of energy efficiency achieved in comparison with a new building standard (KfW Efficiency House 55-115), as spelled out in the Energy Saving Ordinance.[119] Another example is the **Green Deal programme**, which the **UK Government** is going to introduce in October 2012 to provide loans through private financing that covers the upfront costs for retrofitting according to the level of efficiency gains. The repayment levies on utility bills over 25 years and the obligation to repay is tied to the property (if the property is sold, the obligation is transferred to the new owner).[120]

- **Green mortgages** are property-secured financing mechanisms in which energy efficiency credit is factored. In the United States, the **Property Assessed Clean Energy (PACE)** programme

was introduced in 2009 to support retrofitting projects for both residential and commercial buildings. Local governments issue bonds to raise funds for the programme. The loans are provided, based on the property assessment (including property title and tax payment records), and are repaid over 20 years through a special tax, property tax or utility bills.[121]

- **Third-party financing,** which is often referred to as energy performance contracting, is done through **energy service companies (ESCOs)** and provides building owners technical and financial assistance for improving the efficiency of houses. The profits of ESCOs are streamed from the savings afterwards. ESCOs, however, have not been very successful in some countries because the market is not mature enough.

- **Revolving funds** allow developers or building owners to repay loans as the cash flow arises from energy savings. The repaid loans can replenish the fund, which in turn can finance new energy-efficiency projects. The revolving fund can be considered successful when the partner banks decide to leverage their own financial resources to widen the scope of building energy-efficiency activities. Thailand has created a revolving fund and has forged partnership with banks for providing capital at a subsidized rate in order to attract potential beneficiaries.[122]

Table 8: Selected policy options aimed at promoting green buildings

Types	Policy options	Responsibility	Applicability
Informative	Voluntary labelling and certification	Government, private sector	New building, retrofitting
	Energy audit	Private sector, partnership	Retrofitting
Regulatory	Building codes and standards	Government	Mostly for new building
	Appliance standards	Government	New appliances
	Green procurement	Government, partnership	New building, retrofitting
Economic and fiscal	Grants and subsidies, tax breaks	Government	New building, retrofitting
	Preferential loans	Partnership	New building, retrofitting
	Third-party financing	Private sector, partnership	Retrofitting
	Revolving fund	Partnership	Retrofitting
	Green mortgage	Partnership	Retrofitting

POLICY PAPER

- ***Buildings: Policy Recommendations for the Development of Eco-Efficient Infrastructure***

FACT SHEETS

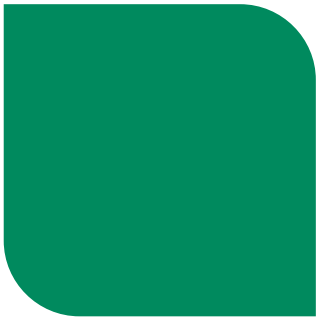
- Appliance standards and labelling
- Building certification
- Building energy standards and codes
- Eco-resorts and hotels
- Energy service companies
- Passive houses
- Tropical architecture
- Zero-energy buildings

CASE STUDIES

- Japan's housing eco-point system
- Japan's Top Runner programme
- United Kingdom's Green Deal and the United States' Property Assessed Clean Energy





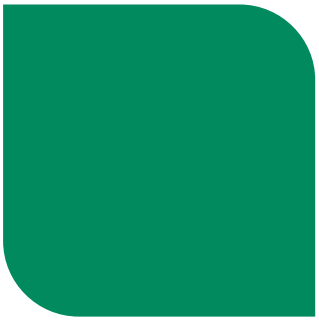





FOCUS AXR-SD
SmartMeter











2.3.4 Eco-efficient energy infrastructure

Change the way we produce, transport and consume energy: Improve the efficiency of the energy system and diversify to renewable energy sources

Governments in the Asia-Pacific region need to meet the growing energy demand and extend access to electricity to the millions still without it while avoiding being locked into unsustainable energy systems. This will require increasing the share of energy generated from renewable sources and promoting decentralized and hybrid generation; but it also will require improving the efficiency of energy generation and transmission from conventional sources.

Key points

How we consume and produce energy will shape the carbon intensity, energy security and quality of growth in the decades to come. Energy is recognized as an essential component for economic and social development. The way in which we build our infrastructure, be it the built environment of cities, transport systems and other municipal services, the way we design the energy supply infrastructure to support these systems and the way we use energy in the industry sector will all impact hugely on how energy is used, the cost to society and overall national energy security.

To transition to a low-carbon economy, we must fundamentally reconsider the design of a comprehensive and integrated energy system. Energy systems should be developed so as to facilitate the production and consumption of low-carbon emitting energy sources while conserving energy. One of the most important factors will be the shifting from the conventional reliance on fossil fuels, especially the high carbon-emitting coal and oil, as the major source of energy supply for running our economy. Another important factor is to consider demand-side management and energy-efficiency measures, such as in transport, buildings and urban planning and design.

There is still a massive unmet demand for energy services. But meeting the unmet demand does not necessarily mean the proportional expansion of an unsustainable energy supply system. In the Asia-Pacific region, 675 million people do not have access to modern energy services.[123] Improving their access can pull many of

them out of poverty and improve socio-economic conditions by reducing pollution and health hazards from wood fuel consumption. In addition, the development of many economies requires more energy for industrialization. For some of the poorest countries, with massive energy shortages and frequent power disruptions, they will need to expand their energy system to meet the rising demand in addition to the existing unmet demand.

The conventional energy system, based on fossil fuel resources, is not sustainable in meeting the unmet and growing energy demands in tandem with long-term growth. In the past, the energy infrastructure of many countries was based on low fossil fuel prices that did not internalize the external costs to society. Given the volatile oil prices in the market and the growing concerns of the constrained fossil fuel resources, pursuing conventional energy production and consumption is no longer sustainable.

Rising energy costs will negatively affect the value added of energy services from the same per unit inputs. In 2009, countries in the region imported about 1.8 billion tonnes of oil equivalent of energy, representing 40 per cent of the world's total energy imports.[124] As energy prices rise, the cost of generating the same unit of energy services increases, burdening long-term economic growth. The International Energy Agency estimated that for every US$1 of investment in low-carbon energy delayed until after 2020, an additional US$4.3 will be needed to compensate for the greenhouse gas emissions.[125] This implies that inaction now over investing in efficient and sustainable energy systems will increase the pressure on the government budget in the medium and long terms, limiting the use of public funds for other development purposes.

Eco-efficient energy infrastructure should focus on increasing the share of renewable energy sources and improving the efficiency of energy generation. Although fossil fuels, such as oil and coal, will still be a part of the energy mix, cleaner fossil fuels, such as gas, or the use of technologies to capture carbon emissions from high carbon-emitting energy sources can begin the transition towards a low-carbon energy system. In many countries, and particularly in the growing urban areas and mega-cities of Asia, energy is consumed wastefully. End-use energy efficiency gains can multiply back across the energy supply chain, resulting in considerable savings of primary energy, such as a significant reduction in the amount of power capacity from coal.

Investments in the energy supply system today should be based on eco-efficiency, together with other objectives, such as stability, reliability, flexibility and affordability. A portfolio of options, such as the deployment of cleaner (renewable) energy sources, improving efficiency in processing fossil fuels and optimizing the transmission and distribution network, can improve the eco-efficiency of the energy supply system. The best mix is largely dependent on the currently available technologies (and their costs), the existing energy infrastructure or network, natural energy endowments and the energy market.

Globally, there are several low-carbon technologies that can be adopted into the energy system. However, cost still remains a stumbling issue, especially in developing countries in terms of investment and production costs. Regionally, the largest potential lies in the improvement of power system efficiency, coupled with improving the end users' efficiency (energy-efficiency measures), for which new systems are expected to be constructed in the coming decades. The potential for improving the efficiency of the energy supply system should be closely

examined against the country context.

Policy options

Polices aimed at improving the eco-efficiency of the energy infrastructure should be applied in accordance with broader energy frameworks. Governments should put in place a comprehensive and integrated national energy policy framework that extends an overarching basis for sector policies. These national frameworks and sector policies wave both short- to long-term policy signals that open an enabling policy environment and investment climate through national targets and goals, such as CO_2 emissions-reduction targets, carbon-intensity targets, renewable energy-deployment targets and energy-efficiency targets.

Specific policy options for improving developing an eco-efficient energy system include the following.

Improve the efficiency of the current energy system

The efficiency of the current energy system using fossil fuel sources can be improved:

- **Energy can be generated more efficiently.** In 2005, the average efficiency of a coal-fired power plant varied, depending on the country, with Japan having an efficiency of around 42 per cent and China's thermal-electrical conversion efficiency at around 33 per cent. The best available coal-fired power plants are still only 47 per cent efficient.[127] Retrofitting existing power thermal-electrical conversion plants with more efficient technologies, such as **combined heat and power generation**, supercritical steam-cycle plants, integrated coal gasification combined-cycle plants, fluidized bed combustion boilers and natural gas-combined cycle plants, would significantly save energy costs and reduce greenhouse gas emissions.

Other clean coal technologies (such as an integrated gasification combined cycle, which has a high power generation rate and is able to treat pollutants, de-sulfurize and store carbon capture) can optimize conventional fossil fuel energy infrastructure. Clean coal technologies reduce the CO_2 emissions into the atmosphere to only one tenth of the emissions compared with conventional coal-fired plants,[128] though it may not necessarily improve the energy efficiency of a power plant. However, these technologies are still in the experimental stage and require more investment in R&D and demonstration.

BOX 20: Getting energy prices right

Efficiency gains and a shift to cleaner energy sources won't be achieved as long as fossil fuel prices are kept artificially low through direct and indirect subsidies that heavily burden national economies. Only 8 per cent of the US$409 billion that was spent on fossil fuel subsidies in 2010 went to the poorest 20 per cent of the population, indicating that energy subsidies go mostly to those who do not need it.[126] Correctly pricing energy sources will be crucial for the shift to low-carbon energy systems.

- **The generated energy can be more efficiently transmitted and distributed.** With energy demand in the region projected to grow due to the rapid industrialization taking place, more efficient transmission and distribution capabilities and systems are required to supply power. The conventional centralized power system generates power at a larger scale, which is transmitted and distributed through long cable lines. The cost to generate per unit of energy in this type of system is fairly efficient within the conditions of economy of scale, but constructing the transmission and distribution network nationwide is extremely costly. In addition, approximately 10 per cent of the total power generation is lost during the transmission and distribution.[129] Superconducting cable or distribution cable can be placed underground to reduce the loss. These solutions provide a promising opportunity for improving the operational inefficiencies of the existing network.

Expand the share of renewable energy

Renewable energy sources can be deployed in several ways. Electricity can be linked to a grid or not (off-grid). Currently, the penetration rate of renewable energy sources to the centralized grid is still limited. In many cases, it operates only to meet local demands or is used as a back-up system, without putting the generated energy on the centralized grid.

Renewable energy generation can be directly connected to the end user through heating and cooling networks, the gas grid and fuel distribution[130] ***through decentralized energy systems, such as mini-grids or stand-alone energy systems.*** For instance, solar lanterns and more versatile solar home systems can provide lighting to urban poor households that are affected by shortages of electricity or lack of access to it. In India, for example, SELCO Solar Pvt. Ltd, a social enterprise, partnered with the SEWA Bank (Self-Employed Women's Association) to provide affordable solar and biogas-based lighting and cooking devices to home-based workers, such as vegetable vendors in urban

BOX 21: Hybrid energy systems for rural electrification

Hybrid energy systems provide options to move away from the reliance of fossil fuel. Hybrid energy systems combine multiple types of energy generation and/or storage or use two or more kinds of power (including fossil fuel and renewable energy) to power a generator. Backing up renewable energy generation with conventional thermal electric production can help expand the use of renewable energy for immediate purposes, considering that new technologies for integrating renewable energy sources are still under development. This can help expand energy access to underserved areas. Malaysia's Ministry of Education, for example, funded the capital costs of providing solar photovoltaic panels for PV-diesel hybrid systems to 63 schools in Sabah (on the island of Borneo) that were either not connected to the grid or relied on diesel generators. With more stable electricity access, the schools are powered for lighting, computer use and Internet access.[132]

areas.[131] When used in cogeneration, heat, electricity and fuels can be simultaneously generated, thereby improving the overall efficiency.

The integration of renewable energy sources into the energy system requires technical support and institutional adjustment, given that the variability of the sources may challenge the reliability of the system. There are a few technology solutions that enable the integration of renewable energy resources from various sources, such as storage technology or demand-response options. However, these options are not yet commercially viable.

Many countries in the region have set up specific measures at the national and local levels to promote renewable energy use. For instance, with a 2006 presidential decree, the Indonesian Government committed to increasing the share of renewable energy from 4.3 per cent (in 2005) to 15 per cent of the primary energy supply by 2025.[133] As well, ministerial decrees specified the pricing for electricity generation from renewable sources, including hydro, biomass and municipal waste and geothermal. Other measures include power purchase obligations, a cash transfer programme to stimulate the development of electricity-generating capacity through coal and natural gas power plants, geothermal and hydropower projects and a rural electrification programme – Energy Self-Sufficient Villages – involving locally available renewable energy sources and biomass.

Regulatory measures can help the adoption of renewable energy technologies. These include: **feed-in tariffs** that require utilities to purchase a specific amount of the renewable energy that is transmitted to the grid; renewable energy portfolio standards (RPS), which is a mandatory quota system for renewable energy deployment; tradable renewable energy certificates (REC) and net-metering. In parallel, fiscal incentives, such as subsidies, grants, rebates and tax credits, can be introduced to encourage investment and consumption of renewable energy sources.

Many governments prefer to adopt the feed-in tariff scheme during the initial stages. In the Republic of Korea due to budgetary constraints, policymakers decided to shift from the feed-in tariffs to a less costly renewable energy portfolio standards scheme. Such a policy shift is usually adopted by countries in which a renewable energy market already exists.

BOX 22: India's Solar Mission

As part of its 2008 National Action Plan on Climate Change, the Government of India launched the Jawaharlal Nehru Solar Mission initiative to generate 20,000 MW of solar energy by 2022. The Solar Mission aims to drive innovation, increase power-generating capacity, develop off-grid energy installations in rural and poor areas and create a strong industry and jobs. The Government pledged US$900 million to support the mission. A core component is the feed-in tariff, launched in 2009. The Solar Mission also benefits from the existing renewable purchase obligations and a new national system of tradable renewable energy certificates.

Source: India, Jawaharlal Nehru National Solar Mission: Towards Building Solar India (New Delhi, Government of India and State Governments, 2010). Available from http://india.gov.in/allimpfrms/alldocs/15657.pdf

BOX 23: Renewable energy potential in the Asia-Pacific region

In the short term, **bioenergy** from forest residues, agricultural waste and municipal waste can offset some fossil fuel-based thermal energy production, usually at the municipal level and depending on the relatively constant regional resources. This can be done by simply upgrading existing thermal energy plants, which reduces the initial capital costs for new infrastructure. Bioenergy is also particularly well suited for small-scale distributed generation because of the reduced need to transport bulky biomass fuels over long distances.

Distributed and off-grid solutions, such as **solar** thermal water, food and process heating, solar PV lighting and micro-hydro systems, are alternative options that can have relatively low economic hurdles. In the long term, harvesting electricity from solar radiation appears to be a promising option due to the high levels of solar radiation across most of the region. As production costs drop and the efficiency and reliability of solar power production increases, particularly with innovations in storage, solar technologies could take over a significant share of energy production and greatly reduce greenhouse gas emissions.

Growth in **wind** energy development is steadily increasing, largely due to extensive wind farm development in China. Due to the high upfront costs and the extensive land requirement, the potential to generate electricity from wind turbines on a large scale is limited across most of the region, except in countries such as China and India. Coupled with other resources, a hybrid mini-grid can be beneficial for rural electrification, providing cost-competitive clean energy by tackling the problem of variability and unpredictability of wind power.

Although **geothermal** energy is a steady source, the degree of its potential for use differs according to location and technologies to be deployed. Around 30 per cent of world's electricity from geothermal is generated in the Asia-Pacific region, mainly in Indonesia and Philippines.[134] In addition, geothermal can be used for district heating and cooling using a heat pump. In Indonesia and Philippines, geothermal energy generation is much more economically and technically feasible than in other parts of the region. China leads in the direct use of geothermal, at 12,605 GWh per year.[135]

Decentralized power-generating systems that cater to the energy demands in rural or urban poor communities provide solutions for both low-carbon and developmental priorities, such as improving energy access. However, these systems must be selected and designed according to the local context and needs.

Developing countries in the region have introduced programmes to accelerate the development of decentralized energy supply, such as Nepal (box 25). In **China**, the Government introduced **rural electrification programmes** targeting dispersed rural settlements using min-grids for achieving efficiency gains, improving energy access and developing the domestic solar PV renewable industry.

BOX 24: Expanding energy access and deployment of renewable energy through decentralized power generation

Decentralized generation is a relatively new approach to generate energy (electricity, fuel, heat, etc.) at the small scale. Unlike the centralized large power plant with long transmission and distribution lines, decentralized power generation produces electricity while either being connected to the central grid or serving a particular site (without feeding potential excess generation into the grid). In addition to generating electricity, decentralized generation also produces fuel mostly from bio-energy or serves distributed heating and cooling systems.

The decentralized generation has its pros and cons: First of all, it presents a promising opportunity for expanding access to clean energy services to remote communities that may presently depend on inefficient and polluting biomass for their basic energy needs. There may also be improvements in efficiency due to the reduced transmission losses. However, decentralized systems can be expensive to initially install and will require skilled people to maintain them.

BOX 25: Biogas support programme in Nepal

The Biogas Support Programme (BSP) in 1992 provided opportunities for private biogas companies to flourish in Nepal. By 2007, more than 140,000 biogas plants had been constructed by recognized companies as per the specification and fixed standards approved by the BSP. These companies also provide after-sales service and repair and maintenance training to users. BSP staff monitor the quality control; as of 2007, 97 per cent of installed plants were still operating. The BSP also promotes the development of a domestic biogas appliance industry by helping several private manufacturers to produce quality appliances that meet BSP standards. Training programmes have been exceptional in creating and strengthening the capacity of biogas companies, banks, NGOs, inspectors and end users. An important feature of the BSP has been its innovative financial engineering and judicious application of consumer subsidies to build the market for biogas plants. A loan and subsidy programme was structured to target small- to medium-scale rural farmers. In addition to two government banks, the BSP is working with more than 140 microfinance institutes to extend loans for biogas entrepreneurialism.

Source: United Nations Asian and Pacific Centre for Agricultural Engineering and Machinery and United Nations Economic and Social Commission for Asia and the Pacific, Recent Developments in Biogas Technology for Poverty Reduction and Sustainable Development (Beijing, 2007).

BOX 26: Optimizing the grid network – energy storage and demand response

In the grid system, electricity is not generated at the most optimal level to maximize the efficiency. Electricity should be generated as needed because it cannot be stored. Placing a greater share of renewable energy sources as well as connecting a number of small generators on the existing grid can render it even more difficult to control because energy generation is intermittent and variable. Some emerging technologies, such as energy storage and the smart grid, present a future opportunity to make the grid more reliable and flexible to accommodate a greater share of renewable energy sources, hybrid generation, distributed generation and electric vehicles. The smart grid in particular stabilizes and optimizes the grid network by closely matching supply and demand. However, these technologies are not fully ready to be integrated into the current grid system; they require more R&D and government support.

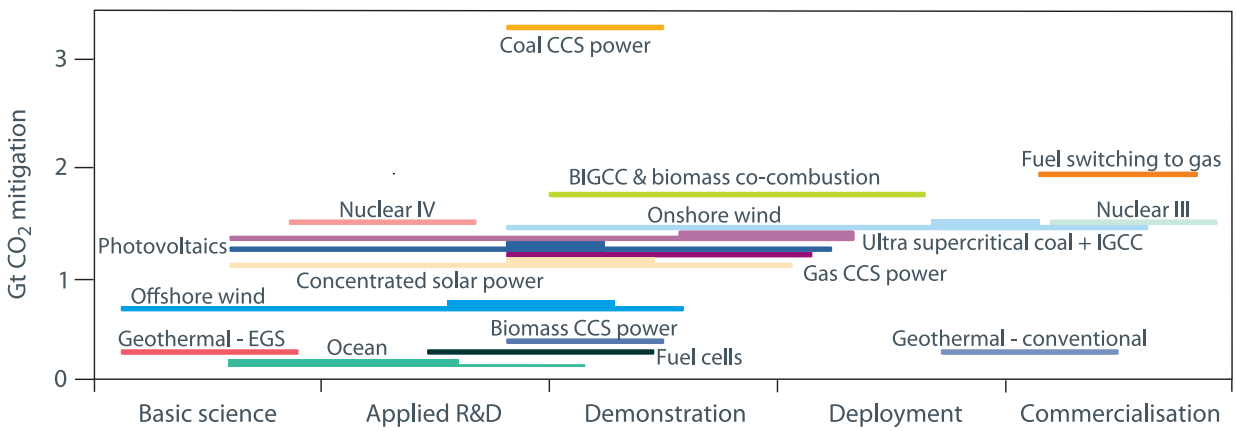
The challenge for renewable energy has to do with its unstable and unpredictable supply. The grid system designed for meeting the energy demands of a community can be less reliable compared with the centralized grid with its greater-capacity transmission and distribution network. Solving the energy storage issue is an important component of decentralized energy generation that focuses on sustaining the supply of energy and reducing energy loss of overproduced energy by storing it. When connected to small generators, the centralized system may not have the required capacity to balance the transmission flow. Technologies to supplement the inefficiencies are needed.

Invest in next-generation technologies and energy systems

Next-generation energy technologies will drive countries from a fossil fuel-based economy to a low carbon-based economy. Investments and early deployment of such technologies will allow abatement costs to be kept low.

There are various types of promising tech-

Figure 21: Near-term technology development priorities for power-generating technologies



Source: International Energy Agency, Energy Technology Perspective 2008: Scenarios and Strategies to 2050 (Paris, 2008).

nologies being developed along the innovation chain (figure 21) including the following:

- **Carbon capture and storage:** Carbon capture and storage (CCS) technologies can prevent the release of CO_2 into the atmosphere from fossil fuel use in power generation and other industries (by bundling it and burying it). Individual technologies that together constitute the CCS system are mature, but the integration of them into a system is still being tested. There are currently seven integrated commercial-scale CCS projects operating worldwide (in Algeria, Canada, Norway and the United States).[136] In 2009, Australia set up the Global CCS Institute to accelerate the deployment of technologies, foster cooperation and share information globally.

- **Smart grids:** A smart grid is an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying demands of end users.[137] The **Republic of Korea** developed a smart grid roadmap and is currently implementing a large-scale demonstration project in Jeju Island to test the infrastructure for power transmission and distribution to connect power production facilities to consumers. The knowledge from the demonstration project will be used for establishing a market, strengthening the industry base and ultimately exporting technologies and associated goods and services. The Japanese Government is also engaging in a smart grid demonstration project in the United States (New Mexico and Hawaii) in collaboration with a private sector and academic consortium from Japan and the United States.

- **Hydrogen and fuel cells:** A hydrogen economy is based on fulfilling the energy demands with hydrogen fuel and fuel cells (devices that can generate electricity by combining hydrogen and oxygen). Hydrogen fuel does not emit greenhouse gases or other hazardous pollutants; it produces only water. Although it is a potential low-carbon energy source, the production cost is still extremely high, and further R&D efforts need to be invested in developing the storage and transportation technologies. Nonetheless, the transport sector has experimented with its application; for instance, some automobile and electronic companies around the world have been developing fuel cell technologies for cars and buses. There are small-scale demonstration projects in the Asia-Pacific region; the Global Environment Facility, for one, is funding a demonstration project on fuel cell bus commercialization in China.

FACT SHEETS

- Bioenergy
- Carbon capture and storage
- Combined heat and power
- Decentralized energy system
- Feed-in tariff
- Geothermal energy
- Hybrid energy system
- Hydropower
- Ocean energy
- Renewable energy
- Smart grid
- Solar energy
- Wind energy

CASE STUDIES

- China's mini-grids for rural electrification
- China's renewable energy policies
- Denmark's renewable energy policies
- India's Solar Mission
- Indonesia's micro hydropower projects
- Japan's Green Power Certificate scheme
- Republic of Korea's smart grid development
- United States' hydrogen economy


WATER


















2.3.5 Eco-efficient water infrastructure

Change the way water resources are managed: Develop an integrated and decentralized system

The current centralized approach to water resource management may lead to high inefficiencies. The approach entails piping in water from reservoirs to end users and piping out water from end users to central treatment facilities. Water infrastructure needs to emphasize water-sensitive and low-impact development that is based on an integrated and decentralized water resource management, including rainwater management. A properly managed decentralized water resource management system can secure water resources, prevent urban flooding and restore the ecosystem.

Key points

Eco-efficient water resource management is critical to achieve low carbon green growth. Water has always been one of the most significant resources for the human condition, ranging from meeting basic needs to supporting economic growth. However, the overextraction of water and poorly treated and managed wastewater have had serious impacts on the sustainability of the world's water supply. Water traditionally has been regarded as a free good. But this has provided no incentive for its efficient use and made cost-recovery for water infrastructure investments difficult.

Poor management of water resources is decreasing per capita availability. Despite a large total endowment of freshwater resources, the availability per capita in the Asia-Pacific region is the second-lowest in the world as a result of population size and misuse and overuse of the supply. In addition, deteriorating water quality negatively affects the ecological carrying capacity of the region. Wastewater treatment is a particular concern because it affects ecosystems. A large portion of wastewater generated is either discharged directly into open water bodies or it leaches into the subsoil, which leads to water-quality problems and thus supply constraints.

Many relatively water-rich countries, such as Bhutan, Indonesia, Malaysia or Papua New Guinea, are now facing challenges regarding water resources in their major cities due to growing water consumption, poor management of water catchment and treatment, and overuse of groundwater. Countries that are less well endowed with water, such as in Central and South Asia, are even more severely affected when water quality deteriorates and pressures on water resources intensify.

Climate-related disasters, such as flood and drought, pose rising challenges. The impacts of climate change have increasingly gained prominence in recent years. Hydrologic extremes have increased in the Asia-Pacific region, leading to an increase in the risks of flooding and droughts and triggering seasonal changes to river flows. The impacts of climate change on the water supply should be taken into account in the overall process of planning water infrastructure.

US$1 invested in water and sanitation returns US$7 of economic benefit. Enhanced access to water contributes to economic growth through increased productivity and improved human health. Research shows that access to water and sanitation spares the loss of 20 billion working days a year, estimated at a US$63 billion savings. Health care savings from access to water and sanitation are estimated at US$340 million for individuals and US$7 billion for health agencies.[138] Achievement of the MDGs for water and sanitation would bring benefits of US$84 billion per annum, with a benefit-to-cost ratio of 7 to 1.[139]

Need for eco-efficient water resource management

The efficiency of conventional water resource management systems, featuring a piped water supply system, single water uses and a large-scale and centralized wastewater treatment system, is now in question. Despite the essential functions and benefits, such as scale effects or the consistency of service, there are several critical issues at the municipal level regarding the centralized water management system and infrastructure that need to be considered.

Water loss during the transmission process, also known as non-revenue water, needs to be better addressed when designing and implementing water infrastructure. The cost for non-revenue water is conservatively estimated at US$14 billion per year globally, of which more than one third occurs in developing countries.[140]

Even though the alternative water management systems, such as decentralized water infrastructure, reduce the adverse impacts of non-revenue water and are eco-efficient, there are a few drawbacks that also should be considered. Additional costs can accrue if the system is not integrated into the initial planning for service provision and infrastructure construction. As well, the financial attractiveness may be limited if the price of water does not reflect the full costs.

Thus, the most appropriate water infrastructure depends on the context and local circumstances. Diversifying the water management system and adopting an integrated approach is essential. A coordinated operation of both centralized and decentralized water systems at the most appropriate scale, based on context specificity, is the essence of eco-efficient water management.

Cost of inaction

While improved water management brings economic benefits, poorly managed water resources may lead to substantial adverse impacts at the macroeconomic level. Extreme climate events, such as floods and droughts, in combination with the mismanagement of water resources result in human loss as well as devastation to the national economy. Dire impacts on the economy may include deteriorated industrial and agricultural production, destroyed infrastructure, decline in tourism and poor sanitation.

For instance, floods destroy railways, roads, buildings and other essential facilities that require government spending for rehabilita-

tion and reconstruction. They can result also in massive damages to agriculture. Destroyed crops and livestock create food scarcity and insecurity while leading to increased food imports and reduced exports, which further influences trade deficits.

The lack of a basic water supply and deteriorated sanitation facilities also has major implications for the economy due to increased risk of disease and premature deaths. Cambodia, Indonesia, Philippines and Viet Nam lose an aggregated US$2 billion a year in financial costs and US$9 billion a year in economic losses due to poor sanitation.[141] These costs weigh heavily on the national economy and affect its competitiveness, which may fall as a severe burden for developing countries.

Policy options

Eco-efficient water infrastructure requires a shift in policies, from piecemeal to integrated, and a shift in infrastructure design, from centralized single-purpose to decentralized and multipurpose. Both policies and infrastructure need to integrate water supply, rainwater harvesting,

BOX 27: Recent flood crises and consequent economic losses

Pakistan experienced the country's worst flood in 2010, which affected more than 18 million people and caused 1,985 deaths.[142] The total flood damage cost was assessed at US$9.7 billion.[143] Infrastructure was severely hit; total highways and key infrastructure losses were estimated at approximately US$258 million,[144] and 1,500 MW of electricity was lost due to the shutdown of the main gas field and six power plants.[145] In addition, the flood caused US$2.9 billion losses in agricultural products.[146] As a result, Pakistan achieved only 2.4 per cent economic growth in 2011, despite a targeted 4.5 per cent.[147]

Thailand was hard hit by flood in the second half of 2011, which affected 13.6 million people.[148] The economic damages amounted to an estimated US$45.7 billion,[149] and the country's GDP growth in 2011 was revised downward to 2.4 per cent, from an earlier prospect of 3.4 per cent.[150]

BOX 28: Water pricing and full-cost recovery

Full-cost pricing is important for the sustainable use of water resources because it provides the right incentive to use water efficiently and allows providers to recover the cost of their operations and further invest in maintaining and improving the infrastructure. Full-cost pricing should be introduced with due consideration of water as a basic human need. This can be done, for example, by increasing block tariffs in which the minimum basic water requirements are provided to households at a very low rate; for subsequent rates, the higher the use the higher the rate. Subsidies can also be provided to the lower-income households. Experiences in **Singapore** show that full-cost recovery can be pursued while upholding equity.

wastewater treatment and recycling and flood control measures. Ensuring full-cost recovery though appropriate water pricing will be essential for reaching both ecological and economic efficiencies with the water infrastructure (box 28).

Adopting an integrated water resource management approach

Integrated water resource management (IWRM) is a valuable approach to overcoming inefficient water uses caused by fragmented policies and uncoordinated governance. The broader aim of IWRM is to overcome sector-based policy fragmentation and inefficient governance structures with an appropriate integration of several sector policies and systems and thereby achieve more compact water infrastructure in an ecologically and economically efficient manner.

Objectives of IWRM also vary depending on national and local circumstances. Particularly critical objectives can be summarized as: i) integrating water resource provision and a wastewater treatment system, ii) optimizing water infrastructure and iii) promoting an environment-friendly water cycle system. Minimizing the water consumption is the first and the most effective step towards significantly reducing wastewater treatment needs. The integration of water provision, demand management and wastewater treatment needs is one of the significant goals. In addition, water resource conservation, eco-system maintenance, disaster risk reduction, stormwater management and effective land use are equally important objectives of IWRM.

Because IWRM is not a fixed blueprint, policy-makers are required to consider what should be included and to what extent integration should be conducted. In Baguio, Philippines, for example, water services and water resource management had been separated, and the lack of coordination among parties had led to a weak regulatory framework and poor monitoring and policy implementation. To overcome the situation, the Sustainable Water Integrated Management and Governance project was launched from 2004 to 2005, leading to the development of a water security agenda and the City Water Operational and Investment Plan, the strengthening of a local water ordinance and the establishment of a City Water Governance Committee.[151]

BOX 29: Adopting a new approach to water infrastructure – low-impact development

Low-impact development (LID) has been introduced in the United States as a means to re-examine conventional development practices for managing stormwater runoff. As an ecologically friendly approach, LID mitigates development impacts to land, water and air by: mimicking natural drainage, using small-scale practices, managing stormwater at the source, using simple and natural practices and making landscape and infrastructure multifunctional. Whereas conventional stormwater management strategies focus on large, centralized treatment plants and water storage facilities, LID emphasizes local and decentralized measures that conserve natural systems and rainwater on site. LID benefits various parties, such as developers, municipalities and individual homeowners.

Distributed wastewater management system

A centralized wastewater management system has critical importance at the regional level. However, the centralized system is generally supply-led and requires large amounts of energy and high-technology knowledge. Thus it doesn't always efficiently fit into wastewater treatment needs at the local level. A decentralized system can function as a supplementary option to the existing centralized system allowing wastewater management to be more locally available as well as result in reduced costs and resource use. For example, the town of Hill End, New South Wales, **Australia** overcame several wastewater treatment-related problems by installing a local wastewater system and conducting a water reuse scheme.[152]

The benefit of a decentralized system is that it can be tailored and developed to meet the wastewater treatment needs of users at the local level. For instance, the city of Kuching, Malaysia was lacking a wastewater treatment plant because the city's unstable terrain made it difficult to expand the conventional centralized system. To overcome this challenge, the Natural Resources and Environmental Board of Sarawak developed a supplementing distributed system equipped with two separate outlets, one for sewage and the other for greywater.[153]

Decentralized wastewater management systems have three main objectives: i) public health improvement, ii) energy and water conservation and iii) environmental protection. Community and household wastewater management is critical to reduce water-borne diseases, particularly diarrhoea, and thus improve public hygiene. At the same time, decentralized wastewater management helps avoid water losses and save energy consumption. Additionally, the treated water goes to nearby leach fields and possibly back into the stream or is reused within houses and communities and thus follow the natural water cycle.

While large-scale centralized water infrastructure is still important, complementing it with decentralized services close to demand enables a reduction in costs and technological requirements. Greater sensitivity to the local context allows systems to take advantage of low-cost and site-specific opportunities by matching systems with specific needs.

Promoting a water cycling system through the reuse and recycling of water

To create an eco-efficient water cycle in an urban setting requires harmonizing several human activities with the natural water cycle. Reusing water by appropriately matching the quantity and quality of water with intended purposes can be an effective option to reduce the withdrawal of freshwater and prevent unnecessary generation of wastewater.

The basic principle of water reuse is to avoid wasting precious water resources. While safe freshwater sources are becoming scarce, freshwater is inefficiently used for non-potable purposes. In the Kathmandu Valley, Nepal, scarce freshwater has been used for such non-potable purposes as irrigation, car washing and toilet flushing. By promoting greywater reuse with a simple and low-cost filtering system, precious water resources can be significantly conserved and consequently lead to a reduction of households' water costs and discharges of untreated wastewater.[154]

Water reuse can achieve two objectives in the water system: minimize freshwater

demand and reduce wastewater treatment needs. By minimizing new water inflow and wastewater effluent, water reuse can make the urban water cycle more compact and sustainable. The application of water reuse depends heavily on local circumstances. Thus, the matching of treatment technologies with water sources and specific uses needs to be context specific. Examples of treatment technologies include membranes, wetlands, sand filters and waste stabilizing ponds. The purposes of use also vary, depending on the quality of reclaimed water and local needs. While a potable use of reclaimed water is practised in some cities, such as Singapore, non-potable uses, such as irrigation, toilet flushing and fire fighting are more common.

POLICY PAPER

- ***Water Resource Management: Policy Recommendations for the Development of Eco-Efficient Infrastructure***

FACT SHEETS

- Decentralized wastewater management
- Integrated water resource management
- Reusing and recycling water

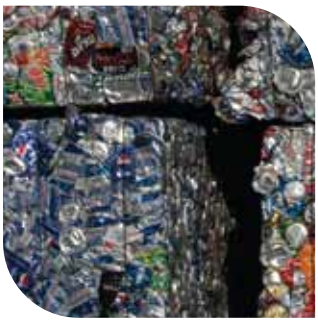
CASE STUDIES

- Australia's water-sensitive urban design
- Cebu City, Philippines' integrated stormwater management
- Singapore's water pricing policy









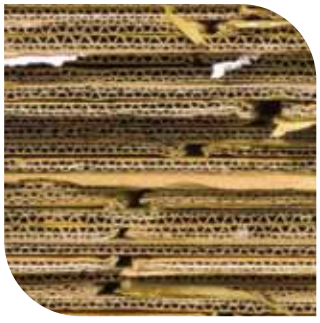
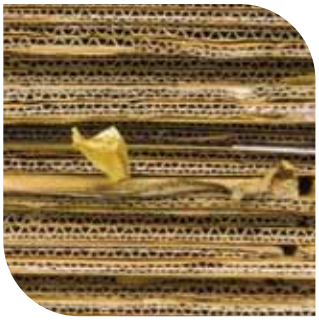
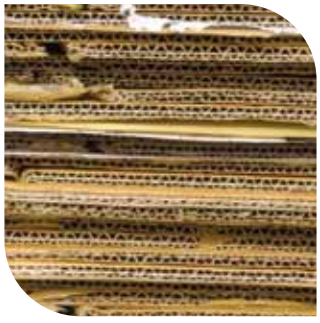

Recycling Our Wo

of Life”







2.3.6 Eco-efficient solid waste management

Change the way solid waste is managed: Turn waste from a cost into a resource

As prices for raw materials rise, the recovery of resources from waste will be crucial. Municipalities spend significant portions of their operating budgets on waste collection. Reducing the volume or weight of waste can save on operating costs, and recovering recyclable materials can generate revenues from their resale. The policy focus for solid waste management has to shift from disposal to the 3R approach (reduce, reuse, recycle).

Key points

Rapid urbanization and economic growth in the Asia-Pacific region has resulted in a corresponding increase of solid waste that municipal governments are finding difficult to dispose. Existing dumpsites have reached capacity, and finding land for new dumpsites is becoming increasingly difficult due to a scarcity within the municipal boundaries and because surrounding rural communities and towns are refusing permission for dumpsites in their vicinity. Investments in sanitary landfills are necessary but expensive. Making sure that the lifetime of constructed landfills can be extended is of utmost importance.

Local governments spend a large share of their budgets on solid waste management. For many local governments, the expense of collection, transport and disposal of solid wastes consumes a large portion of their annual budget. One main reason for this is that the traditional approach to solid waste management focuses on end-of-pipe solutions that are capital and technology intensive and therefore expensive to build and difficult to maintain. Reducing the amount of waste that needs to be disposed at the landfill can save municipalities operating expenses, and recovering recyclable materials can generate revenue from the resale of them. This revenue could be reinvested into pro-poor programmes and into such critical areas as health or education.

Growing and changing waste streams, such as e-waste, pose great challenges. In spite of the expenditure, collection is often insufficient and waste is often disposed of in crude open dumps that pollute the atmosphere and water sources. This puts human health at great risk. New waste streams from electrical and electronic equipment (e-waste) also present a considerable challenge,

especially in developing countries, given that they contain new and complex hazardous substances that can be dispersed into the environment.

Properly managing solid waste can reduce greenhouse gas emissions. When biodegradable waste is deposited in a landfill it produces methane. Methane can either be captured or burned to produce energy or avoided through aerobic composting. Between 60 and 80 per cent of municipal solid waste in Asia's developing countries consists of organic material. This waste is currently sent to landfills and dumps where it contributes to a large amount of greenhouse gas emissions every year. Reducing the amount of food waste going to landfills thus provides great potential for reducing landfill waste volume as well as decreasing methane emissions. In addition, compost can help reduce the use of chemical fertilizer in agriculture, landscaping and nurseries and alleviate related environmental problems.

Waste can be turned into profit and a source of employment. The global waste market, from collection to recycling, is valued at an estimated US$410 billion a year, not including the large informal segment in developing countries.[155] The recycling industry is expected to grow steadily – waste picking can become an important sector in terms of employment. The United Nations Environment Programme estimates that employment in the waste sector would be 10 per cent higher than in a business-as-usual scenario by 2050 if the recycling industry were promoted.[156]

Providing decent employment in the recycling industry can help reduce poverty. Estimates from several cities and towns of developing countries in the Asia-Pacific region indicate that as much as 20–30 per cent of the waste generated is recycled by the informal sector, which includes waste pickers, junk dealers and recyclers. In Delhi, India, for example, as many as 170,000 informal workers (or 1.3 per cent of the total population) are engaged in solid waste management.[157] For them, trash is cash. The amount of waste that is recycled could be significantly increased if municipal solid waste management systems were re-engineered to incorporate the informal waste recycling industry. In Dhaka, Bangladesh, a social business enterprise, Waste Concern, has provided 800 waste pickers with a formal job, health insurance and other benefits through the establishment of integrated resource recovery centres.

Projects that reduce greenhouse gas emissions from the waste sector can tap into available carbon financing sources. Among the Clean Development Mechanism (CDM) projects registered with the UNFCCC, about 17 per cent are from the waste sector. Projects in the waste sector can be registered both as large and small scale. Small-scale projects can be bundled together using a programmatic approach.

Policy options

Low carbon green growth requires a shift in perspective on waste. It requires seeing waste as a resource rather than a cost. Low carbon green growth necessitates shifting from an end-of-pipe approach for solid waste management to one that focuses on minimizing the waste that goes to final disposal by reducing, reusing and recycling it.

Policies are as important as infrastructure. While the main responsibility for the collection and treatment of waste may lie with municipalities, it is essential that national policymakers implant the appropriate legal framework to stimulate an eco-efficient approach to solid waste management. Of

course, lack of resources and capabilities often hampers the implementation of3R policies. Thus, top-down policies need to be supplemented with bottom-up approaches.

Promote the reduce, reuse, recycle approach

The reduce, reuse, recycle approach is a practical policy tool for decoupling resource consumption from economic growth and promoting sustainable production and consumption. The 3R approach proposes a hierarchy of preferences to manage resources. "Reduce" asks that products be designed with an awareness of the full life cycle of the materials used, thus reducing the potential amount of waste generated. If the amount of materials cannot be reduced, products should be "reused" as much as possible, thereby decreasing the demand for new production. If materials cannot be reduced or reused, the materials contained within the products should be "recycled" or used as source materials for new products.

Many countries have introduced national legislation related to the 3R approach. Japan, for example, set up a comprehensive legal framework to promote the 3R approach. In 2000, five milestone laws were passed, including the Fundamental Law for Establishing a Sound Material-Cycle Society and the Law for the Promotion of Effective Utilization of Resources. Laws for promoting specific waste recycling were also passed in subsequent years, such as the End-of-Life Vehicle Recycling Law and the Containers and Packaging Recycling Law. China has also taken steps towards a 3R approach and in 2008 adopted a law to promote a circular (recycling) economy. However, many developing countries are still facing implementing difficulties and require assistance and ideas on how to bridge the policy enforcement gap.

Several upstream policies are focused around the concept of extended producer responsibility. Such policies place responsibility for a product's end-of-life environmental impacts on the original producer and seller of that product. They provide incentives to producers to consider environmental issues in the design of their products and to reduce the materials used, thus improving the product's recyclability and reusability and decreasing waste management costs.

Common policies and instruments that fall under the concept of extended producer resposilitities include the following:

- **Mandated product take-back schemes** require producers and vendors to be responsible for the collection of products and packaging at the end of a product's useful life. In addition, governments may require each producer to meet specific recycling rate targets. This encourages producers to take into account the concepts of waste reduction and material reuse and recycle in designing products because they ultimately will be responsible for them. In Japan, for example, the Home Appliance Recycling Law requires the manufacturers and importers of air conditioners, televisions, electric refrigerators and electric washing machines to take back the end-of-life equipment and recycle it.

- **Deposit and refund schemes** are a type of product take-back policy and refers to a payment (deposit) made by manufacturers and importers of certain products into a fund. Consumers are given a refund when returning the products to the dealer or treatment facilities. The physical responsibility for operating these schemes is delegated to manufacturers of the products who need to agree on

administrative arrangements with retailers. Deposit and refund schemes have been mostly used on beverage containers. It incentivizes reduction of material inputs, contributes to increased collection and recycling rates and encourages the reuse of the products.

- **Advanced disposal and recycling fees** are paid by manufacturers to cover the cost of recycling or disposing of products. Fees may be assessed by weight or per unit of product sold. In some cases, this policy may be changed from producer responsibility to consumer responsibility; the increased costs are transferred to consumers and the tax is displayed as a separate line item on the bill. In Australia, for example, a National Used Tyre Product Stewardship Scheme was instituted to divert end-of-life tyres from landfills.[158]

Positive outcomes can be achieved by applying downstream policies on consumers and waste handlers. These types of policies have the ability to capture some specific types of waste, such as food waste or clothing and other fabric waste that upstream policies may not address. However, downstream policies have less ability to differentiate charges based on the relative hazards imposed by different materials in the waste stream.

BOX 30: Dealing with the challenge of e-waste in the Republic of Korea

Waste from electrical and electronic equipment (WEEE or e-waste) is one of the fastest-growing waste streams in both industrialized and developing countries. Given the potential health and environmental impacts from the toxic materials they contain and the increasing volumes produced, e-waste has become a major issue of concern for local authorities. Several countries around the world enacted legislation to deal with the e-waste, notably in the European Union and Japan.

In April 2007, the Republic of Korea adopted the Act on Resource Recycling of Electrical Electronic Equipment and Vehicles to target the amount of e-waste going to landfills. The law imposes an extended producer responsibility approach, obliging producers to take financial responsibility for the collection, recycling and disposal of old equipment and appliances. The law covers a range of products, including home appliances (refrigerators, washing machines and air conditioners), information technology and telecommunication equipment (computers, printers, mobile phones) and consumer electronic devices (televisions, audio equipment, video cameras). The equipment is collected three ways: suppliers take an old product from consumers free of charge when they purchase similar new products; local governments collect items from households at designated areas near residential complexes; and private collectors pay consumers for the discarded items. The e-waste is then treated and recycled in privately run facilities.

Source: Yong-Chul Jang, "Waste electrical and electronic equipment (WEEE) management in Korea: Generation, collection and recycling system", Journal of Material Cycles and Waste Management (2010), vol. 12, No. 4, pp. 283-294.

- **Unit charging programmes or "pay as you throw" (PAYT)** schemes charge households a fee, either per unit or per weight, based on the waste collected. The fees are usually recovered in property taxes or utility bills. Pay-as-you-throw schemes encourage source separation, material recovery from recycling and reduction of transportation costs for collection and disposal. In the **Republic of Korea**, for example, households are required to separate recyclable items from non-recyclable waste. These separate waste streams must be disposed in government-issued plastic bags that households are required to buy. The amount of waste generated is measured by the size of the bags. After the adoption of the programme, the total amount of waste has decreased about 24 per cent between 1994 and 2004. Economic benefits accrued from 1995 to 2004 are more than 8 trillion won (US$8 billion) resulted from avoided waste treatment and market value of increased recycling products. The amount of recycles in 2004 was 2.8 times higher than in 1994.[159] In Japan, a number of municipalities have also implemented the pay-as-you-throw systems, leading to a reduction of waste of between 20 and 30 per cent.[160]

Integrated resource recovery centres

Integrated resource recovery centres (IRRC) recover valuable resources from waste. This approach can turn 80–90 per cent of waste into resources, leaving only 5–10 per cent of total waste to be disposed in a landfill.

Through their simple, non-mechanical technology, recovery centres can be built and operated at low cost. They directly benefit the urban poor, providing waste pickers with better, more stable incomes and safer working conditions. By limiting the amount of waste going to dumpsites, the centres also help the environment.

An IRRC can be initiated and operated by municipalities, private-sector enterprises and civil society organizations, or a combination of all three, through partnership models. The capacity to process waste can vary from 2 to 20 tonnes per day. IRRCs can be established within neighbourhoods, in several areas in one city or on the outskirts of a city.

An IRRC carries out three primary activities: collection of segregated waste, processing of waste and selling of resources produced from the waste. Income streams can include: i) collection fees from serviced households; ii) sale of compost; iii) sale of recyclables to junk dealers and iv) income from carbon financing.

IRRCs use the following systems to recover resources from waste:

- **Enriched compost:** Through compost enrichment, the IRRC produces different types of fertilizer for specific soil and crops by varying the quantities of nitrogen, phosphorus and potassium and other nutrients that are added. Unlike chemical fertilizer, organic fertilizer returns organic matter to the soil, thus replenishing it and reducing the amount of fertilizer needed, reducing costs and reducing the pollution from excess chemicals in the soil.

- **Biogas plant:** Fish and animal waste cannot be used for compost, but it can be made into biogas using a digester, which can be installed on farms. The biogas can be used for cooking and generating electricity.

- **Recyclable materials:** Inorganic wastes, including plastics and metals, are sorted, cleaned, compacted and stored before being sold to bulk buyers.

- **Used cooking oil recycling unit:** In an IRRC, used cooking oil can be converted into biodiesel, which can run in an unmodified diesel engine. This is an environment-friendly alternative to higher-emission petroleum diesel and can be sold or used in vehicles operated by the IRRC. This process addresses the problem of used cooking oil being disposed into the drainage system of many developing cities.

ESCAP is currently promoting the uptake of IRRCs in the Asia-Pacific region together with Waste Concern, an NGO from Bangladesh (box 31).

BOX 31: Integrated resource recovery centres solve the waste challenge in Matale, Sri Lanka

As with many cities in the region, solid waste management was a challenge in **Matale**, a medium-sized urban centre in central Sri Lanka, with a population of almost 37,000. The city generated 21 tonnes of municipal waste per day, which was disposed into an open dumpsite. Although 20 per cent of the Municipal Council's budget was spent on solid waste management, there was no town-wide collection. Since 2006, the solid waste management situation has improved through a pilot project initiated by ESCAP with the Municipality of Matale and the NGO Sevanatha Urban Resource Centre to set up an integrated resource recovery centre. The objective was to reduce costs for the municipality while providing a business opportunity for local entrepreneurs, improving services to households and managing waste in a more eco-efficient manner. Building on the success of the pilot project, the Matale Municipal Council opted in 2010 to treat all of the town's waste in the same way. The approach is scaling up to treat 20 tonnes of waste per day, as part of a regional ESCAP project on pro-poor and sustainable solid waste management.

FACT SHEETS

- Extended producer responsibility
- Integrated resource recovery centre

CASE STUDIES

- Republic of Korea's volume-based waste charging scheme
- Sri Lanka's community-based decentralized solid waste management


Opportun


be pe
ment


8783.49
2651.89

2.4 TRACK 4
Turning green into a business opportunity

Greening the economy requires upgraded infrastructure and better goods and services and opens up significant opportunities for business. But governments need to create the conditions for businesses to thrive in a green economy.

Key points

System change for green growth will provide significant opportunities for businesses. The transition to a green economy comes with challenges. It also opens up opportunities. Greening the economy requires upgraded infrastructure and better goods and services. For all the challenges and the fears, what is less known is how the greening of an economy can be an engine of growth – driving towards profit and new jobs. Most of the opportunities that such a transition enables will be in emerging markets, especially in the Asia-Pacific region. Businesses stand to gain from this transition. The reality of the green change is inevitable, which means the businesses that embrace it earliest will likely benefit the most from the first-mover advantages.

Governments need to create the enabling environment. Governments need to create the conditions for businesses to thrive in a green economy. Governments need to bridge the gap between short-term costs and long-term benefits and reduce the uncertainty and risk for investors. This will require a mix of regulatory and economic, fiscal and information instruments, in particular: allowing market prices to reflect the real cost of energy and natural resources; using public finances strategically to leverage private investment; greening public procurement practices; resource efficiency policies and incentives; promoting transparency (through environmental reporting); and consumer awareness (through eco-labelling); and enacting predictable long-term and transparent legislation (greenhouse gas emission targets) that give businesses time to adjust.

Business as usual is no longer an option. It is increasingly clear that business-as-usual practices will not sustain prosperity. Businesses are facing increasing risks and uncertainty due to the price volatility of natural resources and energy and to climate change impacts. To be competitive and sustain growth, businesses have to be more efficient in their use of the natural resources and energy. A growing consumer conscience on environmental issues is another formidable

influence on businesses, pressing them to be more productive, efficient and environment-friendly.

Many businesses around the globe are realizing the new reality and are starting to act, often ahead of governments. The trend in environmental reporting is escalating. For example, 81 companies of FTSE 100[161] are now publishing reports solely on the environmental implications of their activities.[162] The private sector is aware of the importance of greening the business, which is changing the rules of the game in the market. If companies ignore the greening trend, they will not survive. It is better to prepare and green early than to watch as the situation moves from bad to worse. Given the rising wave of green consumerism worldwide, how green the services and products are is becoming a critical source of competitiveness in the Asia-Pacific region as well.

Green business: Definitions, trends and opportunities

Urbanization, a growing middle class, efforts to reduce greenhouse gas emissions, resource constraints, environmental degradation and adaptation to climate change – all these trends will create great possibilities for green business.

There is no agreed definition or classification of "green business". When talking of green sectors, reference is usually made to the environmental goods and services industry. The OECD defines environmental goods and services as those that "measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as manage waste, noise and ecosystems".[163] The United Nations Industrial Development Organization uses a two-pronged strategy for its green industry initiative: i) greening of existing industries and ii) establishing a vibrant and innovative environmental goods and services sector.[164]

This Roadmap does not aim to offer any new definition or classification for green business. It illustrates the myriad opportunities arising from a shift to low carbon green growth, which essentially breaks down into two categories:

1. **Improving the eco-efficiency of economic activities: reducing the environmental impact of both production and consumption.** This includes all opportunities arising from assisting existing and emerging industries to reduce the environmental impact of their operations (energy, water and material consumption, emissions and waste) and from the environmental goods and services sector (cleaner production, energy efficiency, renewable energy, environmental monitoring, waste management and recycling).

2. **Investing in natural capital.** This includes all opportunities arising from the sustainable use of biodiversity and ecosystems, such as organic agriculture, certified forestry products, carbon offsets and ecotourism.

Green business is already growing. The world market of low-carbon and environmental goods and services had already reached £3.2 trillion (about US$4.7 trillion) in 2008, up 5 per cent from the previous year.[165] This was bigger than the GDP of Japan in 2009. Emerging low-carbon sectors account for about half of the world market of environmental goods and services, while **renewable energy** and traditional environmental sectors account for 30 and 20 per cent, respectively. The market is estimated to involve 1.4 million companies and employ more than 28 million people; and it's expected to grow by approximately 4 per cent annually over the

next five years.[166]

Some low-carbon sectors have been among the few to grow through the current economic crisis. Analysis from Bloomberg New Energy Finance reveals that asset finance of utility-scale clean energy projects surged to a record US$41.8 billion in the third quarter of 2011, up 9 per cent on the year's second quarter, with overall new investment reaching US$45.5 billion – despite the European debt crisis.[167]

As part of the World Business Council for Sustainable Development's Vision 2050 project, PricewaterhouseCoopers estimated the potential additional opportunities arising from sustainable approaches by 2050 at around US$3–$10 trillion annually, at constant 2008 prices, or up to 4.5 per cent of world GDP (table 9).[168]

Protecting biodiversity and sustainably managing ecosystems encompasses important business opportunities. National parks reserved for biodiversity conservation and traditional culture can attract tourists interested in ecotourism. **Ecotourism** is the fastest-growing market in the tourism industry. Although there is no statistical reference that focuses only on ecotourism, the industry is experiencing rapid growth in the Asia-Pacific region. In 2010, inbound tourists in the region exceeded 200 million, up 13 per cent from 2009. Region-wide expenditures by inbound tourists rose to US$249 billion in 2010, increasing by nearly 22 per cent in a single year.[169] Assuming that the Asia-Pacific region follows the global pattern, it is likely that a roughly estimated 7 per cent of the region's international tourism could be characterized as ecotourism, with several countries exhibiting larger proportions.[170] Suncheon, Republic of Korea attracted more than three million visitors a year and economic benefits amounting to US$89 million by turning its wetlands into an ecotourism attraction (box 36).

Global sales of organic food and drinks amounted to US$60 billion in 2010, a threefold increase since 2000, in spite of the economic slowdown.[171] Sales of certified sustainable forest products quadrupled between 2005 and 2007. In 2011, the global market for eco-labelled fish products attained a retail

Table 9: Estimates of potential additional sustainability-related business opportunities by 2050

Sectors	Annual value in 2050 (US$ trillion at constant 2008 prices: mid-points with ranges shown in brackets)	% of projected world GDP in 2050
Energy	2.0 (1.0 - 3.0)	1.0 (0.5 - 1.5)
Forestry	0.2 (0.1 - 0.3)	0.1 (0.05 - 0.15)
Agriculture and food	1.2 (0.6 - 1.8)	0.6 (0.3 - 0.9)
Water	0.2 (0.1 - 0.3)	0.1 (0.05 - 0.15)
Metals	0.5 (0.2 - 0.7)	0.2 (0.1 - 0.3)
Total: Natural resources	**4.1 (2.0 - 6.1)**	**2.0 (1.0 -3.0)**
Health and education	2.1 (0.8 - 3.5)	1.0 (0.5 - 1.5)
Total	**6.2 (2.8 - 9.6)**	**3.0 (1.5 - 4.5)**

Source: World Business Council for Sustainable Development, *Vision 2050: The New Agenda for Business* (Geneva, 2010). PricewaterhouseCoopers estimates drawing on data from the International Energy Agency, the OECD and the World Bank.

Table 10: Emerging markets for biodiversity and ecosystem services

Market opportunities	Market size (US$ per annum)		
	2008	Estimated 2020	Estimated 2050
Certified agricultural products (organic, conservation grade)	$40 billion (2.5% of global food and beverage market)	$210 billion	$900 billion
Certified forest products (FSC, PEFC)	$5 billion of FSC-certified products	$15 billion	$50 billion
Bio-carbon or forest offsets (CDM, VCS, REDD+)	$21 million (2006 data)	$10+ billion	$10+ billion

Note: FSC=Forest Stewardship Council, PEFC=Programme for Endorsement of Forest Certification, CDM=Clean Development Mechanism; VCS=verified carbon standard

Source: Joshua Bishop and others, *The Economics of Ecosystems and Biodiversity Report for Business*, Executive Summary (Nairobi, United Nations Environment Programme, 2010), adapted from Forest Trends and the Ecosystem Marketplace, *Payments for Ecosystem Services: Market Profiles* (Washington, D.C., 2008).

value of US$2.5 billion.[172] As shown in table 10, the market size for biodiversity and ecosystem services is projected to increase considerably in the coming decades.

Benefits

Investments and growth

The transition to a low carbon green economy will channel investments into eco-efficient projects. This presents great possibilities for new investments and growth for green businesses. Global figures vary, but the total clean energy annual investment cost in 2030 is estimated at between US$170 billion and $550 billion. In 2007, the World Bank estimated that US$160 billion per year is required to meet energy needs in developing countries, with a US$30 billion incremental cost to ensure these investments would be clean energy investments.[173] In 2008 analysis, Project Catalyst suggested that the extra cost for clean energy investment in all developing countries could reach up to US$60 billion per annum. The UNFCCC Secretariat estimated that additional investment and a financial flow of US$200–$210 billion will be needed globally to reduce carbon dioxide emissions by 25 per cent below 2000 levels by 2030. Over half of the additional investment is needed in developing countries, where about 70 per cent of global mitigation opportunities are projected to exist.[174]

Between 2010 and 2020, the region will need to invest an estimated US$8–$10 trillion in new infrastructure, 68 per cent of that for new capacity and 32 per cent for maintaining and replacing current infrastructure.[175] This is an enormous opportunity for economic growth and for channelling foreign direct investment. Infrastructure can represent an important share of GDP creation. In India, for example, a recent market survey placed the infrastructure sector as the largest contributor to the national GDP.[176] In turn, the quality of infrastructure hugely affects prospects of economic growth and can encourage new investment across the economy.

Jobs

Great opportunities for generating jobs will come from investment in eco-efficient infrastructure, in particular from sustainable mobility, energy efficiency in buildings and renewable energies. In China, for example, the railways sector employs some 1.8 million people,[177] while the renewable energy sector already creates an output worth US$17 billion and employs a million people.[178]

There is a growing market around new construction and the retrofitting of buildings in developing countries. In China, the construction market for residential and commercial buildings grows at a rate of 7 per cent per year, while the growth rate in India is 5 per cent.[179] Green building practices influence the greening of the whole supply chain, from eco-friendly construction materials to resource-efficient appliances, and jobs can be generated in all those related sectors.

Investing in natural capital and preserving ecosystems can also generate jobs. In India, every US$1 million spent on sustainably managed forestry has the potential to create between 500 and 1,000 full-time jobs. India could also generate 900,000 jobs by 2025 from biomass gasification projects.[180] Great opportunities are awaiting in the ecotourism potential of preserved ecosystems. For example, preserving wetlands in Suncheon, Republic of Korea led to 6,400 new jobs (box 36).

Early mover advantage

Although the size of the market for many green products and services is expanding rapidly, most opportunities remain untapped, given the projected expansion of the market in the coming decades. Companies that act now can profit from early mover advantages and from the "green ocean" – a very innovative, uncontested marketplace ripe for growth.[181]

Competitiveness and access to markets and financing

Because of rapidly increasing government responses to resource constraints, climate change and environmental degradation, and considering that a growing number of consumers will demand green products, environmental performance has increasingly become an influencing factor on competitiveness and market access. Big players are already taking action and imposing environmental and social standards throughout their supply chain. Companies that do not adapt to emerging requirements across global markets and supply chains will be quickly pushed out of business. Companies that adapt to and even anticipate such requirements are better able to respond to future requirements from markets and thus flourish.

Access to finance will be increasingly determined by how green companies are. Investors are increasingly more interested in companies that demonstrate genuine environmental and social performance because they recognize that this increasingly affects business sustainability. Responsible investment practices have become common features of the world's 100 largest pension funds.[182] Financial institutions and credit rating agencies are devising sustainability indices. In 2007, HSBC launched its Global Climate Change Benchmark Index (and four sub-indices) to track the stock market performance of key companies best placed to profit from the challenges presented by climate change.[183] Similarly, the international rating agency Standard & Poor's (S&P) and the International Finance Corporation launched in December 2009 the S&P/IFCI Carbon Efficient Index, which measures the performance of selected emerging market companies with lower levels of carbon

emissions. Performance of such indices shows that investments in environmentally sustainable industry sectors and companies can be financially rewarding, unlike the general perception that environmentally sustainable businesses are likely to be more expensive to invest in.

The long-term reliance on such instruments by investors in emerging market economies will raise the awareness of an asset class that is environmentally sustainable and offers market rates of return.

Savings and efficiency gains

By greening their operations through resource efficiency or cleaner production, industries and enterprises have opportunity to produce "more with less" – to deliver better goods and services with less resources and waste. These efficiency gains can translate into considerable savings, which largely offset the costs required to introduce such measures.

At the industry level, such innovative models as industrial symbiosis, green industrial clusters or eco-industrial parks help companies realize savings by "sharing" by-products and waste as inputs from one company to another. This closing of the material loop generates not only reduced emissions, waste and raw materials but also considerable economic benefits and new jobs. At the eco-industrial park in Ulsan, Republic of Korea, for example, an investment of US$5 million to exchange steam between the Sung-am municipal waste incineration facility and Hyosung Company generated profits of US$7.1 million per year, with a payback period of less than nine months and the hiring of 140 additional employees.[184]

Obstacles

A number of obstacles hamper the spread of green business, including the following:

- **Time and price gaps:** The time and price gaps highlighted previously are among the main obstacles to green business. The benefits of going green largely manifest over time, while necessary investment is upfront and businesses are pressured to deliver results in the short and medium terms. Additionally, many of the benefits may accrue to third parties and not to those who make the investment. At the same time, unless the real costs of energy and natural resources are reflected in the market, green businesses will not have a level competing field, and there will be little incentive for companies to green their operations. Thus governments need to create the business case for sustainable solutions by bridging the time and price gaps. The private sector will never drive green growth if business-as-usual practices are more profitable than sustainable ones.

- **Uncertainty:** Another significant factor that holds back investment in green businesses is uncertainty. Businesses need predictable and transparent legislation and certainty about costs in order to prepare business cases and plans. Uncertainty over policies translates into uncertainties over return on investment. The uncertainly and slow progress of the current international climate change negotiations, for example, is discouraging long-term investment. The same applies to national policies and targets. Many businesses are ready to act, but they are waiting for reassuring signals from governments. Policymakers can

choose among the policy options that lead to environmental objectives but are more business friendly. A carbon tax may be more preferable to businesses than a cap-and-trade scheme because there is more certainty about the costs. In Australia, for example, a group of leading businesspeople issued a statement that they "strongly support the introduction of a well-designed carbon price to support the transition to a low-carbon economy".[185]

- **Technical know-how:** Many businesses may want to go green, but they lack the know-how to introduce sustainable solutions and maintain them. While this is a hurdle for many businesses, especially those that are small and medium-sized, it provides new business opportunities for third-party companies, like energy service companies (ESCOs).

- **Consumer awareness:** Consumer awareness can also be a problem. Consumers are largely unaware of green products. Even with awareness, they may not know how their purchasing choices benefit the environment. According to McKinsey research, more than one third of the consumers who want to help mitigate climate change don't really know how.[186] Some consumers also have the misperception that green products perform less well than conventional ones. Others are confused by the plethora of environmental labels. False green claims or "green washing" of many companies can erode consumer confidence in the information that companies provide.

Policy options

To stimulate green business and allow markets to drive the transition to a green economy, governments need to enable and guide markets by removing the obstacles. A range of policy instruments exists, as pointed out in table 11.

The spectrum of policy areas and strategies for promoting green as a business opportunity is very broad and touches upon traditional policy areas in support of business promotion, such as trade and investment policy, industrial policy, employment policy and innovation policy. There are four key policy areas that can be emphasized: **green industry, green technologies, green financing** and **green jobs**. Policies related to technology, financing and employment are discussed in section 2.6 on the means of implementation. The following describes policies for promoting green industries (see greater detail in the fact sheets and case studies listed at the end of the section).

Greening existing industries

All industries, regardless of sector, size or location, continuously need to improve their environmental performance. This includes commitment to and actions aimed at reducing the environmental impacts of processes and products by using resources more efficiently, phasing out toxic substances, substituting fossil fuels with renewable energy sources, improving occupational health and safety conditions, taking increased producer responsibility and reducing the overall risks for the environment.

Energy and resource efficiencies drive the **greening of industries**, which makes business sense because they reduce the cost of production as well as the cost of compliance with future environmental standards.[187]

Table 11 : Policy instruments for promoting green as a business opportunity

Category	Subcategory	Description
Regulatory instruments	Target setting	National or sector targets for greenhouse gas emissions, carbon intensity, energy intensity, etc.
	Standards	Performance standards, technology standards, ambient standards, bans and limitations, etc.
	Environmental regulations	Mandatory assessments (such as an environmental impact assessment)
Economic instruments	Fiscal instruments	Taxes, subsidies
	Charge systems	Pollution charges, product charges, user charges, etc.
	Market creation	Tradable emission permits
	Financial mechanisms	Grants, soft loans, funds and green procurement
Information Instruments and tools to engage the private sector and civil society	Eco-labelling	Mandatory or voluntary labelling for various products – general or impact-specific (such as energy labels)
	Voluntary agreements	Voluntary agreements with specific industries, for example on greenhouse gas emissions reductions or energy efficiency, eco-industrial parks
	Corporate social responsibility (CSR) and environmental reporting	Voluntary for overall CSR, partially mandatory agreements with environmental reporting, such as the amount of greenhouse gas emissions
	Partnerships	Partnerships with research institutes and private sector for R&D in key sectors or technologies
	Education and training	Education for sustainable development, awareness campaigns or awards

There are many practical approaches to greening an industry, such as:

- Circular economy
- Cleaner production
- Industrial symbiosis
- 3R – reduce, reuse, recycle.

To promote such approaches, it is essential that governments set up the enabling conditions. In the Republic of Korea, for example, the 1995 Act to Promote an Environment-Friendly Industrial Structure provided the necessary legal framework for a series of actions to transform industrial complexes into eco-industrial parks (box 32). Voluntary approaches can also be effective in stimulating private companies to green their operations. **Japan's Green Power Certificate** programme, for example, provides recognition to those companies whose electricity consumption is supplied from power produced from renewable energy.

Promoting new green products and services

Green growth is an opportunity for new industries to emerge. Green growth requires greener technologies. Enhancing energy systems, for example, provides the opportunity to develop the **renewable energy** industry as well as next-generation technologies, such as **carbon capture and storage** and **smart grids**. In some instances, the spread of these technologies generates a market for other goods and services. For instance, although smart grids are not yet commercially ready, other related technology, such as smart meters and smart appliances, have a sizable market growth potential (box 33). Governments can have a hugely influential hand in how these technologies develop, mature and ultimately are adopted. **China** has become the largest consumer of wind power thanks to strategic policies, including concession projects at the early stages and a **feed-in tariff** at a later stage, and through national targets, under the Guarantee of Renewable Energy Law and its related regulations. **Denmark** was a pioneer in developing wind power in the 1970s and today its companies are global leaders in wind turbine manufacturing.

BOX 32: Eco-industrial parks reap huge profits in the Republic of Korea

In an eco-industrial park, the waste generated by one company is used as a resource for another, leading to a clear business case for a green industry practice. The eco-industrial park in Gyeonggi, Republic of Korea demonstrates how linking various actors promotes eco-efficiency and generates win-win situations. The recovery of copper from wastewater as well as the reuse of the treated wastewater generates an annual profit of 4.72 billion won (around US$4.2 million), thanks to the initial government investment of 440 million won (around US$400,000). Eight eco-industrial parks operate with support and coordination from the Ministry of Knowledge Economy. According to the Government, the annual resource saving is equivalent to 41.2 billion won (around US$37 million). Additionally, the practice avoids the production of 250,000 tonnes of by-products, 37,000 tonnes of wastewater and 280,000 tonnes of CO_2.

Source: Republic of Korea, *Ministry of Knowledge Economy, "Outcomes and Future of Korea's Eco-Industrial Parks Optimizing Resource Efficiency"*, News release, 1 December 2010.

A push towards sustainable mobility provides the opportunity to develop industries around new technologies, such as **electric vehicles** and plug-in hybrid electric vehicles (box 34). Policymakers should agree on a national target for electric vehicles, which would help create a stable market for the industry and provide incentives for consumers and manufacturers, which would increase the cost competiveness of these vehicles. Governments can guide car producers and the public towards more environmentally-friendly vehicles through fiscal incentives. **Thailand**, for example, has boosted **tax incentives** to attract global car makers to invest in the production of small passenger vehicles ("eco-cars") for its domestic and export markets.

Greening the economy provides also an opportunity to develop new materials. In **Thailand**, for example, the Government saw the opportunity to develop the **bioplastics** industry, given its abundance of biomass. To help develop and promote bioplastics industry and establish Thailand as the bioplastic hub of the region, the National Innovation Agency initiated the "2007–2011 National Bioplastics Roadmap".

Greening the economy will also require new services. The push towards energy efficiency, for example, opens opportunities for **energy service companies** (ESCOs) (box 35). The ESCO industry offers a way to fill the time and price gaps of high-capital energy-efficiency projects. Government-led energy saving goals can promote the ESCO industry in both the public and private sectors. Because the ESCO is a relatively new concept outside of the United States and Europe, there is much room for market expansion. For example, ICF International, a consultancy firm, estimated the investment potential in energy efficiency in India at around US$10 billion.[188]

Turning natural capital into a business opportunity

Preserving ecosystems and investing in natural capital also creates the opportunity to generate profit and employment. Suncheon on the south coast of the Republic of Korea, for example, has demonstrated how investing in ecosystems can stimulate economic growth that is green and sustainable thanks to the opportunities brought about by **eco-tourism** (box 36).

Sustainable agriculture practices, such as organic agriculture, marry the need for preserving ecological integrity and the need for profit. Organic and biodynamic farming

BOX 33: Potential growth in the smart meter market

Smart meters let system operators and consumers know when demand for electricity is outstripping supply and thus they can curtail the use. The global number of smart meters installed is expected to reach 535 million units by 2015 and 963 million units by 2020. The Asia-Pacific region is expected to be a major contributor to the growth in use, with China's state grid smart meter market alone valued at US$7.7 billion and a potential market of 300 million smart meter units. Currently, China has a smart meter base of around 70 million. The state grid is expected to install smart meters at a rate of 50–60 million units per year through 2014.

Source: Metering International Magazine, "Efficiency from metering to service solutions", 2011, Issue 3.

BOX 34: Electric vehicles and plug-in hybrid electric vehicles

Electric vehicles use an electric motor for propulsion and batteries for electricity storage. The energy in the batteries provides all the motive and auxiliary power on board the vehicle. Batteries can be recharged from grid electricity, brake energy recuperation and potentially from off-grid sources, such as photovoltaic panels.

Plug-in hybrid electric vehicles use both an engine and motor, with sufficient battery capacity to store electricity generated by the engine or by brake energy recuperation. The batteries power the motor when needed, provide auxiliary motive power to the engine or even allow the engine to be turned off while moving at low speeds.

Source: International Energy Agency, Technology Roadmaps – Electric and plug-in hybrid electric vehicles (Paris, 2009)

BOX 35: Energy service companies

Typically, energy service company (ESCO) services are offered through performance-based contracting. An ESCO acts as an energy-efficiency project developer, in which the costs of a project are repaid through the energy savings generated. In other words, ESCO revenue is directly linked to the actual energy savings. The potential for improving energy efficiency exists in all residential, commercial, industrial, agricultural and municipal corners of an economy.

systems have soils of higher biological, physical and, in many cases, chemical quality than that of conventional practices. When social and environmental costs are accounted for, the organic alternative is economically competitive. The market for global organic food and beverage is currently estimated at around US$51 billion and expected to reach US$104.5 billion by 2015.[189] Governments can support organic and sustainable agriculture by consolidating organic standards and instituting certification and regulatory mechanisms, technology packages and market networks.

Promoting corporate social responsibility

Private sector decisions are affected by consumer and employee pressures towards greater corporate social responsibility (CSR). This often produces win-win results for companies – increasing both consumer approval and staff morale while quickly recuperating any investment costs. CSR measures in relation to the greening of business include: the purchase or in-house generation of renewable energy; increased efforts to reduce, reuse and recycle input material,

BOX 36: Restoring a tidal ecosystem to attract tourism in Suncheon, Republic of Korea

Suncheon was once regarded as fairly backward compared with neighbouring coastal cities, which had reclaimed tidal wetlands to host major petrochemical complexes and steel mills, because it took an opposite approach. Beginning in the late 1990s, the Suncheon city planners turned the undeveloped tidal ecosystem into a source of competitive advantage. The city government and many citizens worked to protect the endangered hooded cranes and restore the tidal ecosystem of Suncheon Bay, enabling the city to emerge as a centre of ecotourism, attracting more than three million visitors a year (more than ten times its population) and creating 6,400 jobs and economic benefits amounting to 100 billion won (US$89 million) as of 2010.[190] Suncheon Bay is now the symbol of ecotourism in the country and one of the world's five largest coastal wetlands (and registered to the Ramsar Convention). Suncheon won the silver medal at the International Awards for Liveable Communities (LivCom Awards) for its environmental management and efforts for creating a liveable community. This success did not come easily, however. Businesses and landowners initially resisted the plans to relocate commercial areas out of the bay area and turn rice fields into a reserve for the migratory birds. The critical factor for mobilizing support behind the scheme was strong leadership from the mayor, Kwankyu Roh, who held to his firm conviction that a rich and vibrant ecosystem can drive economic growth.

water and waste; reducing pollution through better technologies; increasing telecommuting; reducing travel and increasing the use of video conferencing; and balancing carbon emissions by purchasing carbon offset schemes.

Most large transnational corporations now recognize the importance of CSR. Yet the standard of communication varies widely. There is a role for policymakers to enhance the quality of communications. Various policy options exist, such as supporting the harmonizing of CSR reporting and mandating such standardized reporting through stock exchange listing requirements.[191] The more far-sighted companies in the Asia-Pacific region will engage in such behaviour out of self-interest. But too many still confuse CSR with philanthropy. Governments can nudge them in the right direction by increasing awareness of the benefits of CSR, highlighting good examples, and offering incentives for more desirable business behaviour. The United Nations Global Compact is one of the global CSR instruments to help governments and companies advance the CSR agenda.

Promoting eco-labelling

Information on the environmental impacts of products through labels (eco-labelling) is critical for raising awareness, fostering sustainable consumption and assisting environmentally conscientious consumers (both businesses and individuals) in identifying green goods and services. Eco-labelling schemes can be mandatory or voluntary, driven by government, businesses or NGOs. The increasing interest in eco-labels, however, has led to a proliferation of various kinds

of labels, with differing scope, approaches and methodologies. This can be confusing for consumers and be a hurdle rather than an aid in promoting green products.

Governments can help by providing a basic legal framework for eco-labels, promoting the adoption of internationally agreed standards (such as ISO standards) and good practices as well as enhancing credibility. Many national eco-labelling schemes have been developed in the region, such as Japan's Eco-mark, China's HUAN eco-label, India's Ecomark or Thailand's Green Label. Some countries have also started promoting carbon disclosure through labelling. In some countries, such as Japan, Republic of Korea and Thailand, carbon footprint programmes have been introduced on a trial, on a voluntary or mandatory basis. Singapore's Green Labelling Scheme is now branching out into South-East Asia to promote green products, having certified to date 211 products from Malaysia and 58 from Indonesia. The scheme is set to expand also to Cambodia, Lao PDR and Viet Nam.[192]

POLICY PAPERS

- ***Promoting Trade and Investment in Climate-Smart Goods, Services and Technologies in Asia and the Pacific***
- ***A Comparative Study of Selected Asian Countries on Carbon Emissions with Respect to Different Trade and Climate Changes Mitigation Policy Scenarios***
- ***The Impact of Climate Change on the Agricultural Sector: Implications of the Agro-Industry for Low Carbon Green Growth***

FACT SHEETS

- Appliance standards and labelling
- Building certification
- Corporate social responsibility and environmental reporting
- Eco-labelling
- Eco-resorts and hotels
- Ecotourism
- Electric vehicles
- Energy service companies
- Extended producer responsibility
- Feed-in tariff
- Green finance
- Green industry
- Green jobs
- Green marketing
- Green New Deal
- Green public procurement
- Green technology
- Renewable energy
- Smart grid

CASE STUDIES

- China’s renewable energy policies
- Denmark's renewable energy policies
- Green technology grows rural roots in least developed countries
- Indonesia’s micro hydropower projects
- Republic of Korea’s green credit card
- Republic of Korea’s smart grid development
- Japan’s Green Power Certificate scheme
- Japan’s Top Runner programme
- Thailand's bioplastics companies
- Thailand's tax incentives for eco-cars


CO_2


Change
Just Ahead


Threat
Opportunity

2.5 TRACK 5

Formulating and implementing low-carbon development strategies

Although policymakers realize the need for action to respond to climate change, economic growth needs to be sustained to meet pressing socio-economic development goals and improve living standards. Climate change mitigation and adaptation need to be aligned with these goals. A low-carbon development strategy allows combining national economic development and climate change planning into a more integrated and coordinated approach.

Key points

Climate change is one of the most prominent indicators of unsustainable growth patterns. If we are to limit the increase in global temperature to less than 2° C by 2050 to avoid dangerous climate change, global emissions have to be reduced by half by then. The Asia-Pacific region, while emitting relatively low levels of greenhouse gases on a per capita basis, is one of the fastest-growing sources of climate-impacting emissions. Policymakers realize our societies have to respond to climate change.

At the same time, there is pressure to sustain economic growth to achieve socio-economic development goals and improve living standards. If climate change mitigation and adaptation are seen as in conflict with these goals, they may not be prioritized. Low carbon green growth, on the contrary, is about harmonizing environmental protection and economic growth and using climate action to drive the new growth. This section explains how the policy instruments highlighted in the previous sections can be combined to support a low-carbon development strategy.

A low-carbon (or low-emissions) development strategy is generally used to describe a forward-looking national economic development plan or strategy that encompasses low-emissions and/or climate-resilient economic growth.[193] In the context of the United Nations Framework Convention on Climate Change (UNFCCC) negotiations, the term "low-emissions development strategies" was introduced in 2008 in the context of a shared vision to ensure ambitious collective action on climate change.[194] During the sixteenth UNFCCC Conference of Parties (COP 16) in 2010 and as part of the Cancun Outcomes, the delegates agreed that "developed countries should develop low-carbon development strategies or plans" and that they encourage "developing countries to

develop low-carbon development strategies or plans in the context of sustainable development"[195] as part of their national mitigation actions.

A number of developing countries have started concentrating on low-carbon development strategies. In India, for example, the prime minister set up an Expert Group on Low Carbon Growth Strategies for Inclusive Growth to work out the specific polices and measures to achieve the long-term goals of the National Action Plan on Climate Change. One of the central pillars of India's Twelfth Five-Year Plan, to be announced in April 2012, is low-carbon inclusive growth. The Expert Group is also preparing India's roadmap to low-carbon inclusive growth, to feed into the Five-Year Plan.[196]

Similarly, the 2007 Indonesian National Action Plan Addressing Climate Change integrates mitigation and adaptation priorities into the Long-Term Development Action Plan (2005–2025) and the Medium-Term Development Action Plan. In 2010, the Government developed the Indonesia Climate Change Sectoral Roadmap to guide the low-carbon development plans in nine sectors for the next 20 years.[197]

A low-carbon development strategy combines national economic development and climate change planning into a more comprehensive, consistent and coordinated approach. It harnesses synergies, minimizes duplication and avoids trade-offs between existing strategies and plans.

Low-carbon development strategies provide important signals to the private sector on the direction for future investments and research activities. A long-term strategy is essential for promoting technological innovations and deployment of low-carbon technologies, which require considerable lead time for R&D before they become commercially viable. It is also important for guiding infrastructure development, which also requires long-term planning; once built, infrastructure creates path dependency.

Low-carbon development strategies can also provide the basis for planning, developing and implementing nationally appropriate mitigation actions (NAMAs). NAMAs are voluntary mitigation actions that developing country governments propose through the UNFCCC Secretariat. They are a set of government responses to reduce greenhouse gas emissions and are expected to be one of the main mechanisms for mitigation under a future climate agreement.

NAMAs allow developing countries to be recognized internationally for their voluntary actions that are based on their country context and can provide opportunities for attracting financing and technology transfer. A system for measurement, reporting and verification needs to be introduced to monitor emissions and reductions and promote transparency of financial flows and the deployment of technological support that are provided to a specific NAMA. Several countries in the region have submitted NAMAs to the UNFCCC Secretariat. India, for example, proposed to reduce by 2020 the emissions intensity of its GDP by 20–25 per cent of the 2005 level.

A low-carbon development strategy requires engagement across ministries, including planning, finance, environment, industry, trade, agriculture, forestry, transport and construction, and needs to be backed by political commitment at the highest level. Some countries already have national inter-ministerial coordinating mechanisms, such as a national climate change council or a committee chaired by the head of State, as in the case of Indonesia.

Although the components of what constitutes a low-carbon development strategy may differ due to the country context and development priorities, such strategies may include the following:[198]

- Vision – A long-term and shared vision is required to guide policies over the long run and to gather parties around a common purpose
- Assessments – This may include greenhouse gas inventories and projections to understand which are the major emitting sectors, vulnerability assessments to understand what would be the impacts of climate change and the mitigation potential and costs
- Short- to long-term targets and goals (economy-wide or sector-specific)
- Policy measures
- Specific programmes and projects
- Implementing plans
- Funding mechanisms
- Investment plans
- Institutional capacity and coordinating mechanisms
- Monitoring and evaluation plans

All these elements are important, but a few of them are worth emphasizing:

Updating greenhouse gas inventories

Improving carbon efficiency and productivity starts with the need for governments to collect and analyse data in order to track progress of mitigation actions. This includes a system to update the greenhouse gas inventory periodically and accurately. Understanding the sources of emissions and trends is the basis for setting goals and targets, tracking emission and reduction trends and monitoring the impact of mitigation policies. Without an efficient and accurate data collection system in place, it will be difficult to assess whether countries are decoupling emissions growth from GDP. The challenge for many developing countries remains the lack of capacity. A sharpened focus will be required, among others, on how to calculate comparable net greenhouse gas emissions for all countries, including non-Annex I Parties to the Kyoto Protocol (countries that do not have a legal obligation to reduce emissions under the protocol).[199] Greenhouse gas inventory will be one of the central tools for the measurement, reporting and verification system under the NAMA framework in order to assess reductions and track progress on mitigation actions.

Setting targets

Goals and targets are instrumental for aligning sector-specific and climate change policies and decreasing uncertainty for business and encouraging investments. Several countries in the region have set voluntary targets for greenhouse gas emissions reduction. China announced a 40–45 per cent reduction in emissions intensity from its 2005 levels by 2020. The Republic of Korea pledged to reduce carbon emissions by 30 per cent from its business-as-usual levels by 2020. Indonesia announced a voluntary target of reducing greenhouse gas emissions by 26 per cent by 2020, which could become 41 per cent if international funding is provided. Maldives pledged to become carbon neutral by 2020.

Pricing carbon

Putting a price on carbon is crucial for reducing carbon emissions, decreasing carbon intensity and stimulating green growth. It should be the cornerstone of any low-carbon development strategy. One way of doing this is through a **cap-and-trade** scheme, which generates a price for carbon by creating a market for trading emissions permits (low emitters sell their approved but unused allotment of emissions to high

emitters in an effort to limit emissions below the chosen cap). The Republic of Korea, for example, will introduce an emissions trading scheme in 2015. But the design and operation of such schemes are complex and need to be carefully considered; price fluctuations create uncertainty and are not conducive to long-term investments. Pilot phases or interim measures can be introduced before a full-scale cap and trade scheme, to allow participating businesses to prepare and gain experience. **The Republic of Korea's Emissions Target Management Scheme** launched in January 2012 is one such example.

A carbon tax may provide for a much more cost-effective solution. It may also complement and enhance the effectiveness of a cap-and-trade scheme. A carbon tax can be introduced as part of **environmental tax reform** (ETR) or **environmental fiscal reform** (EFR). It supports low-carbon development strategies by generating a double dividend – reducing the environmental impact while increasing growth and employment. ETR has proven to be very effective in reducing CO_2 emissions in **Europe**. Results of ESCAP modelling shown in section 2.2.2 indicate that a carbon tax introduced as part of ETR also has great potential in the Asia-Pacific region, especially in developing countries. In China, for example, emissions could be reduced by up to 21 per cent with positive impacts on GDP and employment if revenues are used to lower other taxes.

As previously stressed, it is important that carbon pricing policies are designed and introduced in a way that does not affect competitiveness and impact the poor.

Increased prices of energy and raw materials may also have a negative impact on certain industries, in particular on specific sectors that exhibit a high energy-intensity (sectors such as aluminium, steel, cement, paper, glass), high trade-intensity, high share of costs as energy expenditure and a low ability to pass costs on to consumers.[200] Special arrangements could be considered for these sectors, such as tax rebates, sector-based exemptions, loan guarantees, voluntary agreements, targeted subsidies for R&D, green job training and transition assistance.

The poor may be directly affected by carbon pricing measures; for example, if the tax increases the price of fuel used by the poor, such as diesel or kerosene. In other instances, the poor may be indirectly affected if their source of livelihood is threatened. Some studies have suggested, however, that a carbon tax may be progressive in some developing countries because higher-income groups tend to buy more carbon-intensive goods and energy-intensive sectors tend to employ skilled labour rather than informal workers.[201] In any case, it is important to carry out a detailed analysis of the effects and of how different social groups may be affected and, if need be, adopt interventions to address the distributional impact of a carbon tax.

Developing low-carbon infrastructure

Infrastructure is one of the main determinants of carbon intensity of economic growth patterns. Buildings, for example, are responsible for 30 per cent of annual greenhouse gas emissions globally,[202] while the transport sector accounts for 23 per cent of global energy-related CO_2 emissions, which is the fastest-growing source of emissions in developing countries.[203]

Urban planning and design considerably influences energy consumption and greenhouse gas emissions. Orienting cities for cars leads to urban sprawl and car-dependent development and, thus, higher energy consumption and greenhouse gas emissions.

Building cities around public transport networks helps reduce energy consumption and greenhouse gas emissions. As noted previously, Japan's urban areas are around five times denser than Canada's, and the use of energy per capita in Japan is around 40 per cent of what it is in Canada.[204]

A shift from road to rail greatly contributes to lowering emissions from the transport sector. The transport sector is a major consumer of energy resources – particularly petroleum products. It is also one of the major emitters of CO_2. In 2008, the Asia-Pacific region was responsible for 26 per cent of the energy consumed by transport globally, or 598 million tons of oil equivalent, which represents an increase of 34 per cent over consumption in 2000. The bulk of this (79 per cent) was consumed by the road sector, while rail accounted for only 4.4 per cent.[205] In particular, significant environmental and efficiency benefits can be achieved with freight movements by rail rather than by road or air.

Controlling the use of private cars through demand-side management mechanisms, such as **congestion charging**, parking restrictions and **license plate auctions**, contributes to lowering emissions. The introduction of **congestion charging in London**, for example, reduced CO_2 emissions by 16.4 per cent between 2002 and 2003.[206]

CO_2 emissions reduction in the building sector can be accomplished with either negative costs or marginal costs through mature low-carbon technologies aimed at reducing energy consumption and improving energy efficiency. The costs and potential to reduce CO2 emission vary according to the specific technologies. According McKinsey research estimates, US$600 billion of energy costs can be saved in developing countries with an additional investment of US$90 billion.[207]

To transition to a low-carbon economy, we must fundamentally reconsider the design of a comprehensive and integrated energy system. Most countries in the region are net energy importers – relying on fossil fuels – and they stand to be hardest hit by oil price increases and volatility. Governments in the Asia-Pacific region need to meet the growing energy demand while avoiding being locked into unsustainable energy systems. This will require increasing the share of energy generated from **renewable sources** and promoting **decentralized generation** as well as improving the efficiency of energy generation and transmission from conventional sources. Next-generation energy technologies will drive countries from a fossil fuel-based economy to a low carbon-based economy. Investments and early deployment of such technologies will allow abatement costs to be kept low. There are various types of promising technologies being developed along the innovation chain including **carbon capture and storage, smart grids** and **hydrogen and fuel cells**.

Properly managing solid waste can reduce greenhouse gas emissions. When biodegradable waste is deposited in a landfill it produces methane, a powerful greenhouse gas. Methane can either be captured or burned to produce energy or avoided through aerobic composting. Between 60 and 80 per cent of municipal solid waste in Asia's developing countries consists of organic material. This waste is currently sent to landfills and dumps where it contributes to a large amount of greenhouse gas emissions every year. Reducing the amount of food waste going to landfills thus provides great potential for reducing landfill waste volume as well as decreased methane emissions. **Integrated resource recovery centres** can turn 80–90 per cent of waste into resources, leaving only 5–10 per cent of total waste to be disposed in a landfill.

Promoting low-carbon lifestyles

Prices have a powerful effect on people's behaviour and affect decisions on what goods and services to consume and how much. Thus pricing policies have immense impact on consumption patterns. At the same time, promoting sustainable consumption requires additional interventions and instruments, such as standards, incentives, education, communication campaigns and labelling.

Financial incentives are useful for engaging consumers and households to make more sustainable choices. These may include grants or tax reductions. They can be particularly effective in spreading the use of new greener technologies. In the Republic of Korea, for example, the **green credit card**, launched in 2011 by the Ministry of Environment, encourages consumers to adopt more environmentally-friendly lifestyles by providing tangible economic rewards. Points are accumulated as rewards for saving on utility use (water, electricity, gas heating), using public transport or purchasing green products. Points can be used like cash to purchase products and services at a variety of places, such as hotels, restaurants and theatres, as well as to buy eco-friendly products, such as energy-efficient light bulbs. Similarly, the Seoul city planners developed in 2009 an individual incentive programme called Eco-Mileage. Reductions in electricity, water and gas earn points that are accrued in individual eco-mileage cards issued by designated partner banks. These points are used as cash when paying apartment maintenance fees, mobile telephone bills and taxes.

In **Japan**, the Government introduced the Eco-Point Programme in 2009 to stimulate the adoption of energy efficient appliances and as part of the economic stimulus package. Following the success of the scheme, the Government decided to introduce an **eco-point system for housing**, to encourage the construction and renovation of eco-friendly houses by offering reward points that can be exchanged for gift vouchers and eco-friendly products.

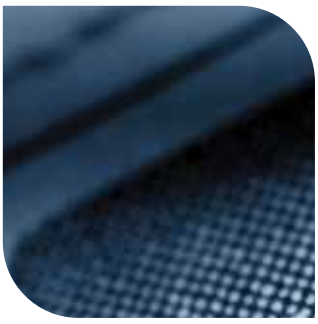
FACT SHEETS

- Cap-and-trade scheme
- Carbon capture and storage
- Carbon pricing
- Congestion and Road-use charge
- Decentralized energy system
- Environment tax reform and environmental fiscal reform
- Hybrid energy system
- Integrated resource recovery centre
- Low-carbon development plan
- Nationally appropriate mitigation action and measurement, reporting and verification
- Renewable energy
- Restricting licence plates
- Smart grid

CASE STUDIES

- Australia's carbon pricing scheme
- Brazil's National Plan on Climate Change and Law
- China's carbon trade
- China's low-carbon city project
- China's mitigation targets
- Europe's environmental tax and fiscal reforms
- European Union's Emission Trading System
- India's Solar Mission
- Indonesia's renewable energy policy
- Japan's housing eco-point system
- Republic of Korea's Emissions Target Management Scheme
- Republic of Korea's Framework Act on Low Carbon, Green Growth
- Republic of Korea's green credit card
- Republic of Korea's investment plan for low carbon green growth
- Republic of Korea's National Strategy for Green Growth and Five-Year Plan
- Republic of Korea's smart grid development
- London, United Kingdom's congestion charge
- Sri Lanka's community-based decentralized waste management
- United Kingdom's carbon budget
- United Kingdom's climate change levy
- United States' hydrogen economy


JOBS
AHEAD




JOB OPPORTUNITIES

2.6 Means of implementation

Once the time and price gaps are closed by changing the visible and invisible structures of the economy, then private investment will flow into eco-efficient projects, and green technologies will be deployed through the market, without the need for public subsidy. But introducing the system change required for low carbon green growth and pursuing the five tracks that can lead countries through the transition will require initial public financial resources, policies to stimulate R&D and retooled capacities.

Financing

The most important factor for mobilizing financing and technology will be changing market prices to reflect the social and environmental cost of resource consumption. Market price reform through **environmental tax and fiscal reforms**, coupled with supportive regulation, will create a level playing field for new and greener technologies and allow private investment to flow into eco-efficient solutions. ETR and EFR also allow for revenues from environmental taxes to be channelled into R&D programmes and further stimulate innovation and investments.

Although a transition to a green economy has the potential to result in higher growth ultimately, it requires substantial financial resources and these need to be used strategically.

Greening the economy ultimately requires greening business practices. On down the road, most of the investment required to drive low carbon green growth will need to come from the private sector. But private capital is unlikely to appear fast enough or on a sufficient scale unless it is encouraged and steered by public policy – by ensuring that green growth priorities that might previously have been seen as externalities are internalized into market mechanisms. As previously discussed throughout this Roadmap, long-term plans and regulatory and market-based approaches that encourage efficient resource management will channel private sector capital into these investments.

At the same time, it will be important to have public financing, especially in the short run. In particular, a sufficient amount of public funds are needed to catalyse the transition. The **Republic of Korea**, for example, has allocated 2 per cent of its GDP per year through its Five-Year Plan for Green Growth. Much of the needed funds will be required for eco-efficient infrastructure that in turn will

channel private sector capital into those investments. The introduction of environmental taxes and subsidy reforms can unlock substantial amounts of funds, which can be partly redirected to sustainable investments.

Government funds can also be used to leverage private funds. For private investors, the risks of many environmentally sustainable projects are not justified by the estimated returns. Public financing mechanisms can tilt the balance in favour of profitability, for example, by offering soft loans or guaranteeing the loans from private sector banks. Governments can also redirect part of public R&D spending to support the development of green technologies – as well as create frameworks of subsidies, taxes and rebates to channel private sector funding of research and development.

Green public procurement can act as a catalyst by creating markets for environmentally friendly goods and services. Public sector purchasing is a powerful force that can influence markets for green products and services. Green public procurement allows governments to leverage public spending to promote the country's social, environmental and economic policies, by creating markets for appropriate technologies and products and stimulating innovative solutions. Governments need to define clear policy frameworks and green criteria so that government agencies can execute green procurement standards. Governments also need to prioritize sectors for green public procurement, to ensure that public expenditure is not used in sectors where there is little room to influence the market or where the government cannot expect to find green or sustainable alternatives at a competitive price.

Access to private financing is also increasingly determined by how green a company's operations are. Investors are increasingly more interested in companies that demonstrate genuine environmental and social performance because they recognize that this affects business sustainability. Responsible investment practices have become common features of the world's 100 largest pension funds.[208] Financial institutions and credit rating agencies are devising sustainability indices, such as the HSBC Global Climate Change Benchmark Index.[209]

Carbon finance and mechanisms for payment for ecosystem services can help in funding low-carbon development and investments in natural capital.

Some low-carbon development projects have benefited from the Clean Development Mechanism (CDM) of the Kyoto Protocol. CDM projects in developing countries that demonstrate emission reductions can earn certified emission reduction credits (CERs) that they can sell to industrialized countries – which use the CERs to meet a part of their emission reduction targets. By boosting project viability, CER payments also help attract other sources of debt and equity capital. CDM provides opportunities for technology transfer. So far, however, the uptake of the CDM has been limited and concentrated in a few developing countries.

Private sector funds are another avenue for accessing carbon finance. Private carbon funds are able to harness private sector capital and, by using expertise from scientists and technology experts, are able to acquire and invest in green technologies across Asia. Some activities, though on a small scale, are being financed through voluntary carbon markets. Consumers wanting to purchase carbon offsets for products and services have been financing a number of small-scale projects.

The proposed mechanism under discussion at the UNFCCC aimed at reducing emissions

from deforestation and forest degradation (**REDD**), plus the role of conservation, the sustainable management of forests and the enhancement of forest carbon stocks (**REDD+**) in developing countries will provide opportunities to channel funds from the North to the South for investments in natural capital that can help in poverty reduction and low-carbon development. Although the REDD+ framework is still being discussed, funds and initiatives on REDD+ are already available for the benefit of developing countries. These include the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD) and the Forest Carbon Partnership Facility, with trusteeship from the World Bank.

In a similar vein, governments across the region are exploring the potential of rewarding communities that preserve ecosystems; for example, by sequestering carbon, maintaining the aesthetic beauty of the environment, or managing watersheds to the benefit of those living downstream. These payments for ecosystem services can be in cash or in non-monetary forms, such as greater market access, more secure land tenure, better local infrastructure or help in building local knowledge and capacity. In Lombok, Indonesia, for example, downstream water users are now paying upstream rural communities for managing the forest land on which the water supply depends.

All of these mechanisms will be instrumental in mobilizing the required financial resources.

Overseas development assistance (ODA), however, remains a critical source of funding for countries with special needs, such as least developed countries, landlocked developing countries and small island developing states. Its continued presence is necessary in the transition to a green economy. ODA can support the critical investments required in infrastructure as well as catalyse foreign direct investment. Multilateral and bilateral finance institutions are also instrumental in influencing the financing decisions of the private sector, which values their ability to enhance the credit worthiness of projects, particularly for the construction of long-term infrastructure.

Technology and innovation

Achieving environmental sustainability requires changes in public policy, business strategies and personal behaviours. But it also requires better technologies.

Green technologies will not just change the character of economic growth, they will also help drive growth. This has happened in industrialized countries where **R&D investment** in green technologies has contributed to innovation and economic competitiveness. Similar opportunities have opened up in middle-income developing countries with high-technology capabilities, such as China, India, Malaysia and Thailand. **China**, for example, has rapidly become the world's leading manufacturer of solar photovoltaic panels. Investment for R&D on technologies for sustainable development in the Asia-Pacific region, however, is still at relatively low levels. If the region is to make faster progress, the more developed countries will need to increase investment.

Richer countries can invest in developing new systems. But for developing countries an important condition for ensuring environmental sustainability is their access to appropriate green technologies. The bulk of it, however, is protected by intellectual property rights that tend to be dominated by corporations based in industrialized countries, reducing the access of developing countries to relevant technologies.

While most technology transfer is currently driven by the private sector, in the case of green growth a strong impulse can and should come from the public sector. Many steps in the development, transfer and diffusion of environmentally sound technologies, particularly those that are not immediately viable or profitable, will benefit from public policies, initiatives and support structures. This can start with basic research. Publicly funded research can lead to considerable economic benefits, both direct and indirect – as happened with the Green Revolution. However, most of these potential benefits have yet to materialize.[210]

One problem is the lack of effective national systems of innovation in the region. Some good examples exist, such as the National Innovation Agency of Thailand, but in most countries in the Asia-Pacific region such systems remain weak. To some extent these gaps could be filled by a regional network. The ESCAP Asia and Pacific Centre for Transfer of Technology (APCTT), for example, could guide and support a network of centres or agencies to develop good practices. Indeed, instead of setting up expensive national training and research institutions in each country, it may be more effective to create them at the regional level. This would be particularly appropriate for the many small islands in the Pacific.

Many other countries in the region will also require assistance for the diffusion of clean energy technologies. They should be able to rely on greater bilateral, regional and international cooperation. Industrialized countries should promote the transfer of publicly-funded environmentally sound technologies (box 37).

Only an appropriate enabling environment will spur technological innovation for green growth. Governments need to provide policy certainty through national frameworks, such as low-carbon development strategies or technology roadmaps as well as a level competing field through, for example, tax

BOX 37: Tapping into the potential of publicly funded technologies

Agenda 21, adopted at the Rio Summit in 1992, highlighted the need to strengthen developing countries' access to environmentally sound technologies. This requires governments to establish specific policies to promote and establish effective modalities and mechanisms for the development, diffusion and transfer of environmentally sound technologies in the public domain (those that are freely accessible and usable), in public ownership (those publicly owned technologies that require acquisition on the basis of the intellectual property rights held by the public entity) and those in private ownership. In the latter case, governments are encouraged to prevent abuse of intellectual property rights, including rules with respect to their acquisition through compulsory licensing with the provision of equitable and adequate compensation.[211]

However, visible progress in transferring publicly funded technologies is yet to be made: In most cases, the ownership of the technologies developed with public funding is transferred to the private sector, and these may become unaffordable to developing countries. Therefore, governments in industrialized countries can appraise the potential global benefit that could accrue from publicly funded research and consider the wider dissemination of publicly owned technologies to developing countries.

and subsidy reforms. Governments will also need to identify and remove the hurdles for the market entry of businesses that can develop new green technologies, especially small and medium-sized enterprises.

It is important that governments develop comprehensive policies that strengthen institutional frameworks and governance and provide incentives for exploring new technologies and improving capacities. The green technology policy of Malaysia is a case in point (box 38).

Capacity building and awareness raising

The transition to a green and low-carbon economy will need to be accompanied with policies and programmes to sharpen the required skills and capacities at all levels.

First is the institutional capacity at different levels of government to design appropriate policies. This may include the ability to i) develop and enforce policy, legal and regulatory frameworks, ii) incorporate low carbon green growth approaches into national policy, legislation and institutions, and iii) mobilize national and international resources and determine the most efficient, equitable and effective allocation of those resources.[212]

Second is enterprise capacity and helping small and medium-sized businesses to use new or existing knowledge to green their operations and take advantage of the opportunities in the green economy.

Third is the skills and capacity of the workforce to engage in green and low-carbon economic activities. In the green economy, new jobs will be created, some will be eliminated, others will be substituted (such as with the shifting from fossil fuels to renewables) and many will simply be transformed and redefined as day-to-day skill sets, work

BOX 38: Green technology policy in Malaysia

In Malaysia, green technology has been recognized as a driver of future economic growth, energy security, and climate change mitigation and adaptation. Policies to strengthen institutional frameworks include the formation of a Green Technology Council and a Cabinet Committee on Green Technology, chaired by the prime minister, and the establishment of a Malaysia Green Technology Agency. Policies to encourage the growth of green technology sectors include support for higher-learning and research institutions for R&D; increased foreign and domestic investment; establishment of a Green Technology Fund; feed-in tariff legislation to woo renewable energy in power generation; and the recognition of green products through standards, ratings and labelling programmes. To improve human resource capacity, several policies centre on training and education, such as financial and fiscal incentives for students pursuing studies in green technology disciplines at both the undergraduate and graduate levels; retraining and apprenticeship schemes for green jobs; a grading and certification mechanism for green technology-related skills; and brain gain programmes to strengthen local expertise.

Source: Box 38: Malaysia, The National Green Technology Policy (Putrajaya, Ministry of Energy, Green Technology and Water, 2010). Available from www.kettha.gov.my/en (accessed 6 December 2011).

methods and profiles are greened.[213] Skills gaps and shortages have emerged as one of the constraints to greening the economy in industrialized and developing countries alike.[214] It is imperative to train and educate the current workforce that lacks the skills required for **green jobs** and to prepare the future workforce to take on the jobs that will be in demand in a green economy. This should include both white collar and blue collar workers.

Because greening the economy requires collective action, from government, businesses, workers and civil society, there is a need to raise awareness of the imperative for sustainability across the board. Education for sustainable development can be at the centre of such efforts to impress upon everyone equally that the future requires necessary changes in individual behaviour, attitudes and lifestyles. Learning and teaching processes of all types, at different levels and in different contexts of education, as well as curricula and learning materials, need to integrate education for sustainable development.[215]

Long-term investments in human capital through quality education and training will be critical for promoting low carbon green growth and ensuring a bridge between efforts geared towards greening the economy and other development goals.

Committed international, regional and bilateral cooperation will be essential to assist developing countries, especially least developed countries.

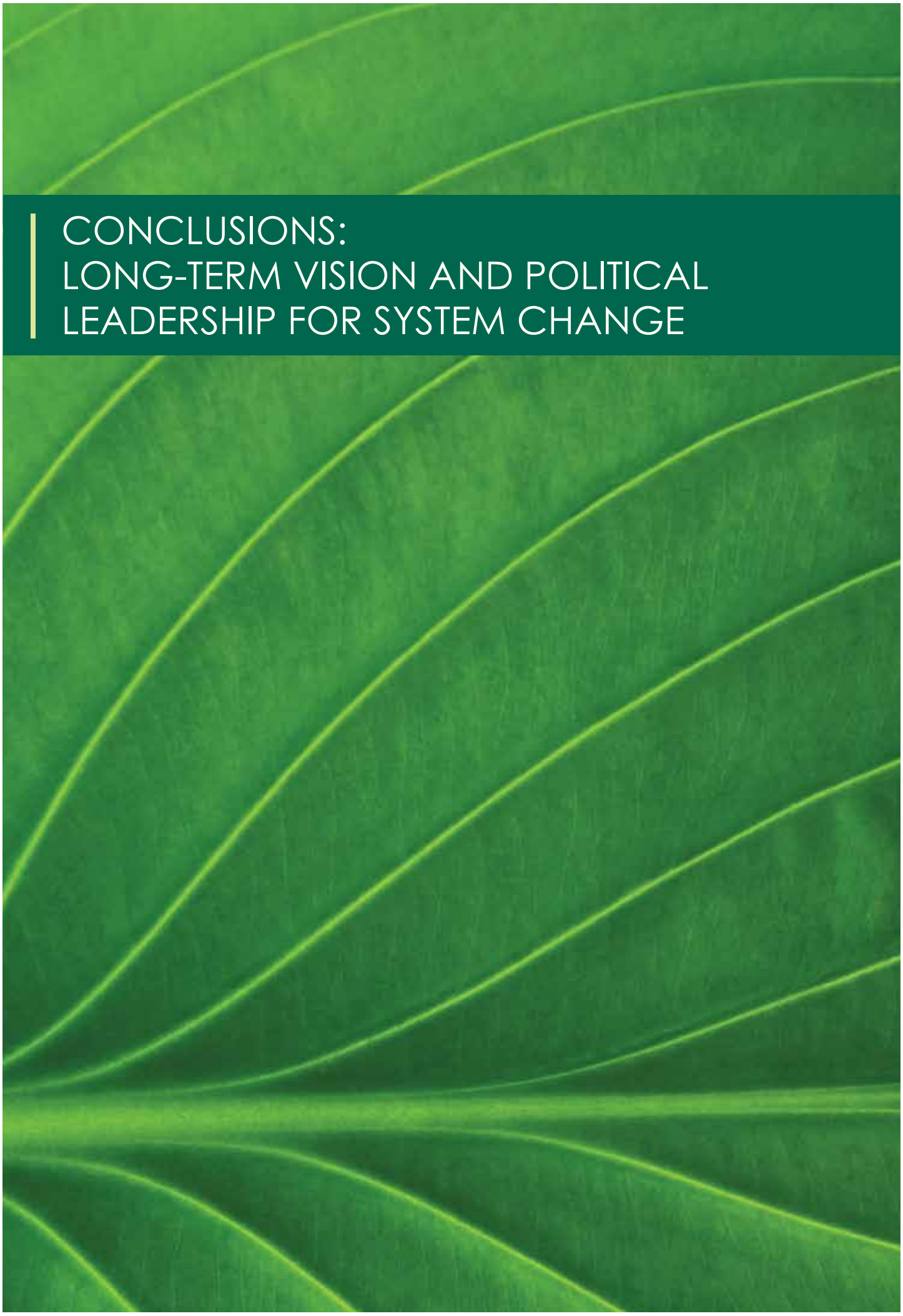
FACT SHEETS

- Green finance
- Green jobs
- Green New Deal
- Green public procurement
- Green technology
- REDD and REDD+
- Research and development and technological innovation

CASE STUDIES

- China's renewable energy policies
- Denmark's renewable energy policies
- Republic of Korea's investment plan for low carbon green growth
- Green technology grows rural roots in least developed countries

CONCLUSIONS: LONG-TERM VISION AND POLITICAL LEADERSHIP FOR SYSTEM CHANGE



Conclusions:
Long-term vision and political leadership for system change

The Asia-Pacific region has reached a historical crossroad: development goals are within reach and the region has the opportunity to lift its people out of poverty. But reaching those goals and pulling millions more people out of poverty cannot be done through conventional growth strategies. If the region is to realize the promise of greater inclusive development, then it needs to move in a different direction.

Countries within the region use three times the resources as the rest of the world to create one unit of GDP. And they are the most vulnerable to climate-related disasters. Resource constraints and the climate crisis have made business-as-usual practices no longer an option; they compel a re-examination of current growth strategies that are resource and carbon intensive.

The region needs to drastically improve its resource efficiency. We have to urgently set in motion a new economy in which improving the efficiency of resource use and investing in natural capital propels economic growth.

Green growth provides the solution. Green growth is turning crises into opportunities. It is an essential route for strengthening an inclusive, resilient and sustainable Asia-Pacific region. Green growth preserves the human, social and natural capital that underpins it. It stimulates innovation, which will lead to higher growth ultimately.

But capturing the fruits of green growth will require a bold and ambitious transformation of the economic system. A green economy will not materialize through incremental changes. A shift towards green growth requires a restructuring of both the visible (physical infrastructure) as well as the invisible structure of the economy (market prices, fiscal policies, institutions and governance, lifestyles).

This Roadmap has shown how to start this process through the five tracks for pursuing green growth.

First, countries need to improve the quality of their growth and maximize net growth. Focusing only on increasing growth will, in the long run, undermine the prospects of sustaining it. Developing countries in the Asia-Pacific region need to shift away from the conventional economic paradigm of maximizing production (as reflected in GDP) towards a new paradigm of improving quality of growth, focusing on employment generation, economic resilience, social inclusiveness and ecological sustainability. This requires integrating the notion of quality of growth into socio-economic development strategies, addressing market failures, adopting an integrated approach to policy development and planning and measuring what matters. Green growth strategies can maximize net growth by reducing the hidden GDP losses that erode human, social and natural capital.

Second, green growth requires changing the invisible structure of the economy, including prices, institutions, governance and lifestyles. The transition to a green economy requires certain enabling conditions that can then create the necessary policy architecture. Long-term plans and targets, institutional arrangements and governance, regulation and behavioural change are the building blocks of the policy framework for low carbon green growth. In particular, green growth needs to be driven by the top level of government. It requires an inter-ministerial committee for green growth, chaired by the head of State, and a supporting legal framework. The most essential factor, however, will be allowing prices to reflect the real costs of production and consumption. Properly designed environmental tax and fiscal reforms can do this by shifting taxes from income to pollution, while generating higher growth and employment.

Third, system change for green growth requires new infrastructure planning and design. Prices alone will not be sufficient to shift production and consumption patterns. Given the long lifespan of infrastructure, eco-efficiency criteria need to factor into the planning, designing and operations. Urban areas need to be compact and walkable, with mixed land uses and enhanced public and green spaces. Transport systems require a shift from road to rail, investment in public transport and limits on private car use. Existing buildings need to be retrofitted to substantially improve their energy efficiency, and new buildings have to be defined by green building standards. Energy systems should improve the efficiency of fossil fuel use, expand the share of renewable energy sources and cater for next-generation technologies. In fact, energy efficiency should be the starting point of any energy policy. Water infrastructure should emphasize integrated and decentralized water resource management to secure water resources, prevent urban flooding and conserve and restore the ecosystem. Waste needs to be turned from a cost into a resource, and waste management should prioritize treatment at the source and recycling.

Fourth, green needs to be turned into a business opportunity. Greening the economy will require new and upgraded infrastructure, the greening of current industries and creating new ones along with new and greener goods and services. Businesses stand to gain from this transition. But governments need to create the conditions for businesses to thrive in a green economy. Governments need to bridge the gap between short-term costs and long-terms benefits and reduce uncertainty and risk for investors. This will require a mix of regulation, economic, fiscal and information instruments, in particular: allowing market prices to reflect the real cost of energy and natural resources; using public finances strategically to leverage private investments; greening public procurement practices; promoting transparency (through environmental reporting) and consumer awareness (through eco-labelling) as well as enacting predictable long-term and transparent legislation (greenhouse gas emissions targets) and giving businesses enough time to adjust.

Fifth, governments must construct the required low-carbon development strategies. A low-carbon development strategy combines national economic development and climate change planning into a more integrated, comprehensive, consistent and coordinated approach. It waves important go-ahead signals to the private sector on the direction for future investment, research and development. Low-carbon development strategies also help identify and prioritize nationally appropriate mitigation actions. Important elements of a low-carbon development strategy are greenhouse gas inventories and greenhouse gas emissions

reduction targets. Low-carbon development strategies require engagement across ministries, backed by political commitment at the highest level.

The extent to which green growth can deliver a double dividend (higher growth with lower environmental impact) depends on the breadth and depth of the system change that is put in place. Towards this end, a long term vision and political leadership are essential.

Many governments in the region have already recognized the necessity of green growth and are taking important steps towards greening their economies. There are many examples of effective approaches in the region, including at the local and community levels. There is a need to build on these "green shoots" and identify, analyse, replicate and scale up the practices that are making a difference.

Fully realizing the potential of green growth will require collective action. System change entails risks and uncertainties, and some countries may be reluctant to be the first movers. Collective action and partnership can reduce the risk and uncertainty any one party takes on and increase effectiveness. The Asia-Pacific region can lead the way if each country commits to making the necessary and likely inevitable changes now.

Regional cooperation needs to be stepped up. A number of important regional initiatives have emerged in recent years, including the Seoul Initiative on Green Growth adopted at the MCED-5 in March 2005 and the Astana Initiative for Green Bridge adopted at MCED-6 in September 2010, to link Europe, Asia and the Pacific through green growth. Promoting collective action for system change requires strengthening such regional initiatives.

A global partnership is urgently needed to enable developing countries to adopt green growth policies and initiatives that will help meet their development goals. In particular, there is a need to mobilize financing, transfer technologies and build the required capacities of least developed countries, landlocked developing countries and small island developing states. The 2012 United Nations Conference on Sustainable Development (Rio+20) offers a unique opportunity to develop such a partnership.

The region can drive the dialogue and shape the global agenda on the green economy and green growth. This will require enhancing a coordinated Asian and Pacific "voice" and leadership. The region can also spearhead the global partnership at the regional level. The Asia-Pacific region can lead the vision of an inclusive, resilient and sustainable future – not just for those who live here but for the whole world.

ENDNOTES

1 McKinsey & Company, *Resource Revolution: Meeting the World's Energy, Materials, Food and Water Needs* (McKinsey Global Institute, 2011).

2 Jeremy Grantham, "Time to Wake Up: Days of Abundant Resources and Falling Prices Are Over Forever", *GMO Quarterly Newsletter*, April 2011.

3 International Energy Agency, *World Energy Outlook 2011* (Paris, 2011).

4 World Economic Forum, *More with Less: Scaling Sustainable Consumption and Resource Efficiency* (Geneva, 2012).

5 United Nations Environment Programme, *Metal Stocks in Society: Scientific Synthesis* (Nairobi, International Panel for Sustainable Resource Management, 2010).

6 United Nations Economic and Social Commission for Asia and the Pacific, Asia Development Bank and United Nations Environment Programme, *Green Growth, Resources and Resilience: Environmental Sustainability in Asia and the Pacific* (Bangkok, 2012).

7 Based on data from the CSIRO and UNEP Online Asia-Pacific Material Flows Database, as of March 2011. See www.cse.csiro.au/forms/form-mf-start.aspx

8 Ganghua Wan and Iva Sebastian, *Poverty in Asia and the Pacific: An Update*, ADB Economics Working paper Series No 267 (Manila, Asian Development Bank, 2011).

9 United Nations Development Programme and International Labour Organization, *Asian Experience on Growth, Employment and Poverty: An Overview with Special Reference to the Findings of Some Recent Case Studies* (Sri Lanka, 2007).

10 United Nations Economic and Social Commission for Asia and the Pacific, *Economic and Social Survey of Asia and the Pacific 2011* (Bangkok, 2011).

11 United Nations Economic and Social Commission for Asia and the Pacific and United Nations International Strategy for Disaster Reduction (2010). *Protecting Development Gains: Reducing Disaster Vulnerability and Building Resilience in Asia and the Pacific*, The Asia-Pacific Disaster Report 2010 (Bangkok, 2010).

12 Sven Harmeling, *Global Climate Risk Index 2011: Who Suffers Most From Extreme Weather Events? Weather-Related Loss Events in 2009 and 1990 to 2009* (Bonn, Germanwatch, 2010).

13 Asian Development Bank, *The Economics of Climate Change in Southeast Asia: A Regional Review* (Manila, 2009).

14 United Nations Secretary-General's High-level Panel on Global Sustainability, *Resilient People, Resilient Planet: A future Worth Choosing* (New York, United Nations, 2012).

15 HSBC Global Research, *The World in 2050: Quantifying the shift in the world economy* (HSBC, 2011)

16 Asian Development Bank, *Energy Outlook for Asia and the Pacific* (Manila, 2009).

17 Food and Agriculture Organization of the United Nations, International Water Management Institute and Asia Pacific Water Forum, *Revitalizing Asia's Irrigation: To Sustainably Meet Tomorrow's Food Needs* (Rome, 2009).

18 United Nations Economic and Social Commission for Asia and the Pacific, *Statistical Yearbook for Asia and the Pacific 2011* (Bangkok, 2011)

19 International Energy Agency, *World Energy Outlook 2011* (Paris, 2011).

20 Li-gun Liu and others, "Solar energy development in China: A review", *Renewable and Sustainable Energy Reviews* (2010), vol. 14, pp. 301-311.

21 Organisation for Economic Co-operation and Development, *Green Growth Strategy Synthesis Report* (Paris, 2011).

[22] United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication – A Synthesis for Policymakers* (Nairobi, 2011).

[23] ibid.

[24] The G20 Summit is the meeting of the Group of Twenty Finance Ministers and Central Bank Governors from 20 major economies: 19 countries plus the European Union.

[25] G20 Seoul Summit Leaders' Declaration, November 11-12, 2010

[26] Asia Pacific Economic Co-operation, "Joint Statement: APEC Ministers Agree on Enhanced Trade, Green Growth, Regulatory Reform", Press release, November 11 2011. Available from www.apec.org/Press/News-Releases/2011/1111_amm.aspx (accessed 5 March 2012).

[27] The Climate Group and the Office of Tony Blair, *Cutting the Cost: The Economic Benefits of Collaborative Climate Action* (London, 2009).

[28] Terry Barker and Serban Scrieciu, "Modeling low climate stabilization with E3MG: Towards a 'New economics' approach to stimulating energy-environment-economy system dynamics", *The Energy Journal* (2011), pp. 137-164.

[29] California Air Resources Board, *Climate Change Scoping Plan: A Framework for Change* (Sacramento, CA, 2008).

[30] United Nations Environment Programme, *Green Economy Report: Towards a Green Economy - Pathways to Sustainable Development and Poverty Eradication* (Nairobi, 2011).

[31] Paul Ekins and Stefan Speck, *GFC Briefing Paper 7: Competitiveness and Environmental Tax Reform* (London, Green Fiscal Commission, 2010).

[32] Green Budget Germany, *Ecotaxes and Emissions Trading in Germany and Europe: Market-based Instruments for the Environment* (Berlin, 2006).

[33] United Nations Economic and Social Commission for Asia and the Pacific, Asian Development Bank and United Nations Development Programme, *Paths to 2015 – MDG Priorities in Asia and the Pacific*, Asia-Pacific MDG Report 2010/2011 (Bangkok, 2010).

[34] World Health Organization, *Preventing Disease through Healthy Environments: Towards an Estimate of the Environmental Burden of Disease* (Geneva, 2006).

[35] The World Bank, *Cost of Pollution in China: Economic Estimates of Physical Damages* (Washington, D.C., 2007).

[36] Ramón E. López, Vinod Thomas and Yan Wang, "The Quality of Growth: Fiscal Policies for Better Results", The World Bank, IEG Working Paper 2008/6 p.14 (Washington, D.C., 2008).

[37] Republic of Indonesia, *The Annual Report* (Jakarta, Presidential Work Unit for Development Monitoring and Control, 2010).

[38] Christopher Willoughby, "Managing Motorization", TWU discussion paper No. 42. (Washington, D.C., The World Bank, 2000).

[39] The Korea Transport Institute, *2008 Traffic Congestion Costs: Estimation and Trend Analysis* (Goyang, Republic of Korea, 2010).

[40] United Nations Economic and Social Commission for Asia and the Pacific and International Strategy for Disaster Reduction, *Protecting Development Gains: Reducing Disaster Vulnerability and Building Resilience in Asia and the Pacific*, The Asia-Pacific Disaster Report 2010 (Bangkok, 2010).

[41] Alisa Tang, "Thailand cleans up: Areas remain flooded", *Time*, December 2 2011. Available from www.time.com/time/world/article/0,8599,2101273,00.html (accessed 3 March 2012).

[42] *BBC*, "Thailand's Economy Shrinks 9% after Flood Disruptions", February 20 2012. Available from www.bbc.co.uk/news/business-17093011 (accessed 3 March 2012).

[43] Asian Development Bank, *The Economics of Climate Change in Southeast Asia: A Regional Review* (Manila, 2009).

[44] Paul Ekins, *Economic Growth and Environmental Sustainability: the Prospects for Green Growth* (Routledge, London and New York, 1999).

[45] United Nations Economic and Social Commission for Asia and the Pacific, *Economic and Social Survey of Asia and the Pacific 2011* (Bangkok, 2011).

[46] Development Research Centre of the State Council, the People's Republic of China and the World Bank, *China 2030: Building a Modern, Harmonious and Creative High-income Society* (the World Bank, Washington, D.C., 2012).

[47] United Nations Economic and Social Council, Economic and Social Commission for Asia and the Pacific, *Report of the Committee on Statistics on its second session*, E/ESCAP/CST(2)/9 (Bangkok, 2010).

[48] International Energy Agency, *Energy Technology Perspective 2010* (Paris, 2010).

[49] Joanna Lewis, *Energy and Climate Goals of China's 12th Five-Year Plan* (Arlington, Pew Center on Global Climate Change, 2011). Available from www.pewclimate.org/docUploads/energy-climate-goals-china-twelfth-five-year-plan.pdf (accessed 21 March 2012).

[50] India, *National Action Plan on Climate Change* (New Delhi, Prime Minister's Council on Climate Change, 2008). Available from http://india.gov.in/innerwin20.php?id=15651 (accessed 21 March 2012).

[51] United Nations Framework Convention on Climate Change website "Copenhagen Accord Appendix II". Available from http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php (accessed 26 February 2012).

[52] Joanna Lewis, *Energy and Climate Goals of China's 12th Five-Year Plan* (Arlington, Pew Center on Global Climate Change, 2011). Available from www.pewclimate.org/docUploads/energy-climate-goals-china-twelfth-five-year-plan.pdf (accessed 21 March 2012).

[53] United Nations, *Working Towards a Balanced and Inclusive Green Economy: A United Nations System-Wide Perspective* (Geneva, United Nations Environment Management Group, 2011).

[54] European Environment Agency, *Market Based Instruments for Environmental Policy in Europe*, Technical Report 8/2005 (Copenhagen, 2006).

[55] Paul Ekins and Stefan Speck, *Environmental Tax Reform (ETR): A Policy for Green Growth* (London, Oxford University Press, 2001).

[56] Organisation for Economic Co-operation and Development, *Environmental Fiscal Reform for Poverty Reduction*, DAC Guidelines and Reference Series (Paris, 2005).

[57] ibid.

[58] International Energy Agency, *World Energy Outlook 2011*, Forthcoming (Paris, 2011). Available from www.iea.org/weo/subsidies.asp (accessed 17 January 2012).

[59] Republic of India, *India: Taking on Climate Change Post-Copenhagen Domestic Actions* (New Delhi, Ministry of Environment and Forests, 2010).

[60] *China Daily*, "China Pledges Deeper Economic Reforms", February 16 2012. Available from www.chinadaily.com.cn/business/2012-02/16/content_14623081.htm (accessed 28 February 2012).

[61] Robert Bacon and Masami Kojima, *Coping with Higher Oil Prices* (Washington, D.C., The World Bank, 2006).

[62] ibid.

[63] Dominique Guillaume, Roman Zytek and Mohammad Reza Farzin, "Iran: The Chronicles of the Subsidy Reform", IMF Working paper WP/11/167 (Washington, D.C., International Monetary Fund, 2011).

[64] Seungjoon Park, Masato Yamazaki and Shiro Takeda, *Environmental tax reform: Major findings and policy implications from a multi-regional economic simulation analysis for low carbon green growth* (ESCAP, United Nations, Bangkok, 2012).

[65] ibid.

[66] Mark Brenner, Matthew Riddle and James K. Boyce, "A Chinese sky trust? Distributional impacts of carbon charges and revenue recycling in China", *Energy Policy* (2005), vol. 35, pp. 1771-1784.

[67] Arief Anshory Yusuf, *The Distributional Impact of Environmental Policy: The Case of Carbon Tax and Energy Pricing Reform in Indonesia* (Singapore, Economy and Environment Program for Southeast Asia, 2008).

[68] Sustainable Prosperity, "Carbon Pricing, Social Equity and Poverty Reduction", *Policy brief*, May 31 2011. Available from www.sustainableprosperity.ca/article1398 (accessed 3 March 2012).

[69] National Environmental Research Institute, Cambridge Econometrics, the Economic and Social Research Institute, Institute for Economic and Ecological Policy and the Vienna Institute for International Economic Studies, *Competitiveness Effects of Environmental Tax Reform* (COMETR), Publishable Final Report to the European Commission, DG Research and DG Taxation and Customs Union (Roskilde, Denmark, 2007).

[70] Paul Ekins and Stefan Speck, *Briefing Paper Seven on Competitiveness and Environmental Tax Reform* (London, Green Fiscal Commission, 2010).

[71] Border tax adjustments are levies imposed on imported goods that were produced in countries that do not tax carbon or energy and rebated on domestically produced goods for export.

[72] Organisation for Economic Co-operation and Development, *Environmental Fiscal Reform for Poverty Reduction*, DAC Guidelines and Reference Series (Paris, 2005).

[73] Paul Ekins and Stefan Speck, *Environmental Tax Reform (ETR): A Policy for Green Growth* (London, Oxford University Press, 2001).

[74] United Nations Environment Programme, *Buildings and Climate Change: Summary for Policymakers* (Nairobi, 2009).

[75] Asian Development Bank, "Rethinking Transport and Climate Change", ADB Sustainable Development Working Papers No. 10 (Manila, 2009).

[76] Organisation for Economic Co-operation and Development, *Cities and Climate Change* (Paris, 2010).

[77] KoROAD, *Traffic Accident Statistics* (Seoul, 2009). Available from http://eng.koroad.or.kr/Eng/Code/RotaStatistic/RotaStatistic11.jsp (accessed 6 March 2012).

[78] Felix Creutzig and Dongquan He, "Climate change mitigation and co-benefits of feasible transport demand polities in Beijing", *Transport*. Research Part D (2008).

[79] United Nations Department of Economic and Social Affairs website "Urbanization Prospects the 2009 Revision: Urban population in Asia in 2030" (19 February 2012). Available from http://esa.un.org/unpd/wup/index.htm (accessed 22 April 2011).

[80] Asia Development Bank and Asia Development Bank Institute, *Infrastructure for a Seamless Asia* (Manila, 2009).

[81] United Nations Human Settlements Programme, *The State of Asian Cities 2010/2011* (Fukuoka, 2010).

[82] Asian Development Bank, "Rethinking Transport and Climate Change", ADB Sustainable Development Working Paper Series (Manila, 2009).

[83] United Nations Environment Programme, *Buildings and Climate Change: Summary for Policymakers* (Nairobi, 2009).

[84] Organisation for Economic Co-operation and Development, *Cities and Climate Change* (Paris, 2010).

[85] United Nations Economic and Social Commission for Asia and the Pacific, *A Guide to the Application of Public Participation in Planning and Policy Formulation towards Sustainable Transport Development* (Bangkok, 2003)

[86] United Nations, *World Urbanization Prospects: The 2009 Revision* (New York, 2010).

[87] ibid.

[88] United Nations Human Settlements Programme, *State of the World Cities 2010/2011: Bridging the Urban Divide* (Nairobi, 2010).

[89] Asian Development Bank, "The challenge of rapid urbanization", in *Policy and Strategy Papers* (Manila, 1996). Available from www.adb.org/documents/policies/urban_sector/urban0201.asp?p=policies (accessed 22 April 2011).

[90] ICLEI – Local Governments for Sustainability, "Local authority's statement", presented at the UNEP Governing Council 2010, Bali, 22 February 2010. Available from www.unep.org/civil-society/LinkClick.aspx?fileticket=5K38DQP4vg8%3D&tabid=2910&language=en-US (accessed 22 April 2011).

[91] American Association for the Advancement of Science, *AAAS Atlas of Population and Environment: Population and Land Use; Urbanization* (Washington, D.C., 2001). Available from http://atlas.aaas.org/index.php?sub=intro (accessed 1 June 2011).

[92] Center for Clean Air Policy, *Growing Wealthier* (Washington, D.C., 2011).

[93] American Forests, *Local Ecosystem Analysis Garland Texas: Calculating the Value of Nature* (Washington, D.C., 2000). Available from www.americanforests.org/downloads/rea/AF_Garland.pdf (accessed 3 March 2012).

[94] Economist Intelligence Unit and Siemens AG, *Asian Green City Index: Assessing the Environmental Performance of Asia's Major Cities* (Munich, 2011).

[95] Malaysian Resources Corporation Berhad website: www.klsentral.com.my/Home.aspx (accessed 2 January 2012).

[96] International Energy Agency, *World Energy Outlook 2008* (Paris, OECD and IEA, 2008).

[97] International Energy Agency, *CO_2 Emissions from Combustion* 1971-2003 (Paris, OECD and IEA, 2006).

[98] International Energy Agency, *World Energy Outlook 2006* (Paris, OECD and IEA, 2006).

[99] International Energy Agency, *Transport, Energy and CO_2: Moving towards Sustainability* (Paris, OECD and IEA, 2009).

[100] Holger Dalkmann, *Case Study of a Transport MRV NAMA: TDM Measures in Jakarta, Indonesia*, Report for the Asian Development Bank (Manila, 2010).

[101] Sutanto Soehodho, "Jakarta urban transport problems and their environmental impacts", PowerPoint presentation at the International Climate Change Workshop on Research Priorities and Policy Development, Jakarta, 17-19 March 2010.

[102] International Road Federation, *World Road Statistics 2010: Data 2003-2008* (Geneva, 2010).

[103] Lee Schipper, Bert Fabian and Jamie Leather, *Transport and Carbon Dioxide Emissions: Forecasts, Options Analysis, and Evaluation* (Manila, 2009). Available from www.adb.org/documents/papers/adb-working-paper-series/ADB-WP09-Transport-CO2-Emissions.pdf (accessed 21 March 2012).

[104] Asian Development Bank, *Sustainable Transport Initiative Operation Plan* (Manila, 2010).

[105] U.S. Federal Railroad Administration, *Preliminary National Rail Plan* (Washington, D.C., 2009). Available from www.fra.dot.gov/downloads/railplanprelim10-15.pdf (accessed 27 February 2012).

[106] Lee Schipper, Celine Marie-Lilliu and Roger Gorham, *Flexing the Link between Transport and Greenhouse Gases: A Path for the World Bank* (Paris, IEA, 2000).

[107] Seoul Metropolitan Government, "Seoul Metropolitan Government Announces a Yearly Plan to Phase-Out Overpass Roads", *Press release*, December 10 2009. Available from http://spp.seoul.go.kr/main/news/news_report.jsp?search_boardId=4114&act=VIEW&boardId=4114 (accessed 13 March 2012) [in Korean].

[108] Shin Wei Ng and Nick Mabey, *Chinese Challenge or Low Carbon Opportunity?: The Implications of China's 12th Five-Year-Plan for Europe* (London, Third Generation Environmentalism Ltd (E3G), 2011). Available from www.e3g.org/images/uploads/E3G_Chinese_Challenge_or_Low_Carbon_Opportunity.pdf (accessed 8 December 2011).

[109] KPMG, *Infrastructure in China: Foundation for Growth* (Beijing and Hong Kong, 2009). Available from www.kpmg.de/docs/Infrastructure_in_China.pdf (accessed 6 December 2011).

[110] *CNC World*, "China's High Speed Railway", February 10 2011. Available from www.cncworld.tv/news/v_show/12388_China_s_high_speed_railway.shtml (accessed 8 December 2011).

[111] Anne Binsted, Daniel Bongardt,, Holher Dalkmann, and Ko Sakamoto, *Accessing Climate Finance for*

Sustainable Transport: A practical Overview, Sustainable Urban Transport Technical Document # 5 (Berlin, GTZ, 2010). Available from www.transport2012.org/bridging/ressources/files/1/956,TD05_FinGuid.pdf (accessed 20 March 2012).

112 Asian Development Bank, *Sustainable Transport Initiative – Operational Plan* (Manila, 2010). Available from www.adb.org/sites/default/files/pub/2010/Sustainable-Transport-Initiative.pdf (accessed 16 March 2012).

113 Bert Metz and others, eds., *Climate Change 2007: Mitigation of Climate Change*, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge, United Kingdom and New York, NY, Cambridge University Press, 2007), and United Nations Environment Programme, Buildings and Climate Change: Summary for Policymakers (Nairobi, 2009).

114 International Energy Agency, *Combined Heat and Power: Evaluating the Benefits of Greater Global Investment* (Paris, 2008).

115 International Passive House Association, Active for More Comfort: The Passive House (Darmstadt, Germany, 2010). Available from http://www.passivhaustagung.de/Passive_House_E/passivehouse.html (accessed 12 December 2011).

116 McKinsey & Company, *Energy Efficiency: A Compelling Global Resource* (Chicago, 2010).

117 Singapore, Building and Construction Authority website "About BCA Green Mark Scheme". Available from www.bca.gov.sg/GreenMark/green_mark_buildings.html (accessed 27 January 2012).

118 Korea Energy Management Corporation website "Energy Audit Scheme" (2009). Available from www.kemco.or.kr/web/kem_home/introduce/business/system/diagno/overview.asp (accessed 18 March 2012) [Korean language website].

119 Germany, *GER 33: KfW Energy-Efficient Refurbishment* (Berlin, Federal Ministry of Economics and Technology, 2011).

120 United Kingdom of Great Britain and Northern Ireland, *The Green Deal: A Summary of the Government's Proposals* (London, Department of Energy and Climate Change, 2010).

121 United States of America, *Property-Assessed Clean Energy (PACE) Programs* (Washington, D.C., Department of Energy, 2011). Available from www1.eere.energy.gov/wip/solutioncenter/financialproducts/pace.html (accessed 31 January 2012).

122 Energy Futures Australia Pty Ltd and Danish Management Group (Thailand) Co Ltd, *Thailand's Energy Efficiency Revolving Fund: A Case Study Prepared for APEC Energy Working Group* (2005). Available from http://efa.solsticetrial.com/admin/Library/David/Published%20Reports/2005/ThailandsEnergyEfficiencyRevolvingFund.pdf (accessed 21 March 2012)

123 United Nations Economic and Social Commission for Asia and the Pacific, *Statistical Yearbook for Asia and the Pacific 2011* (Bangkok, 2011).

124 International Energy Agency website "World Energy Statistics and Balances" database. Available from http://stats.oecd.org (accessed 2 February 2012).

125 International Energy Agency, *World Energy Outlook 2011* (Paris, OECD and IEA, 2011).

126 International Energy Agency, "World energy outlook 2011: IEA analysis of fossil fuel subsidies", PowerPoint presentation, Paris, 4 October 2011. Available from www.worldenergyoutlook.org/files/ff_subsidies_slides.pdf (accessed 1 December 2011).

127 International Energy Agency, *Energy Technology Perspectives* (Paris, IEA, 2008).

128 United Nations Economic and Social Commission for Asia and the Pacific, *Low-Carbon Development Path for Asia and the Pacific: Challenges and Opportunities for the Energy Sector* (Bangkok, 2010).

129 International Energy Agency, *Cities, Towns and Renewable Energy* (Paris, 2009).

130 Intergovernmental Panel on Climate Change, *Special Report on Renewable Energy Sources and Climate Change Mitigation* (Bonn, 2008).

[131] Intellectual Capital Advisory Services Pvt. Ltd. and the Rockefeller Foundation, *Opportunities for Private Sector Engagement in Urban Climate Change Resilience Building* (Bangkok and Mumbai, 2010). Available from www.rockefellerfoundation.org/uploads/files/2ad3aea5-525b-4a9b-991c-a024a59a3762-private.pdf (accessed 29 November 2011).

[132] Alliance for Rural Electrification, *Best Practices of the Alliance for Rural Electrification: What Renewable Energy Can Achieve in Developing Countries* (Brussels, 2009). Available from www.ruralelec.org/fileadmin/DATA/Documents/06_Publications/Position_papers/ARE_Publication_-_Case_studies_for_renewable energy_in_Developing_countries.pdf (accessed 10 February 2012).

[133] International Energy Agency, *Renewables and Waste in Indonesia in 2008* (Paris, 2011

[134] International Energy Agency, *Statistics and Balances* (Paris, 2009). Available from www.iea.org/stats/index.asp (accessed 15 February 2012).

[135] Ruggero Bertani, "Long-term projections of geothermal-electric development in the world", presented at the GeoTHERM Congress, Offenburg, Germany, 5-6 March, 2009. Available from www.iea-gia.org/documents/LongTermGeothermElecDevelopWorldBertanioffenburg23Feb09.pdf (accessed 26 September 2011).

[136] Francisco Almendra, Logan West, Li Zheng and Sarah Forbes, *CCS Demonstration in Developing Countries: Priorities for a Financing Mechanism for Carbon Dioxide and Capture and Storage*, Working Paper (Washington, D.C., World Resource Institute, 2011), Available from http://pdf.wri.org/working_papers/ccs_demonstration_in_developing_countries.pdf (accessed 5 September 2011).

[137] International Energy Agency (IEA), *Technology Roadmap: Smart Grids* (Paris, IEA and OECD, 2011).

[138] Stockholm International Water Institute, *Making Water Part of Economic Development* (Stockholm, 2005). Available from www.who.int/water_sanitation_health/waterandmacroecon.pdf (accessed 8 February 2012).

[139] Organisation for Economic Co-operation and Development, *Benefits of Investing in Water and Sanitation: An OECD Perspective*, Executive summary (Paris, 2011).

[140] William D. Kingdom, Roland Liemberger and Philippe Marin, *Reducing Water Loss in Developing Countries Using Performance-Based Service Contracting*, Water P-Note Issue 4 (Washington, D.C., The World Bank, 2008).

[141] ibid.

[142] United States Agency for International Development, *Pakistan: Complex Emergency and Floods*, Fact Sheet No.1, Fiscal Year 2011(Washington DC, 2011). Available from www.usaid.gov/our_work/humanitarian_assistance/disaster_assistance/countries/pakistan/template/fs_sr/fy2011/pakistan_cefl_fs01_04-05-2011.pdf (accessed 6 February 2012).

[143] Asian Development Bank and the World Bank, "ADB-WB Assess Pakistan Flood Damage at $9.7 Billion", *Press release*, October 14 2010. Available from http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22733998~pagePK:34370~piPK:34424~theSitePK:4607,00.html (accessed 6 February 2012).

[144] Michael J. Hicks and Mark L. Burton, *Preliminary Damage Estimates for Pakistani Flood Events 2010* (Muncie, Center for Business and Economic Research, 2010). Available from http://cber.iweb.bsu.edu/research/PakistanFlood.pdf (accessed 6 February 2012).

[145] Brookings website "Pakistan's Water World: The Political and Economic Impact of the Recent Floods" (17 August 2010). Available from www.brookings.edu/opinions/2010/0817_pakistan_floods_karamat.aspx (accessed 6 February 2012).

[146] Hugh Collins, "Pakistan Floods Destroyed $2.9 Billion of Agricultural Products", *Daily Finance*, August 13 2010. Available from www.dailyfinance.com/2010/08/13/pakistan-floods-destroyed-2-9-billion-of-agricultural-products/?icid=sphere_copyright (accessed 6 February 2012).

147 Shahbaz Rana, "Economic Survey 2010-11: Floods, Terrorism, Oil Price Surge Restrict Growth to 2.4%", The *Express Tribune News Network,* June 3 2011. Available from http://tribune.com.pk/story/180824/economic-survey-2010-2011-pakistan-failed-to-meet-growth-target/%5e/ (accessed 6 February 2012).

148 Emergency Operation Center for Flood, Storm and Landslide, *Flood, Storm and Landslide Situation Report* (Bangkok, 2012). Available from http://disaster.go.th/dpm/flood/news/news_thai/EOCReport17JAN.pdf (accessed 6 February 2012) [in Thai language].

149 The World Bank, *The World Bank Supports Thailand's Post-Floods Recovery Effort* (Washington, D.C., 2011). Available from www.worldbank.or.th/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/THAILANDEXTN/0,,contentMDK:23067443~pagePK:141137~piPK:141127~theSitePK:333296,00.html (accessed 6 February 2012).

150 The World Bank, *Navigating Turbulence, Sustaining Growth*, East Asia and Pacific Economic Update 2011, vol. 2 (Washington DC, 2011).

151 United Nations Economic and Social Commission for Asia and the Pacific, *Pro-poor Water and Wastewater Management in Small Towns Case Studies: Integrated Water Management in Baguio City*, Philippines (Bangkok, 2007). Available from www.unescap.org/pdd/prs/ProjectActivities/Ongoing/Water/Baguio/Baguio_MR.pdf (accessed 2 February 2012).

152 United Nations Economic and Social Commission for Asia and the Pacific, *Generic Guidelines to an Eco-efficient Approach to Water Infrastructure Development* (Bangkok, United Nations, 2011).

153 Antoine Morel and Stefan Diener, *Greywater Management in Low and Middle-Income Countries, Review of Different Treatment Systems for Households or Neighbourhoods* (Dübendorf, Switzerland, Swiss Federal Institute of Aquatic Science and Technology, 2006). Available from www.north-south.unibe.ch/content.php/publication/id/1733 (accessed 2 February 2012).

154 ibid.

155 United Nations Environment Programme, "Waste: Investing in energy and resource efficiency" in *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication* (Nairobi, 2011).

156 ibid.

157 United Nations Human Settlements Programme, *Solid Waste Management in the Worlds Cities: Water and Sanitation in the World's Cities 2010* (London and Washington, D.C., 2010).

158 Commonwealth of Australia, Department of Sustainability, Environment, Water, Population and Communities website "Product Stewardship for End-of-Life Tyres" (2011). Available from www.environment.gov.au/settlements/waste/tyres/index.html (accessed 17 November 2011).

159 Ministry of Environment of Republic of Korea, "Evaluation Results on the Progress of Volume Based Waste Charging Scheme Over Ten Years (1995 to 2004)", *Press release*, January 16, 2006. Available from www.me.go.kr/web/286/me/common/board/detail.do?boardId=notice_02&idx=142913 (accessed 1 March 2012) [in Korean language].

160 S. Sakai and others, "Unit-charging programs for municipal solid waste in Japan", *Waste Management* (2008), vol. 28, pp. 2815-2825.

161 The FTSE 100 Index is a share index of the 100 most highly capitalised UK companies listed on the London Stock Exchange. The index is maintained by the FTSE Group, an independent company jointly owned by the Financial Times and the London Stock Exchange.

162 Spada Ltd., *Environmental Reporting: Trends in FTSE 100 Sustainability Reports* (London, 2008). Available from www.masonhardy.com/downloads/environmental-reporting-spada-white-paper.pdf (accessed 5 March 2012).

[163] Organization for Economic Co-operationand Development, *Opening Markets for Environmental Goods and Services*, Policy Brief (Paris, 2005).

[164] United Nations Industrial Development Organization, *UNIDO Green Industry: Policies for Supporting Green Industries* (Vienna, 2011).

[165] United Kingdom of Great Britain and Northern Ireland, *Low Carbon and Environmental Goods and Services: An Industry Analysis Update for 2008/09* (London, Department for Business Innovation and Skills, 2010).

[166] ibid.

[167] Angus McCrone, "Clean Energy Project Investment Overcomes Headwinds with Record Quarter", *Bloomberg New Energy Finance*, October 13 2011. Available from http://bnef.com/PressReleases/view/169 (accessed 17 October 2011).

[168] World Business Council for Sustainable Development, *Vision 2050: The New Agenda for Business* (Geneva, 2010).

[169] United Nations Economic and Social Commission for Asia and the Pacific, *Statistical Yearbook of Asia and Pacific 2011* (Bangkok, 2011).

[170] Food and Agriculture Organization of the United Nations website "Ecotourism". Available from www.fao.org/docrep/w7714e/w7714e06.htm (accessed 8 March 2012).

[171] Global Organic Market Access project website "Global Organic Food & Drink Sales Approach US$ 60 Billion" (19 January 2011). Available from www.goma-organic.org/around-the-world/global-organic-food-drink-sales-approach-us-60-billion-2/ (accessed 18 October 2011).

[172] Marine Stewardship Council, *Annual Report 2010/2011* (London, 2011). Available from www.msc.org/documents/msc-brochures/annual-report-archive/annual-report-2010-11-english/view (accessed 19 march 2012)

[173] World Economic Forum, *Scaling-up in a Downturn? Ideas for Building the Low Carbon Economy in 2009* (Geneva, 2009).

[174] United Nations Framework Convention on Climate Change, *Investment and Financial Flows to Address Climate Change: An Update*, Technical paper (Geneva, 2008).

[175] Asian Development Bank and Asian Development Bank Institute, *Infrastructure for a Seamless Asia* (Manila, 2009).

[176] *The Economic Times*, "Infra Sector Remains Largest Contributor to India's GDP", November 20 2010. Available from http://articles.economictimes.indiatimes.com/2010-11-20/news/27585698_1_project-management-defence-sector-practices (accessed 27 September 2011).

[177] United Nations Environment Programme, *Green Jobs: Towards Decent Work in a Sustainable, Low-carbon World* (Nairobi, 2008).

[178] ibid.

[179] Kevin Baumert, Timothy Herzog and Jonathan Pershing, *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy* (Washington, D.C., World Resources Institute, 2005).

[180] Promode Kant, "REDD Should Create Jobs, Not Merely Bring Compensation", IGREC Web Publication No. 13/2010 (New Delhi, Institute of Green Economy, 2010). Available from http://www.igrec.in/redd_should_create_jobs_not_merely_bring_compensation.pdf (accessed 8 March 2012).

[181] As a marketing theory, W. Chan Kim and Renée Mauborgne proposed the concept of "Blue Ocean", very innovative, uncontested market place ripe for growth, in contrast to "Red Ocean", very competitive low profit market. See Harvard Business Press (2005) *Blue Ocean Strategy: How to create Uncontested Market Space and Make Competition Irrelevant*, W. Chan Kim and Renée Mauborgne

[182] United Nations Conference on Trade and Development, *Investment and Enterprise Responsibility Review* (New York and Geneva, United Nations, 2011).

[183] HSBC, *HSBC Launches Climate Change Benchmark Index*, Press release of 25 September 2007. Available from www.hsbc.com.hk/1/PA_1_3_S5/content/cr/common/pdf/CC_benchmark_eng.pdf last accessed on 9 March 2012

[184] Hung-Suck Park, *Case Study: Eco Industrial Park in Ulsan, Republic of Korea*, Prepared for the Project of Eco-Efficient and Sustainable Urban Infrastructure Development in Asia and Latin America (Bangkok, United Nations Economic and Social Commission for Asia and the Pacific 2011).

[185] Business for a Clean Economy website: Available www.b4ce.com.au/home/aboutus.html (accessed 19 October 2011).

[186] McKinsey, "Helping 'Green' products grow", *The McKinsey Quarterly*, October 2008.

[187] Pierre Desrochers, "Cities and industrial symbiosis: Some historical perspectives and policy implications", *Journal of Industrial Ecology* (2001), vol. 5, No. 4, pp. 29-41.

[188] Amit Khare, "Identifying strategies for ESCO based energy efficiency market in India", PowerPoint presentation at the Asia ESCO Conference, New Delhi, 14-15 January 2010.

[189] Market and Market, *Global Organic Foods & Beverages Market Analysis by Products, Geography, Regulations, Pricing Trends, & Forecasts (2010 – 2015)* (Dallas, 2011). Available from www.prnewswire.com/news-releases/marketsandmarkets-global-organic-food-and-beverages-market-worth--10450-billion-by-2015-116804058.html (accessed 8 March 2012).

[190] Republic of Korea, *Progress Report on Environmental Protection Policies and Measures 2011* (Seoul, Ministry of Environment, 2011). Available from http://webbook.me.go.kr/DLi-File/pdf/2012/01/5507860.pdf (accessed 16 March 2012) [in Korean].

[191] United Nations Conference on Trade and Development, *Investment and Enterprise Responsibility Review* (New York and Geneva, United Nations, 2011).

[192] Eco-business.com, Singapore Green Label to go regional, news article, 16 March 2012. Available at www.eco-business.com/features/singapore-green-label-to-go-regional/ (accessed 20 March 2012).

[193] Christa Clapp, Gregory Briner and Katia Karousakis, *Low Emission Development Strategies: Technical, Institutional and Policy Lessons* (Paris, OECD and IEA, 2010).

[194] ibid.

[195] United Nations Framework Convention on Climate Change Conference of the Parties, *Report of the Conference of the Parties on Its Sixteenth Session, Held in Cancun from 29 November to 10 December 2010. Addendum. Part Two: Action Taken by the Conference of the Parties at Its Sixteenth Session* (FCCC/CP/2010/7/Add.1) (Cancun, 2011), p.11.

[196] Republic of India, *Low Carbon Strategies for Low Carbon Inclusive Growth*, Interim Report (New Delhi, Planning Commission, Government of India, 2011). Available from http://planningcommission.nic.in/reports/genrep/Inter_Exp.pdf (accessed 16 February 2012).

[197] Syamsidar Thamrin, *Indonesia's National Mitigation Actions: Paving the Way towards NAMAs*, Discussion document prepared for the OECD/IEA Global Forum on Measuring, Reporting and Verification & Carbon Markets, 28-29 March 2011, Paris, available from http://www.oecd.org/dataoecd/52/45/48304156.pdf (accessed 15 March 2012).

[198] Christa Clapp, Gregory Briner and Katia Karousakis, *Low Emission Development Strategies: Technical, Institutional and Policy Lessons* (Paris, OECD and IEA, 2010).

[199] Organisation for Economic Co-operation and Development, *Towards Green Growth: Monitoring Progress* (Paris, 2011).

[200] Paul Ekins and Stefan Speck, *Briefing Paper Seven on Competitiveness and Environmental Tax Reform* (London, Green Fiscal Commission, 2010).

[201] Mark Brenner, Matthew Riddle and James K. Boyce, "A Chinese sky trust? Distributional impacts of carbon charges and revenue recycling in China", Energy Policy (2005), vol. 35, pp. 1771-1784.

202 United Nations Environment Programme, *Buildings and Climate Change: Summary for Policymakers* (Nairobi, 2009).

203 Asian Development Bank, "Rethinking Transport and Climate Change", ADB Sustainable Development Working Papers, No. 10 (Manila, 2009).

204 Organisation for Economic Co-operation and Development, *Cities and Climate Change* (Paris, 2010).

205 United Nations Economic and Social Commission for Asia and the Pacific, *Statistical Yearbook for Asia and the Pacific 2011* (Bangkok, 2011).

206 European Environment Agency, *Success Stories within the Road Transport Sector on Reducing Greenhouse Gas Emissions and Producing Ancillary Benefits*, Technical report No. 2/2008 (Copenhagen, 2008).

207 McKinsey & Company, *Energy Efficiency: A Compelling Global Resource* (Chicago, 2010). Available from www.mckinsey.com/clientservice/sustainability/ (accessed 4 March 2012).

208 United Nations Conference on Trade and Development, *Investment and Enterprise Responsibility Review* (New York and Geneva, United Nations, 2011).

209 HSBC, *HSBC Launches Climate Change Benchmark Index*, Press release of 25 September 2007. Available from www.hsbc.com.hk/1/PA_1_3_S5/content/cr/common/pdf/CC_benchmark_eng.pdf last accessed on 9 March 2012

210 Rene Van Berkel, *Regional Study to Guide Policy Interventions for Enhancing the Development and Transfer of Publicly-Funded Environmentally Sound Technologies in Asia and the Pacific* (Bangkok, United Nations Economic and Social Commission for Asia and the Pacific, 2008).

211 United Nations General Assembly Official Records, 46th Session, Agenda Item 21, UN Doc A/Conf. 151/26 (1992), Section IV, Chapter 34: Transfer of Envrionmentally Sound Technology, Cooperation & Capacity-building, Article 34.9 and Article 34.18.

212 United Nations Development Programme, *National Capacity Self-Assessments: Results and Lessons Learned for Global Environmental Sustainability* (New York, 2010).

213 United Nations Environment Programme, *Green Jobs: Toward Decent Work in a Sustainable, Low-Carbon World* (Nairobi, 2008).

214 ibid.

215 *United Nations, Working Towards a Balanced and Inclusive Green Economy: A United Nations System-Wide Perspective* (Geneva, United Nations Environment Management Group, 2011).

The Asia-Pacific region has come to a historical crossroad: development goals are within reach and the region has the opportunity to lift its people out of poverty. But arriving at those goals and pulling millions more people out of poverty cannot be done through conventional growth strategies. Resource constraints, price volatility and the climate crisis have removed business as usual as an option for all economies. The situation now requires a serious re-examination of the resource- and carbon-intensive growth strategies. Every country in the Asia-Pacific region needs to drastically improve its resource efficiency. The region must embrace a new growth strategy that can turn the trade-off between economic development and environmental protection into a win-win synergy in which "going green" drives economic growth.

The ***Low Carbon Green Growth Roadmap for Asia and the Pacific*** explores the opportunities that a low carbon green growth path offers to the region. It articulates five tracks on which to drive the economic system change necessary to pursue low carbon green growth as a new economic development path. In particular, the "visible structure" of the economy, comprising such physical infrastructure as transport, buildings and energy systems, together with the "invisible structure", which encompasses market prices, governance, regulations and lifestyles, have to be re-oriented towards resource efficiency. The Roadmap provides policymakers in the region with a comprehensive list of policy options and practical implementing strategies as well as examples of successful practices, woven through more than 100 fact sheets and case studies.

United Nations publication
Printed in Bangkok
ISBN: 978-974-680-329-8
April 2012 – 1,500