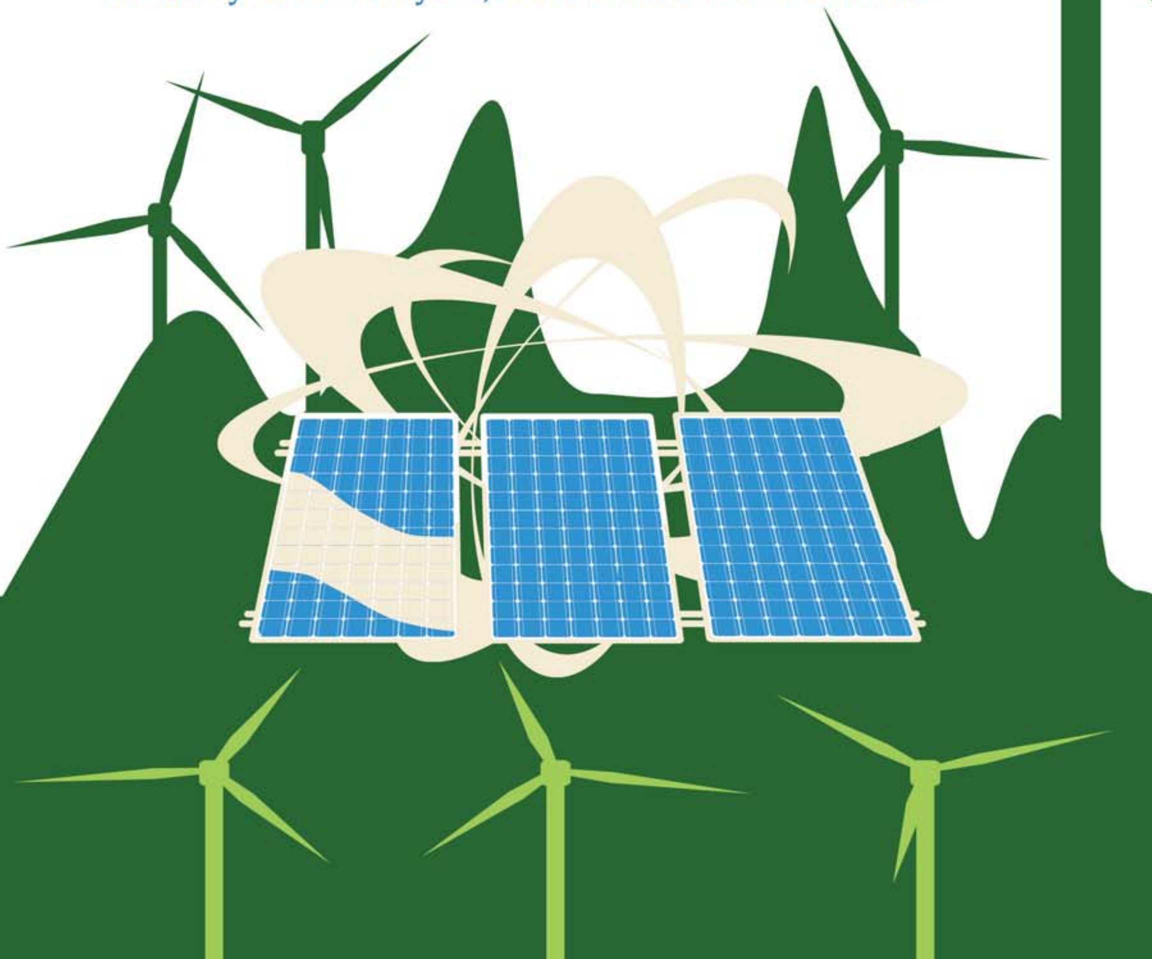
STUDIES IN TRADE AND INVESTMENT 73

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

CLIMATE-SMART TRADE and INVESTMENT in ASIA and the PACIFIC

TOWARDS A TRIPLE-WIN OUTCOME

Edited by Ravi Ratnayake, Marc Proksch and Mia Mikic



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A supplement to the Asia-Pacific Trade and Investment Report 2011

United Nations publication
Sales No. E.12.II.F.10

Printed in Thailand
ISBN: 978-92-1-120645-6
e-ISBN: 978-92-1-055611-8
ISSN: 1020-3516
ST/ESCAP/2614

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References to dollars ($) are in United States dollars, unless otherwise stated.

A space is used to distinguish thousands and millions.

Where the designation “country or area” appears, it covers countries, territories, cities or areas.

ACKNOWLEDGEMENTS

This study was prepared under the substantive direction and guidance of Ravi Ratnayake, Director, Trade and Investment Division of the Economic and Social Commission for Asia and the Pacific (ESCAP). The core team of authors, led by Marc Proksch, comprised Mia Mikic, Marit Nilses and Jeffrey Crawford. As the principal consultant for this study Jeffrey Crawford also providing substantive inputs to all chapters. Marc Proksch was the principal author of chapter 1 and most of Part II. Mia Mikic wrote parts of chapters 2 and 3 with inputs from Jeffrey Crawford and Marc Proksch. Dinda Soumyananda, Martin Wermelinger, Somesh Kumar Mathur and Witada Anukoonwattaka contributed inputs to statistics and the analysis in chapter 3. Marit Nilses and Jeffrey Crawford wrote chapter 4 with inputs from Marc Proksch. The sectoral analysis was undertaken by Masato Abe (automobile industry), Chang-Gil Kim (agriculture) and Philip Lawrence (pulp and paper). Yann Duval provided inputs on cap-and-trading systems. Mr. Krishnamurthy Ramanathan, Head of the Asian and Pacific Centre for Transfer of Technology (APCTT), was the principal author of chapter 10. Yoong Yoong Lee provided substantive inputs on individual country's climate-smart policies and measures. Deanna Morris and Lina Mjornheim assisted with the preparation of selected figures and updating of data. Shamika Sirimanne provided guidance on the overall structure and outline of the study. The study benefited from valuable comments received from Mr. Masakazu Ichimura, Chief, Environment and Development Policy Section, Environment and Development Division of ESCAP, and his staff.

The study benefited from a review of the issues by experts during the Regional Symposium on Low Carbon Economy: Trade, Investment and Climate Change, which was held on 13 and 14 October 2010 in Bali, Indonesia. Joong-Wan Cho, who organized this Symposium on behalf of TID, provided some useful inputs to Part I of the study. The Symposium was attended by the following experts: A.K.M. Nazrul Islam, Research Fellow, Centre for Policy Dialogue, Bangladesh; Xian Weiyi, First Secretary, Department of International Organizations and Conference, Ministry of Foreign Affairs, China; Hu Tao, Senior Environmental Economist, Policy Research Centre of Ministry of Environmental Protection, China; Agrim Kaushal, Director, Ministry of Environment and Forest, India; Rajinder Kumar, Deputy Director, Department of Commerce, India; Sulistyowati, Director for Climate Change Impact Control, Ministry of Environment, Indonesia; Sulistianingsih Sarassetawaty, Head of Sub-Division for Economic Instrument, Ministry of Environment, Indonesia; Kasan Muhri, Director, Centre for Foreign Trade Policy, Ministry of Trade, Indonesia; Irma Rubina Sianipar, Staff, Directorate of Multilateral Cooperation, Ministry of Trade, Indonesia; Yermek Smagulov, Head of the Department, Kazakh Research Institute of Ecology and Climate, Seifullina, Kazakhstan; Aidar Zhiyenbekov, National Expert, Kazakh Research Institute of Ecology and Climate, Kazakhstan; Dayang Nor Izan Abang Halil, Principal Assistant Director, Environment and Natural Resource Economics Section, Economic Planning Unit, Malaysia; Jazzie Di S. Dela Cruz, Economic Development Specialist, National Economic and Development Authority, Philippines; Sang In Kang, Head, The Green Growth Research Centre, National Research Councils for Economics, Humanities and Social Science, Republic of Korea; Geraldyn Lim, Deputy Director, International

Negotiation Division, Ministry of Trade and Industry, Singapore; Siti Aishah Mohamed, Assistant Director, International Trade Cluster, Ministry of Trade and Industry, Singapore; Wannakuwatta Waduge S.A. Piyadasa, Commercial Research Assistant, Department of Commerce, Sri Lanka; Srirat Rastapana, Director-General, Department of Trade Negotiation, Ministry of Commerce, Thailand; Pathkamol Dattibongs, Trade Officer, Department of Trade Negotiation, Ministry of Commerce, Thailand; Angkana Chalermpong, Environmental Official, Office of Natural Resources and Environmental Policy and Planning, Thailand; Niramon Sutummakid, Associate Professor, Faculty of Economics, Thammasat University, Bangkok, Thailand; Pham Hoai Linh, Ministry of Industry and Trade, International Cooperation Department, Viet Nam; and Tam Van Hoang, Deputy Director, Environmental Department Management, Industrial Safety Techniques and Environment Agency, Ministry of Industry and Trade, Viet Nam.

The symposium benefited from inputs by the following resource persons: Truong Phouc Truong, Honorary Professor in Sustainable Transport Systems, Institute of Transport and Logistics Studies, Faculty of Economics and Business, University of Sydney, Australia; Philip Lawrence, Managing Director, Eco Logical Strategies, Sydney, Australia; Alexander C. Chandra, South-East Asia Coordinator, Trade Knowledge Network, IISD, Indonesia; Joy A. Kim, former Climate Policy Analyst, OECD Environment Directorate, Paris; and Chang-Gil Kim, Senior Research Fellow, Korea Rural Economic Institute, Seoul.

This study was externally edited by Mr. Robert Oliver. Marc Proksch provided editorial support to the whole study. The ESCAP Editorial Unit carried out a comprehensive spot-check of the study. Financial support for preparation of some inputs to the study under the project “Development of a low carbon green growth roadmap for East Asia and organization of the 2nd East Asia Climate Forum” sponsored by the Republic of Korea is acknowledged with appreciation.

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ABBREVIATIONS AND ACRONYMS

ACCI	ASEAN Climate Change Initiative
ADB	Asian Development Bank
AFTA	Association of Southeast Asian Nations Free Trade Area
AGP	Agreement on Government Procurement
APCTT	Asian and Pacific Centre for Transfer of Technology
APEC	Asia-Pacific Economic Cooperation
APTA	Asia-Pacific Trade Agreement
APTIR	Asia-Pacific Trade and Investment Report
ASEAN	Association of Southeast Asian Nations
BCA	border carbon adjustment
BIT	bilateral investment treaty
CCBA	Climate, Community and Biodiversity Alliance
CCS	carbon capture and storage
CDM	clean development mechanism
CFL	compact fluorescent lamp
CI	competitiveness index
CH_4	methane
CO_2	carbon dioxide
CSGTs	climate-smart goods and technologies
CSP	concentrated solar power
CSR	corporate social responsibility
CSTs	climate-smart technologies
EGS	environmental goods and services
EIA	Energy Information Administration of the United States of America
ESCAP	Economic and Social Commission for Asia and the Pacific
EST	environmentally sound (or sustainable) technology
EVs/PHEVs	electric and plug-in hybrid electric vehicles
FAO	Food and Agriculture Organization of the United Nations
FCV	fuel-cell vehicle
FDI	foreign direct investment
FiT	feed-in-tariff
FTA	free trade agreement
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product

GHG	greenhouse gas
GWP	global warming potential
HFC	hydrofluorocarbon gases
HS	Harmonized Commodity Description and Coding System
ICT	information and communication technology
ICTSD	International Centre for Trade and Sustainable Development
IEA	International Energy Agency
IIAs	international investment agreements
IMF	International Monetary Fund
IPA	investment promotion agency
IPCC	Intergovernmental Panel on Climate Change
IPRs	intellectual property rights
ISO	International Organization for Standardization
IT	information technology
ITU	International Telecommunication Union
LDCs	least developed countries
LED	light-emitting diode
MDGs	Millennium Development Goals
MEPS	minimum energy performance standards
MFN	most-favoured-nation
MOP	margin of preference
MTS	multilateral trading system
N_2O	nitrous oxide
NAMAs	Nationally Appropriate Mitigation Actions
NAPAs	National Adaptation Programmes of Action
NGOs	non-governmental organizations
NMEEE	National Mission for Enhanced Energy Efficiency
NTBs	non-tariff barriers
NTMs	non-tariff measures
OECD	Organisation for Economic Co-operation and Development
PPM	parts per million
PFC	perfluorocarbons
PV	photovoltaic
R&D	research and development
RCA	revealed comparative advantage
RE	renewable energy
REDD	reducing emissions from deforestation and forest degradation

RETs	renewable energy technologies
ROI	regional orientation index
RPS	renewable portfolio standards
RTA	regional and bilateral trade agreement
SAFTA	South Asian Free Trade Agreement
SF_6	sulphur hexafluoride
SED	sustainable energy development
SEZ	special economic zone
SIP	Standards Implementation for Productivity
SMEs	small and medium-sized enterprises
SWFs	sovereign wealth funds
TBT	technical barriers to trade
TNC	transnational corporation
TRIMS	trade-related investment measures
TRIPS	trade-related intellectual property rights
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WCO	World Customs Organization
WTO	World Trade Organization

EXECUTIVE SUMMARY

Part I: Trade, investment and climate change: an overview of issues, concepts, linkages and trends

Trade and investment play a key role in mitigating climate change. The experiences of many Asian-Pacific economies over the past few decades provide clear evidence that trade and investment are the engines of economic growth and development. At the same time, questions can be raised about the sustainability of trade and investment, and the economic growth they trigger. With regard to climate change, it is obvious that trade and investment have been principal, if indirect, contributors to global greenhouse gas (GHG) emissions: trade through transportation and investment through production. As trade and investment increased rapidly in the region, GHG emissions rose as well. This is known as the "scale" effect. However, trade and investment also affect GHG emissions in other ways. For example, trade allows access to climate-friendly or climate-smart goods and technologies (CSGTs) while investment is required to develop and produce CSGTs, including renewable energy technologies (RETs). Second, as trade triggers growth and more wealth, consumers become more environmentally aware and may demand environmentally-friendly goods and technologies. In the end, it is only through trade and investment that more effective and efficient climate-smart technologies (CSTs) and RETs can be developed, produced and disseminated. When renewable energy (RE) replaces traditional fossil fuels, trade and investment are no longer associated with GHG emissions. Instead, trade and investment become principal components of efforts to mitigate climate change. Hence, sustainable trade and investment related policies at the national, regional and global levels are required to promote climate-smart trade and investment.

Trade and investment are essentially business activities that take place most efficiently and effectively in the context of a free but fair market and economy. Government policy is required to ensure that the benefits of trade and investment are both optimized and shared equitably by all. Policies are also required to ensure that trade and investment lead to sustainable and climate-smart growth, i.e. growth that entails sharply reduced GHG emissions to a level (450 parts per million [ppm]) that limits the global temperature rise to not more than 2ºC by the end of the century. Such policies can be structured into regulatory measures (including regulations, standards and labelling), and economic incentives (including taxes, tradeable permits and subsidies) and cover trade and investment policies but also other policies (i.e. financial, energy and enterprise development policies), which have a direct impact on trade and investment.

Global and regional approaches towards promoting climate-smart trade and investment need to be properly coordinated and to address the concerns of developing countries to achieve a 3W outcome. Addressing climate change effectively may affect the economic growth of developing countries, at least in the short term. Such countries are clearly concerned that any global or regional action to mitigate climate change may negatively affect them. Already, many developing countries hold the view that the problem of climate change is basically caused by developed countries and, hence, developed countries must bear the main responsibility to address the issue, including through the provision of technical assistance and transfer of CSTs to developing countries. Without technology transfer and technical assistance, developing countries would not be able to develop capacity to trade and invest in CSGTs. Developing countries also fear, not entirely unjustifiably, that measures put in place by developed countries to mitigate climate change are sometimes protectionist measures in disguise. At the same time, many developing countries have witnessed significant growth in recent years but have at the same time significantly raised their GHG emissions. As they are, in turn, heavily affected by such emissions they need to be part of the solution through active engagement and levels of commitment to GHG reductions that do not unduly affect their growth and efforts to reduce poverty. The promotion of trade and investment in CSGTs is a strategy that leads to a win-win-win (3W) outcome for all, i.e. the simultaneous achievement of growth in trade and investment, economic growth and climate change mitigation. Such an outcome can be achieved if trade and investment policies are properly coordinated with, and mainstreamed into climate change mitigation policies at the global, regional and national levels.

The Asia-Pacific region, led by China and India, has rapidly increased its GHG emissions over the past decade due to the export-led growth of the region.

The engagement of Asian and Pacific developing countries in global, regional and national efforts to mitigate climate change is particularly important, as the region has rapidly increased its GHG emissions over the past decade due to export-led growth. In 2005, East and North-East Asia accounted for the largest share of the Asia-Pacific region's emissions at 53.3 per cent, followed by South and South-West Asia at 18.8 per cent. China surpassed the United States to become the world's largest emitter of GHGs in 2005, the latest year for which data are available for all greenhouse gases. Of 185 countries and economies, India was ranked fifth and Indonesia twelfth. However, emissions per capita are relatively low while the CO_2 emission intensities (the level of CO_2 emissions per economic output or CO_2/GDP) dropped for most Asian economies during 1992-2006, as their economies grew faster than their CO_2 emissions. Energy is the largest contributing sector to GHG emissions in the region, accounting for almost two thirds of all regional GHG emissions. The agricultural sector also significantly contributes to GHG emissions; worldwide, farms and related facilities contribute approximately 20 per cent of the annual increase in anthropogenic GHG emissions. The share of the transport sector to GHG emissions varies from country to country. In the manufacturing sector, carbon-intense industries in the region include iron and steel, pulp and paper, forestry and furniture, and cement as well as fossil fuels.

Emissions resulting from trade (covering production and transportation) are not necessarily higher than emissions resulting from local production replacing trade. It is tempting to associate trade in a good to be associated with higher GHG emissions that are related to the transportation of that good. However, when GHG emissions are calculated on the basis of emission intensity indices of exports and imports it appears that sometimes the import of a good will result in lower GHG emissions than if the good has been produced locally. Thus, a careful analysis of the impact of trade on GHG emissions is in order before a judgement can be made on the contribution of trade to GHG emissions. Such an analysis shows that China, Indonesia and Viet Nam import commodities that are produced (overseas) with lower emissions than if they were produced locally (import emission indices are less than 1), while the reverse holds true for Bangladesh, India and Thailand. This implies that China, Indonesia and Viet Nam are importing from regions that use cleaner production techniques than those used domestically to produce such goods, while the reverse holds true for Bangladesh, India and Thailand. A similar analysis shows that Bangladesh, China, India, Indonesia, Thailand and Viet Nam export commodities that are locally produced with more emissions than the emissions that would have resulted from production locally in the destination countries, while the opposite is true for Japan, the Republic of Korea and European Union-15 economies.

It follows that emissions from trade (covering production and transportation) are not necessarily higher than emissions from local production replacing trade. This finding is based on partial accounting for transportation-related emissions and on the fossil fuel energy use in production, but should be improved when more recent and more comprehensive data become available. However, based on currently available data, it is obvious that the solution to climate change mitigation is not a reduction in trade but rather the replacement of conventional fossil fuel-based technologies by climate-smart technologies. This would allow countries to benefit from trade-led growth with no (or little) adverse impact on climate and environment.

Whatever the scenario for future GHG emissions, trade and investment in the Asia-Pacific region will most likely be severely affected by climate change. While it can be argued that climate change will trigger changes in comparative advantages that lead to potentially new but long-term trade and investment opportunities, generally most reports refer to the potentially huge damage effects of climate change on developing countries leading to increased vulnerabilities in important economic sectors, particularly in the Asia-Pacific region. Even under the most optimistic scenarios for mitigation of climate change, global temperatures will rise; even a moderate rise will have major impacts on production, trade and transportation patterns in the region.

In particular, the likely consequence of climate change is an increase in severity of weather patterns that lead to floods, drought and desertification, particularly in coastal areas. Such natural disasters lead to loss of productivity, particularly in agricultural areas in (sub)tropical regions and, hence, a decrease in food production. Increased agricultural land may become available only in more temperate climates. Inundation of coastal areas will affect transport infrastructure for trade such as ports and production – and, hence, investment – most of which normally takes place in areas close to rivers and coasts. There will be a decrease in biodiversity and traditional knowledge, which often provide competitive advantages in trade for some countries, while (water-borne) diseases are also likely to increase leading to a loss in labour productivity.

It is therefore important to take drastic and collective measures to mitigate climate change to at least minimize the negative effects of climate change. As the energy requirements of the Asia-Pacific region are forecast to grow rapidly during the next few decades, reliance on “business-as-usual” is no longer an option for ensuring sustainable development. According to Asian Development Bank (ADB) estimates, by 2030, primary energy demand in Asia and the Pacific is expected to grow by more than 79 per cent compared with 2005 if recent trends in energy development and use persist. This translates into an additional 7.7 trillion tons of CO_2 emissions entering the atmosphere, and positions Asia and the Pacific markedly ahead of the Organisation for Economic Co-operation and Development (OECD) in terms of aggregate emissions.

Global and regional trade in climate-smart goods and technologies is rising, but still only around 3 per cent of total global and regional trade, respectively. At the core of climate change mitigation efforts is the switch from fossil-based energy to RE sources in manufacturing and transportation (and household use). ESCAP has compiled a list of 64 CSGTs that are essentially goods and technologies which, when effectively used in the production process, would reduce or minimize GHG emissions. It appears that global and regional trade in CSGTs is rising, but is still only around 3 per cent of total global and regional trade, respectively. A major problem associated with the relatively low level of trade in CSGTs, and trade in environmental goods and services in general, is the absence of a viable market.[1] However, Asia and the Pacific is emerging as the most dynamic region with regard to trade in CSGTs, with China and Japan the top two exporting countries. In 2009, the region accounted for about 34.4 per cent of world trade in CSGTs while intraregional trade in CSGTs is about 50 per cent of the region's total trade in these goods.

The CSGT group contains four subcategories of technologies related to RE – solar PV systems, wind power generation, clean coal technologies and energy-efficient lighting (a residual fifth category comprises the largest number of CSGTs). The Asia-Pacific region as a whole is a net exporter of solar PV systems and energy-efficient lighting. In contrast, the region is a net importer of both wind power generation and clean coal technologies. However, there are sharp differences with regard to the development of trade performance in these two technologies. For example, while the region is a net importer of wind power generation and clean coal technologies, the import-export coverage is much higher for wind power generation technology than for clean coal technology.

China has become the world's largest solar PV manufacturing base, but around 95 per cent of China's solar cell production was exported in 2007 largely due to feed-in tariffs and other financial incentives that were provided to support solar power in major foreign solar markets. China is also a leading exporter of wind energy technologies, although most of the output is for domestic consumption. Japan and the Republic of Korea are two other leading exporters of CSGTs.

The estimated trade potential in 2008 for CSGTs in Asia and the Pacific was $30 billion. Promoting trade in CSGTs is only a viable policy option if there are opportunities for such trade. A recent ESCAP analysis revealed that such opportunities indeed exist and can be significant, as measured by indices such as the competitiveness index (CI), revealed comparative advantage (RCA) index and regional orientation index (ROI). In particular, the analysis found that trade in CSGTs had a regional bias for most of the economies in the

[1] In addition, trade in CSGTs is not adequately captured by statistical data.

region and that almost all CSGT net-importing economies import predominantly from Japan, Hong Kong, China, and, more recently, China. There is also a clear propensity to export CSGTs intraregionally rather than outside the grouping, although this propensity has declined the past few years. The analysis also found that not all economies were globally or regionally competitive in CSGTs, but could be potentially competitive if appropriate policies were implemented.

In this regard, promoting trade in CSGTs means, most of all, reducing barriers to such trade. Although import tariffs on key groups of CSTs have come down in most countries of the region, in others tariffs remain high, both in absolute terms and relative to their average tariff for all industrial goods. However, a gravity model-based analysis reveals that tariffs do not appear to play a huge role in determining trade in CSGTs. At the same time, various non-tariff barriers (NTBs) continue to hamper effective global and regional trade in CSGTs. If such obstacles were to be removed and countries were to exploit the opportunities offered by trade complementarities through adopting relevant climate-friendly regulations and standards, the export potential for CSGTs in the region would be close to $30 billion based on 2008 data.

Reducing GHG emissions will require major investments in power generation, manufacturing, transport and buildings. Already, the Asia-Pacific region is leading global investments in RE projects. Unlike the case of trade, investment data on CSGTs are more difficult to come by. Global investments in sustainable energy reached $243 billion in 2010, up from $186 billion in 2009, and represent a nearly five-fold increase since 2004. The majority of global investments in RE projects in 2009 went to the wind sector (57 per cent of investments and nearly half of installed capacity), followed by solar (20 per cent), and biomass and waste (9 per cent). Several ESCAP members were among the major investors in RE globally. Despite the economic downturn, RET investments in Asia and the Pacific increased by 30 per cent in 2010. This compares very well with a drop of 22 per cent in Europe. The best performer overall was China, which by far topped the list ($39.1 billion in 2009, nearly double the investment of $22.5 billion in the United States). Renewable energy still accounts for a small share of overall energy capacity, both globally and regionally, but that share is growing. Together with China, both India and Japan are among the world’s top seven countries in terms of installed capacity in RE. Other countries in Asia and the Pacific that have exhibited relatively strong growth in either investment or installed capacity during a five-year period included Australia, Indonesia, the Republic of Korea and Turkey. Wind energy attracted the most investment (as a percentage of total investment), not only globally but in most G-20 ESCAP countries, including Australia, China, India and Turkey. Solar power garnered the majority of investment in Japan (72 per cent) and the Republic of Korea (69 per cent). In Indonesia, almost all investment in RE has been directed to geothermal energy.

An additional annual $1 trillion of global investments will be needed by 2030 to meet emission targets, with more than half (some $600 billion) in Asia and the Pacific. It is estimated that approximately $600 billion in investments will be needed in the Asia-Pacific region to meet emission targets that will limit the global temperature rise to less than 2ºC by the end of the century. China is expected to constitute a large part of these investments, at around 26-33 per cent of global investments. In addition, close to $100 billion a year will be needed in India, followed by Japan and the Russian Federation with investment needs of $46 billion and $42 billion per year, respectively. Together, these four countries alone are projected to account for almost $500 billion or 53 per cent of the required global investments in the energy sector during 2021-2030.

The majority of investments are expected to be required in the transportation and buildings sectors. This will particularly be the case after 2030, when the transportation sector is expected to make up for nearly half of all investments. Investments in “green” buildings are likely to occur earlier, as the necessary technologies are already largely available. The power sector (generation, transmission and distribution) is expected to come third, followed by industry (mainly through investments in the three sectors of iron and steel, chemicals and petrochemicals, and cement). Most investments in reducing energy-related emissions are expected to be in energy efficiency improvements, particularly end-use efficiency (industry, residential and transport).

Savings in fuel and electricity costs will more than make up for additional investments in mitigation of climate change.

Most climate change-related studies highlight that any delay in investments in mitigation efforts will drastically increase the total cost of overall required investments. Therefore, quick action is imperative. The quicker that action is taken, the lower the costs over time will be. Rapid action to mitigate GHG emissions in the power and industry sectors is particularly important in order to avoid a long-term lock-in in high GHG-emitting infrastructure.

In view of the above, there are clearly many investment and business opportunities in developing and producing CSGTs, particularly with regard to investment in energy efficiency, RE production and RETs. However, business needs to get the proper signals from governments. For that purpose, a comprehensive policy framework will be needed for decreasing business risk and increasing business opportunities in climate change mitigation.

Part II: Cohesive and coherent climate-smart trade and investment policies

Effective mitigation of climate change requires a comprehensive and carefully coordinated policy approach that focuses on policies promoting trade and investment in CSGTs.

The mitigation of climate change requires a comprehensive and carefully coordinated policy approach with the focus on policies that promote trade and investment in CSGTs and climate-smart services. As discussed above, RE assumes a central role in the mitigation of climate change; however, the effective development and utilization of CSTs and RETs require large amounts of investment as well as liberalization and facilitation of trade in those technologies to ensure access by all countries. Trade and investment policies therefore assume a central role in the policy mix to mitigate climate change and they would similarly be important in efforts to adapt to climate change. However, such policies cannot be formulated in a vacuum; instead, this should be done in the context of the formulation of a comprehensive policy mix, including other policies that are not, strictly speaking, trade or investment policies but have nevertheless a potentially large impact on trade and investment. Part II of this study explores the following policy areas:

(a) General policies, such as Nationally Appropriate Mitigation Actions (NAMAs), National Adaptation Programmes of Action (NAPAs), appropriate legal framework and compliance mechanisms, cap-and-trade systems, sectoral policies, including reducing emissions from deforestation and forest degradation (REDD), and sustainable public procurement;

(b) Trade policies consisting of policies that restrict or ban the import or export of carbon-intensive products, but with focus on policies that promote export and import of CSGTs;

(c) Investment policies comprising policies that promote domestic and foreign investment, particularly foreign direct investment (FDI), in the development and production of CSGTs;

(d) Financial policies in support of climate-smart trade and investment, including policies that offer financial rewards or incentives for processes, products and services considered to be climate-smart, and policies that impose financial penalties on processes, products and services considered to be carbon-intensive;

(e) Renewable energy and RET policies and related industrial policies, such as feed-in-tariffs and renewable portfolio standards, policies for promoting climate-smart standards and labels, and policies for facilitating the transfer of CSTs and RETs;

(f) Policies that support the development of climate-smart enterprises, particularly small and medium-sized enterprises (SMEs), including public-private partnerships;

(g) Policies to strengthen regional cooperation in support of climate-smart trade and investment.

The liberalization and facilitation of international trade in CSGTs and climate-smart services should be pursued through every available channel, preferably unilaterally and multilaterally, and regionally and bilaterally as a second-best option. Trade policy in the context of mitigation of climate change can take two forms. One set of policies discourages trade in relatively carbon-intensive goods and services while the other set promotes trade in CSGTs. Trade in carbon-intensive goods and services should be discouraged through environmental laws and regulations implemented on a non-discriminatory basis rather than through trade-distorting measures, which should be avoided. In general, this study does not advocate restrictions on trade and therefore the focus is on the promotion of trade in CSGTs and climate-smart services. Direct promotion can take place on the basis of trade fairs and trade missions etc., especially for countries that have developed competitive advantages in

CSGTs. Countries could also promote paperless trade in all goods, including CSGTs, and facilitate trade and transport of all goods and services through easy procedures and single windows.

However, it appears that trade in CSGTs is hampered by numerous obstacles, particularly NTBs. Therefore, there is much scope for liberalizing and facilitating trade in CSGTs. This can be done unilaterally, multilaterally, regionally or bilaterally. Attempts to liberalize CSGTs and climate-smart services at the multilateral level have taken place within the context of the Doha negotiations on liberalization of environmental goods and services, but the negotiations have failed to make much progress in the absence of a consensus on definitions and lists of environmental goods and services. Nevertheless, multilateral and unilateral liberalization efforts remain the priority channel. At the same time, countries could negotiate for "policy space" in WTO rules to allow climate-smart policies that currently could violate existing WTO rules.

Liberalization of CSGTs and environmental goods can also take place through regional and bilateral trade agreements (RTAs). Various RTAs in the region have already high coverage of CSGTs (as per the ESCAP list). For example, the coverage of CSGTs is 100 per cent in the case of the Association of Southeast Asian Nations Free Trade Area (AFTA) and the South Asian Free Trade Agreement (SAFTA), and close to 90 per cent in the case of the Asia-Pacific Trade Agreement (APTA), when the Fourth Round will be finished, although the level of liberalization may not be as substantive. However, many other RTAs remain rather shallow in terms of coverage and commitment. When negotiating RTAs, countries could ensure a comprehensive coverage of CSGTs (by their own definition, if there is no consensus). In addition to general exception clauses in RTAs, countries could also ensure inclusion of comprehensive and clear environment clauses in RTAs, which would enable parties to facilitate the control, regulation and import of climate-unfriendly goods and services. In the final analysis, however, RTAs have inherent limitations in that they are by definition discriminatory and often have rather restrictive rules of origin. They remain a second-best option.

Border carbon adjustments (BCAs) should be avoided. The application of such adjustments should not be a preferred climate-smart trade policy tool, as BCAs may constitute disguised restrictions on international trade and disproportionally affect exports from developing countries. Various countries have contemplated their use in order to level the playing field between domestic products and imports, and to prevent so-called "carbon leakage", which refers to the relocation of businesses from countries with relatively strict climate mitigation laws and regulations to countries with less strict laws and regulations (similar to so-called "pollution havens"). However, there is no strong evidence of such a phenomenon. In addition, it is very difficult to calculate adjustments for direct and indirect cost differentials associated with climate change policies. In any case, as the compatibility of BCAs with WTO law is uncertain, Asia-Pacific countries could in the meantime consider the establishment of a regional mechanism and disciplines for BCAs on a non-binding basis.

Climate-smart FDI should be pursued on a priority basis as it has high potential to transfer capital, technology and expertise for climate-smart growth and development. While transnational corporations (TNCs) have often been accused of violating environmental laws and regulations, they are important players in developing and producing CSGTs. They also tend to develop climate-smart standards and labels, and expect their suppliers, often SMEs, to conform to such standards. Therefore, the attraction and promotion of FDI in CSGTs is an important climate change mitigation policy, as such FDI can potentially bring capital, technology and expertise in convenient packages. However, FDI in CSGTs faces various obstacles that do not significantly differ from obstacles to FDI in general. Among the most important barriers to climate-smart FDI are technical/infrastructure (including grid-related) barriers, and administrative and market-related hurdles. In addition, the lack of financial incentives and clear environmental regulations, existence of domestic energy monopolies and subsidies for conventional energy sources are cited by investors as important barriers.

Investors (including those who can be characterized as climate-smart investors) obviously favour countries that: (a) maintain open markets, and enforce their laws and regulations; (b) have a good reputation in investor after-care with a minimum of corruption; (c) are WTO members and employ investment-conducive trade and industrial policies; (d) enforce intellectual property rights and international labour standards; and (e) have a good track record in settling investment-related disputes. Within the context of this study, the following policy recommendations are proposed:

(a) Mainstream FDI into climate-smart development strategies;

(b) Create an enabling regulatory framework;

(c) Pursue regional market integration in support of regional climate-smart value chains;

(d) Liberalize and deregulate energy markets (particularly the power sector);

(e) Provide specific incentives and privileges for climate-smart investment;

(f) Avoid performance requirements;

(g) Provide the necessary infrastructure (such as special economic zones) and institutional framework for climate-smart FDI;

(h) Promote and target specific climate-smart investment;

(i) Leverage the power of institutional investors such as pension funds, insurance companies and sovereign wealth funds (SWFs);

(j) Facilitate climate-smart investment and pay due attention to investor after-care;

(k) Formulate and implement supporting policies related to enhancing fair trade (competition), IPR protection and human resources development;

(l) Fill investment gaps through public investment or public-private partnerships.

International investment agreements could be an important tool for promoting climate-smart FDI. Countries should also pursue international investment agreements (IIAs) conducive to climate-smart FDI. Like RTAs, IIAs – particularly bilateral investment treaties (BITs) – have proliferated. Although BITs usually do not have specific environmental clauses they also tend to focus on post-establishment rather than pre-establishment issues, leaving the country in charge of the decision of what kind of investor to admit. However, pre-establishment rights are making inroads in BITs, which may, in any case, restrict policy space for environmental purposes, in particular under provisions such as “fair and equitable treatment” and stabilization clauses. Such restrictions may also be included in investment contracts between investors and host governments. In negotiating BITs and other IIAs, countries need to ensure that their policy space to limit GHG emissions and protect the environment in general is not compromised and that such policies cannot be challenged under standard provisions of such agreements. For example, IIAs should not undermine the right of countries to undertake environmental impact assessments, including assessments of impacts and implications of GHG emissions associated with a particular investment. Such assessments should be made for all investments. Countries should also ensure that IIAs have clear provisions and procedures for international arbitration of investment-related disputes.

Financial policies need to be implemented that put a cost on carbon (e.g. carbon tax) and provide financial incentives for the development and use of CSGTs (subsidies). The promotion of trade and investment in CSGTs will be difficult if there are no proper price signals discouraging the use of carbon-intensive products. A carbon tax is a convenient if not perfect market-based instrument that puts a price on carbon and helps to change the behaviour of producers and consumers towards the use of RE and the adoption of energy efficiency. Carbon taxes should ideally be revenue-neutral, i.e. the tax revenue is returned to businesses producing or using RE and consumers of RE rather than fossil fuel in the form of tax breaks or subsidies of “green” projects. As such, local businesses will not lose international competitiveness as a result of the tax.

At the same time, financial support should be given to the development and use of CSGTs, for example in the form of subsidies. Such subsidies, however, have to conform to WTO rules, which allow general subsidies for the support of an industry, including CSGTs, not contingent on export performance, such as subsidies for research and development (R&D). Direct RE subsidies would be considered “specific”, which warrants their prohibition. With regard to biofuels, the WTO Agreement on Agriculture allows domestic and export subsidies on the products covered under the Agreement, provided that WTO members schedule their subsidies that are subject to reductions. At the same time, traditional financial support for fossil fuels should be reduced or eliminated in a phased manner in order to prevent undue harm to the poor segments of society. The funds could have better alternative use, i.e. to directly assist the poor. For example, complementing the removal of such subsidies with the introduction of targeted transfers or tax relief for low-income households is one way of ensuring subsidy removal would achieve GHG reductions while at the same time being pro-poor.

Apart from taxes and subsidies, there are many other financial instruments that governments can deploy to support climate-smart development, such as low-cost loans by development banks, green bonds, and risk insurance and guarantees. Some of these instruments require public-private partnerships. Whatever form of financial support for climate-smart growth is adopted, it is important that it should be temporary, performance-based and easy to implement, not unduly distort international trade and conform to WTO rules.

Mandatory and voluntary private technical climate-smart standards and labels are a powerful tool to influence consumer behaviour and upgrade climate-smart competitiveness of enterprises along whole value chains. Climate-smart standards can be private or public, mandatory or voluntary. They have become increasingly common as an important tool for both governments and businesses to promote “green” growth and curb GHG emissions. The principal concern with standards is that many developing countries are unable to meet them and view them as important NTBs. Therefore, standards and labels should conform to international trade rules, in particular the WTO Agreement on Technical Barriers to Trade, and not be abused as disguised forms of protectionism.

Many countries already have a vast array of national standards comprising energy-efficiency standards and labels, fuel-efficiency standards for motor vehicles, minimum energy performance standards, greener building codes, and carbon emission standards and labels. The costs of conforming to those standards can be prohibitive for many developing countries and the measurement of the carbon footprint of a particular product can be very complicated. However, to the extent that such standards are a response to consumer pressure or an important strategy for businesses to increase competitiveness in “green” products, the important message is for developing countries to engage in the process of standard setting and to upgrade their own capacity to conform to those standards. In addition, there is a need to harmonize the many different sets of national level standards and strive towards (sub)regional standards and labelling schemes in each industrial subsector.

At the global level, various international standards related to climate change management already exist, such as: the ISO 14000 series; the Gold Standard, which is the only independent global standard for creating high-quality emission reductions projects developed under the Kyoto Protocol Clean Development Mechanism (CDM); and the Greenhouse Gas Protocol (GHG Protocol). However, these standards are not product-related; rather, they are accounting tools for businesses and governments to measure and manage GHG emissions. In any case, national and (sub)regional standards should conform to international standards where they exist to the maximum extent possible.

The development and transfer of viable and effective CSTs is at the core of the solution to climate change. Trade and investment have traditionally contributed to climate change as transportation and production – the processes directly associated with trade and investment – require energy generated from the burning of fossil fuels, which leads to GHG emissions. A clear solution to the problem of GHG emissions is to replace fossil fuels with RE sources, which would allow transportation and production to take place without fossil fuels. However, although the use of RE is on the rise, as yet it is not able to meet total demand for energy effectively, efficiently and competitively. Hence, there is a need for more R&D, which requires investment. In the meantime, CSTs, including RETs that allow for the effective generation and utilization of RE, are already available; however, not every country has access to them. Trade plays an important role in improving such access while investment is important to improving the performance and cost-efficiency of these technologies.

Effective technology transfer entails more than just the transfer itself. The transferred technology needs to be properly diffused, and adopted and adapted to fit local needs and requirements. Technology transfer and diffusion are also not automatic, easy and predictable processes. Both technology transfer and development require public support, particularly funding, while for transfer an appropriate investment climate needs to be in place to attract climate-smart FDI. In general, governments need to address barriers to technology transfer. These barriers can be institutional and legal, political, technological, economic, information-related, financial, and cultural. One particular barrier relates to intellectual property rights (IPR) protection, which can make effective transfer of CSTs prohibitive in the absence of certain flexibilities. However, the importance of IPR varies from country to country in technology transfer. One option is to include additional flexibilities in the WTO Agreement on Aspects of Trade-Related Intellectual Property Rights (TRIPS) with regard to compulsory licensing and trade in generic CSTs in a similar manner as the existing flexibilities for pharmaceutical products.

In order to promote the development and transfer of CSTs, the following interrelated recommendations are proposed:

(a) Strengthen effective national innovation systems and R&D capacity;

(b) Reward “climate-smart” innovation and R&D;

(c) Promote transmission of CST through forging linkages between domestic suppliers and climate-smart TNCs;

(d) Use public-private partnerships to build absorptive capacities of domestic enterprises;

(e) Set up CST clusters and parks;

(f) Link R&D to practical use and commercialization of CSTs;

(g) Specify policy targets for promoting CSTs;

(h) Introduce CSTs in national and regional value-chains;

(i) Improve access to finance, with focus on venture capital;

(j) Pay special attention to agriculture;

(k) Strengthen the national IPR regime;

(l) Pay special attention to the needs of least developed countries.

Enterprises that adopt “green” practices and technologies early in anticipation of government regulations are likely to emerge as stronger competitors in the longer term. Not all enterprises, in particular SMEs, are enthusiastic about embracing “green” practices and adopting “green” technologies as doing so could lead to higher costs which would undermine their competitiveness. Many SMEs are already struggling to gain access to finance, technology and markets. However, as SMEs in developing countries are emerging as important suppliers to TNCs and are increasingly integrated into global and regional value chains, they would have to conform to technologies and standards developed and adopted by the leading TNCs in such value chains. Increasing government regulations may also force them to act sooner or later. In this regard, those enterprises which manage to adapt early may well find that they have competitive advantages which gives them an edge in trade and investment in CSGTs and climate-smart services. In other words: going “green” is a good business strategy and SMEs in particular should exploit early mover advantages.

While businesses plays an important role in helping other businesses adopting “green” practices (in particular if they are both part of the same value chain), governments need to support this process as well and ensure a level playing field. This study presents the following recommendations for governments to promote climate-smart SMEs:

(a) Promote climate-smart entrepreneurship and provide comprehensive support to new and promising climate-smart SMEs through incubation programmes;

(b) Link climate-smart TNCs with domestic enterprises, through SME integration into regional and global value chains and formation of industry clusters;

(c) Enforce consistent and predictable climate-smart rules and regulations;

(d) Establish climate-smart government procurement schemes for SMEs;

(e) Improve access to credit for climate-smart SMEs;

(f) Provide climate-smart technology support;

(g) Promote climate-smart human resources development;

(h) Promote corporate social responsibility (CSR).

Enhanced (sub)regional cooperation in the form of a regional climate-smart trade and investment partnership is highly desirable. Climate change, and trade and investment are cross-border phenomena. They therefore require an international approach. Regional cooperation among like-minded countries inclined, willing and ready to move forward and reap early mover advantages could cooperate, perhaps in the form of a regional partnership or number of partnerships to promote trade and investment in CSGTs. Already, at the subregional level, some initiatives exist, particularly in the area of cooperation in the promotion and development of RE and RETs. Examples are ASEAN’s Climate Change Initiative and the Asia-Pacific Economic Cooperation (APEC) forum’s Asia-Pacific Network for Energy Technology. APEC has also defined an environmental goods and services (EGS) list, of which CSGTs are part. However, these initiatives have so far failed to significantly enhance trade and investment in CSGTs and, while commendable, would be inadequate by themselves to curb GHG emissions to acceptable limits. Clearly, a more pro-active approach is necessary. While trade and investment in CSGTs and climate-smart services can be promoted within the context of RTAs, such as the ASEAN-China FTA or other ASEAN+ FTAs, or APTA, this study advocates a regional trade and investment cooperation partnership for the mitigation of, and adaptation to climate change that, short of a legally binding agreement, could incorporate the following elements subject to political will:

(a) Reduction of tariffs and NTBs on a defined and agreed list of CSGTs and climate-smart services;

(b) Establishment of a regional emission trading scheme, which would be much more effective with an increasing number of participating countries;

(c) Regional investment collaboration;

(d) Regional harmonization of climate-smart standards and labels;

(e) Regional financing schemes;

(f) Regional cooperation in CST development and transfer;

(g) Technical assistance from the more developed and wealthy participating countries to the less developed and wealthy ones.

Regional investment collaboration could include:

(a) Harmonization of investment regulations and incentives for climate-smart investment;

(b) According pre- and post-establishment MFN and national treatment for climate-smart investment from partner countries and possibly all countries of the world;

(c) Establishment of a regional credit guarantee facility for high risk climate-smart investment;

(d) Undertaking joint climate-smart investment promotion and targeting activities, e.g. road shows, investment fairs and forums;

(e) Exchanging lists of promoted climate-smart sectors/industries where partner countries could encourage investments from other partner countries and initiate promotional activities;

(f) Developing cross-border special economic zones for climate-smart investment;

(g) Establishing a joint database for supporting industries and technology suppliers among partner countries as well as a database to enhance the flow of investment data and information on investment opportunities in partner countries;

(h) Establishment of a joint climate-smart investment promotion committee with participants from the various investment promotion agencies (IPAs) in each partner country.

In the area of financial cooperation to support climate-smart trade and investment, the levying of a regional carbon tax, the establishment of a region-wide subsidy for the development and/or use of CSGTs, and/or the establishment of a regional development fund for the promotion of CSGT development could be considered. Participating countries in a regional partnership could consider harmonization of national climate-smart standards or at least agree on mutual recognition of national-level standards. In the area of CST development and transfer (in addition to the other initiatives outlined above), countries could:

(a) Promote (sub)regional innovation systems linking national innovations systems to create synergies and efficiencies in technology development;

(b) Form a regional R&D alliance that would pool national resources for regional-level R&D and testing;

(c) Establish cross-border CST clusters and climate-smart science parks;

(d) Set up regional databases on supplies and customers of CSTs and, in a wider context, covering ESTs. (The current databases and search engines of the Asian and Pacific Centre for Transfer of Technology (APCTT) are good starting points for this purpose);

(e) Form (sub)regional partnerships to facilitate intraregional transfer of CSTs;

(f) Set up a regional technology venture capital fund.

With regard to technical assistance and aid-for-trade, regional cooperation could result in the establishment of a regional technical assistance centre (for example, at ESCAP).

The successful implementation of the proposed recommendations is a function of political will and leadership, effective technical and financial assistance, and effective cooperation and coordination among stakeholders, including solid public-private partnerships. Proposing recommendations for the promotion of climate-smart trade and investment is one thing; implementation is another. As yet, political will seems to be inadequate and many countries balk at binding commitments, and even voluntary cooperation schemes may be difficult to implement in the absence of clear political will and leadership. Such political will and leadership are nevertheless crucial if the Asia-Pacific region is to make a significant contribution to GHG emission mitigation through enhanced trade and investment in CSGTs and climate-smart services.

Second, despite all efforts, many countries lack the financial resources and technical skills to seriously mitigate their own GHG emissions, and they require technical and financial assistance, such as aid for climate-smart trade and investment. Last, the promotion of climate-smart trade and investment in particular, and the mitigation of climate change in general, requires the cooperation of all stakeholders together with proper coordination of policies among all concerned government ministries and agencies at the central and local government levels. In particular, solid public-private partnerships would go a long way to raising not only resources but also awareness. Governments and businesses can do a great deal on their own, but together they will provide the necessary synergy to tackle the problem of climate change effectively and efficiently.

INTRODUCTION

Trade and investment in the Asia-Pacific region have largely recovered from the global economic crisis that started in 2008, with monthly exports reaching pre-crisis levels in 2010 (ESCAP, 2011). However, all countries in the region continue to face challenges in sustaining international competitiveness. Rising public debts (although not as high as in most developed countries) and inflation as well as rising prices of food and other commodities are of particular concern to the low-income and least-developed countries of the region. In this regard, it is high time for those countries to reflect on their future policies and strategies for trade and investment as the traditional engines of growth. In particular, with rapidly rising populations and consumer demand and, consequently, rising GHG emissions and dwindling natural resources, the sustainability of economic growth, and therefore trade and investment, need to receive due attention. In this regard, it is argued that the future competitiveness of economies lies to a large extent in their ability to develop, produce and export environmentally sustainable goods and services.[2]

With growing global concerns about the impact of climate change, the focus of this study is on an important subgroup of environmentally sustainable goods and services, i.e. CSGTs. For the purpose of this study, CSGTs are understood to be goods and technologies that allow for production processes that have no or minimum GHG emissions and negative impacts on the environment, and which are (at least, potentially) economically efficient and acceptable. Such goods or technologies are known as “climate-smart” and the category of CSTs mainly comprises RETs.[3] Countries and companies that take an early lead in this area are expected to become the leaders of the future and to benefit from early movers' advantage. In particular, development paradigms need to be adjusted to allow countries to continue pursuing economic growth, alleviating poverty and achieving the Millennium Development Goals (MDGs) while simultaneously addressing the severe economic and environmental impacts of climate change and other environmental sustainability issues. Such a paradigm shift forms the basis of ESCAP's low-carbon green growth strategy, which is currently being developed; this study provides inputs to the strategy by highlighting the role of trade and investment in climate-smart goods, technologies and services.

According to the Intergovernmental Panel on Climate Change (IPCC) (2007), there is compelling evidence that GHG emissions cause climate change and that most GHG emissions are due to anthropogenic factors[4] (see box I.1). The changes in climate foreseen towards the end of this century involve a gradual warming of the planet, with a temperature increase ranging from 1.1ºC to 6.4ºC above pre-industrial levels during the twenty-first century. Therefore, there appears to be a certain urgency to initiate actions to curb global

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[2] There is no international consensus on the definition of environmentally sustainable goods and services or, in short, environmental goods and services, though various definitions exist. See annex A in chapter 3 for a brief overview of the discussions on definitions.

[3] See annex 1 of chapter 3 for a more detailed overview of coverage and definition of CSGTs.

[4] According to IPCC (2007), there is less than 5 per cent chance that climate change is the result of only natural climatic processes.

GHG emissions and drastically reduce the unsustainable use of so-called carbon sinks, such as the world's forests and oceans, in order to prevent global temperatures from rising by more than 2ºC, which is the rate at which climate change can still be managed. This was also the target adopted at the Fifteenth Conference of Parties (COP15) of the United Nations Framework Convention on Climate Change (UNFCCC) and climate change summit in Copenhagen in December 2009. However, in lieu of a legally binding global climate agreement for post-2012 action, the most that could be salvaged from the Conference was a "noted" Copenhagen Accord, which reaffirms the importance of restricting global temperature rise to 2ºC, but does not necessitate sufficient action to actually accomplish this goal.[5] The Accord requires Annex I signatories to submit individual mitigation targets and non-Annex I countries to submit NAMAs.[6] Of particular concern, however, is the fact that the estimated sum of submitted targets by Annex I countries falls markedly short of limiting CO_2e concentrations to 450 ppm and the associated rise in global average temperatures of 2ºC (Levin and Bradley, 2010; see also box article, "Greenhouse gases: some concepts explained"). If the proposed mitigation targets are, in fact, even achieved, by some estimates this would still set the world on a course for a rise in the realm of 3ºC -4ºC (Project Catalyst, 2010; Sustainability Institute, 2009).[7] According to IPCC (2007), a 4ºC increase would very likely lead to a decrease in global food production, major extinctions around the globe and near-total loss of Greenland's ice sheet, precipitating a sea-level rise of between two and seven metres in the long term. It would lead to extreme weather conditions in many countries as well as long-term droughts in some areas and permanent flooding in others. Whole island nations, especially in the Pacific, run the risk of disappearing below the sea level. Many coastal areas will be at risk and livelihoods in those areas will no longer be sustainable if envisaged scenarios become reality.

Obviously, the appropriate response is to take urgent action at the national, regional and global levels to limit and reduce GHG emissions according to common but differentiated responsibilities, in order to prevent the problem from running out of control. Although such actions may require short-term investments, they must be seen as a necessary insurance against the worst possible effects of a disastrous natural phenomenon, the severity of which is not altogether known but is most likely to happen.

The failure to reach a consensus at the multilateral level on binding reduction targets of GHG emissions at COP15, and on liberalization modalities of environmental goods and services (EGS) within the context of the Doha Round of multilateral trade negotiations, illustrates the level of complexities of the issues as well as the wide divergence of concerns and positions between developed and developing countries. However, in the meantime, the urgency for action is more evident from the faster-than-predicted increasing GHG emissions

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[5] The Copenhagen Accord was only taken note of, not actually adopted at the conference. Thus, it is not considered to be a legally binding agreement like the Kyoto Protocol.

[6] Annex I countries are those member countries of UNFCCC and its Kyoto Protocol that are classified as industrialized countries and as countries with economies in transition. Annex II countries, a subgroup of Annex I countries, comprise the developed countries that pay for the costs of developing countries. In addition, there is the group of developing countries (non-Annex I countries).

[7] See also: www.guardian.co.uk/environment/2010/jul/05/ipcc-rising-temperature-targets-greenland-ice-sheet for an overview of studies predicting temperature rises by more than 2ºC.

and, in parallel, the worsening signs of climate change.[8] This urgency was again underscored at COP16 in Cancún, Mexico, held from 29 November to 10 December 2010 and COP17 in Durban, South Africa, held from 28 November to 9 December 2011. However, expectations were clearly reduced at those conferences. The agreement adopted by COP16 called again for a paradigm shift towards building a low-carbon society and establishing a “Green Climate Fund” worth $100 billion annually by 2020, to assist poorer countries in financing emission reductions and adaptation. It also established a Technology Mechanism, which will consist of a Technology Executive Committee, and a Climate Technology Centre and Network. At the time this publication went to print, COP17 had just come to an end, agreeing to an extension of the Kyoto Protocol,by five years and to advance the implemention of the Bali Action Plan,[9] agreed at COP13 in 2007, and the Cancún Agreements. The “Durban Platform for Enhanced Action” commits all countries to cut carbon emissions for the first time. A road map guides countries towards the conclusion of a legal agreement which includes mandatory cuts in carbon emissions for all countries by 2015, but the agreement will only come into affect from 2020 onwards. While the achievements are noteworthy they are widely considered to be insufficient to prevent global temperatures to rise to unsustainable levels.

While the historical responsibility for the build-up of GHG emission concentrations in the atmosphere lies mainly with developed countries, developing countries with rapidly developing and emerging economies, including Brazil, China, India and Indonesia, are rapidly increasing their share of current emissions. By 2025, it is estimated that non-Annex I countries will account for more than 58 per cent of global CO_2 emissions from fuel consumption, an increase of 25 per cent from the 1990 level (World Resource Institute, 2009). Against this background, successfully stabilizing CO_2e concentrations and avoiding the more severe effects of climate change will, at the very least, be more effective with substantial action from developing countries as well. This could be to their advantage, as they are expected to disproportionately bear the adverse impacts of climate change, with many having little recourse to adaptation.

In recognizing the gravity of development challenges originating from unsustainable resource use, including the potential costs of climate change inaction, some ESCAP developing countries have started taking measures to foster “green” growth and make the transition to a low-carbon development path. However, their efforts are often constrained by

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[8] For example, recent data released by the World Meteorological Organization indicate that the decade 2000-2009 was the warmest on instrumental record and that 2009 was among the 10 warmest years on record. See press release 869, 8 December 2009 (www.wmo.int/pages/mediacentre/press_releases/pr_869_en.html).

[9] The Bali Action Plan is part of the Bali Road Map agreed to at the Thirteenth Session of the Conference of Parties of UNFCCC in Bali in December 2007. The Action Plan encompasses a comprehensive process to enable the implementation of the UNFCCC through long-term cooperative action up to and beyond 2012, by addressing the following pillars: (a) a shared vision for long-term cooperative action, including a long-term global goal for emission reductions; (b) enhanced national/international action on mitigation of climate change; (c) enhanced action on adaptation; (d) enhanced action on technology development and transfer to support action on mitigation and adaptation; (e) enhanced action on the provision of financial resources and investment to support action on mitigation and adaptation and technology cooperation.

Greenhouse gases: Some concepts explained

Greenhouse gases are chemical compounds that are released both naturally and from human activity. They contribute to trapping heat from sunlight on the Earth's surface (greenhouse effect) and hence trigger a global rise in temperatures. The most potent GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and others such as hydrofluorocarbon gases (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF_6). Water vapour and ozone are also GHGs. Actually, water vapour accounts for up to 66 per cent of the greenhouse effect.

Of all these gases, CO_2 from fossil burning accounts for the largest share, at close to 90 per cent of all GHG emissions. CO_2 is the standard bearer for global warming potential (GWP) – it has been assigned a GWP value equal to one. However, other gases, once released, have much stronger global warming effect than CO_2. For example, N_2O has 170 to 190 times greater GWP than CO_2, methane 24 times, HFC 4,000 to 10,000 times, and SF_6 25,000 times larger GWP. Clearly, CO_2 is not a potent greenhouse gas compared to the others. However, because CO_2 is produced in such huge quantities, its effect dwarfs all the other greenhouse gases combined In this study, the focus is therefore on CO_2, as it is also the easiest to measure and is the most common GHG arising from human activity such as burning of fossil fuel for energy.

When an organization calculates its GHG emissions they are studied as though they were equivalent to a given volume of CO_2. This is written as CO_2e. For example, GHG emissions from a landfill of 100 tons of methane are recorded as 2,100 tons CO_2e (GWP = 2,100). Using CO_2e as a measure of GHG emissions allows comparison of the greenhouse impact of a variety of GHG emissions sources.

The 2ºC rise limit is typically associated in climate models with a CO_2 concentration of 400-500 ppm by volume. Of this 2ºC temperature rise, 0.8ºC has already taken place and 0.5ºC is already committed. Consensus among the scientific community is growing that a CO_2 concentration of 350 ppm is a more realistic target for preventing temperatures rising more than 2ºC. In order to reach these targets, actions need to be taken to incrementally reduce GHG emissions. Such actions are known as stabilization wedges.

a lack of a long-term development vision as well as a lack of policy coherence and coordination among different actors and sectors, which hampers the adoption of a holistic approach to addressing climate change. Without such appropriate and integrated policy interventions, access to, and deployment of RETs and other CSTs at affordable prices remain an enormous challenge. Increased trade and investment in such technologies to and among developing countries may contribute not only to mitigation, but also to expanding access to and future supply of clean and reliable energy to a rapidly expanding population. UNFCCC recognizes the existing gap between developed and developing nations in terms of capacity to act on the basis of common and differentiated responsibilities for climate change, and Annex I countries have agreed to offer assistance in terms of financing and technology transfer.

As discussed in ESCAP *Asia-Pacific Trade and Investment Report 2009*, it is widely recognized that trade and investment are the main drivers of economic growth and development but that trade and investment must be inclusive and sustainable. In other words, economic growth is needed to support growing populations and lift them out of poverty. At the same time, however, such growth should be environmentally sustainable, and this includes limiting global warming.[10] Trade and investment have been traditionally linked to GHG emissions as the production and transportation of traded goods requires energy; most energy today comes from burning fossil fuels, which leads to GHG emissions. However, if the modalities for production and transportation change from fossil fuel-based to clean and RE sources, then trade and investment emerge as important solutions to climate change while also contributing to trade expansion and economic growth. This win-win-win or 3W outcome (achieving trade expansion, economic growth and reduction in GHG emissions simultaneously) can only be achieved through a combination of comprehensive, consistent, coherent and well-coordinated policy interventions at the national, regional and global levels. As a step to better defining areas for most effective policy interventions, those climate-smart goods, services and technologies need to be identified in which trade and investment could be promoted. Such a list is subject to much debate and there is certainly no international consensus on a common definition. For analytical purposes, this study identifies a list of 64 such goods (see annex 1 to chapter 3).

This study is divided into two parts. Part I explains the concepts, issues and linkages with regard to trade, investment and climate change. It also describes the current situation with regard to GHG emissions in Asia and the Pacific, and presents the role of trade and investment in mitigating climate change through the promotion of trade and investment in CSGTs.

Chapter 1 provides the conceptual framework and explains the linkages between trade, investment and climate change. It also presents the general climate-smart trade and investment policy framework required for a 3W outcome as well as the concerns of developing countries in achieving such an outcome.

Chapter 2 assesses the evidence of the contribution of trade and investment to GHG emissions, and analyses the impact of climate change on trade and investment in the region. It also identifies the implications of various future emission scenarios, particularly “business-as-usual”.

Chapter 3 describes trends in trade in CSGTs, and identifies opportunities for expanding trade and investment in CSGTs on the basis of quantitative analysis using gravity modelling.

Chapter 4 describes trends in investment in CSGTs in the region. Due to the lack of data on FDI in this area, the analysis defines investment in broad terms (i.e. as financial investment) and tracks trends in new investment in sustainable energy in the region. It assesses these trends against the investment needs for achieving the 450 ppm scenario and identifies business opportunities in filling the observed “investment gap”.

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[10] Some would argue that the pursuit of economic growth is the crux of the problem and that the Earth’s limited resources prevent infinite economic growth. However, efficient utilization of the Earth’s resources including recycling and better technologies go a long way in sustaining economic growth, which is necessary to end poverty in a world with a rising population. The inclusivity of growth implies an improvement in distribution of gains, which would also have effects on sustainability.

Part II is entirely devoted to identifying a comprehensive trade and investment-related policy framework at the national and regional levels that is required to achieve the 3W outcome.

Chapter 5 defines the climate-smart trade and investment policy framework, and distinguishes the following broad categories of policies – general, financial, trade, investment, RE and RET policies, enterprise development policies and regional cooperation. Most of these policies are further discussed in the subsequent chapters.

Chapter 6 discusses policies for promoting trade in CSGTs. It discusses the issue of border carbon adjustments (BCAs) to discourage trade in carbon-intensive goods and modalities for liberalizing trade in CSGTs, and in particular the role of regional and bilateral trade agreements (RTAs) and the multilateral trading system (MTS) with the focus on the current negotiations within the framework of the Doha Development Agenda or “Doha Round”. It concludes with a summary of policy recommendations.

Chapter 7 is devoted to policies for promoting climate-smart investment. While the focus of the analytical chapter on investment in part I is on financial investments in a broader perspective, this chapter focuses on the role of FDI. It defines the determinants of climate-smart FDI and describes policies to attract, promote and facilitate climate-smart FDI. This chapter also discusses the role of international investment agreements in attracting climate-smart FDI and provides a summary of policy recommendations.

Chapter 8 discusses the following financial policies in support of climate-smart trade and investment – financial penalties for the use and production of carbon-intensive products such as the carbon tax, the granting of subsidies to promote CSGTs and the removal of fossil fuel subsidies, and other financial instruments to promote trade and investment in CSGTs. It concludes with a summary of policy recommendations.

Chapter 9 discusses the issue of developing and aligning national and international climate-smart standards and labelling. While such standards and labels can play an important role in the promotion of trade and investment in CSGT, they can also be seen as a form of “murky” protectionism undermining trade in violation of international trade rules. This chapter defines and describes the various national and international level standards, and concludes with a summary of policy recommendations.

Chapter 10 discusses barriers related to the effective transfer of CSTs, in essence RETs, and then presents modalities and policies for overcoming these barriers. It concludes with a summary of policy recommendations.

Chapter 11 discusses the issue of climate-smart enterprise development with the focus on the role of SMEs. The chapter recognizes that SMEs, which account for well over 90 per cent of all enterprises in any given economy, will have to adopt “green” practices as well and take action to mitigate their GHG emissions. The chapter concludes with a summary of policy recommendations.

Chapter 12 discusses regional climate-smart trade and investment cooperation mechanisms, and describes the impact of subregional and regional initiatives – planned or currently in force – on trade and investment in CSGTs. The chapter explains that climate change and related GHG emissions are cross-border phenomena, as are trade and investment, and therefore regional cooperation would be strongly desirable. In the absence of a global consensus, the chapter recommends a regional climate-smart trade and investment cooperation partnership with a view to promoting trade and investment in CSGTs and climate-smart services; however, it notes that current political support for such a proposal is weak. The chapter then presents a number of concrete recommendations for regional cooperation in this area.

In the epilogue, three main determinants for the successful implementation of the policy recommendations presented in the previous chapters are discussed: political will and leadership; aid for climate-smart trade and investment; and the need for coordination and cooperation among stakeholders, including public-private partnerships.

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PART I

TRADE, INVESTMENT AND CLIMATE CHANGE: AN OVERVIEW OF ISSUES, CONCEPTS, LINKAGES AND TRENDS

CHAPTER 1

TRADE AND INVESTMENT-RELATED GREENHOUSE GAS EMISSIONS: OVERVIEW OF LINKAGES, CURRENT ISSUES AND CONCERNS

A. Trade, investment and climate change

1. Linkages

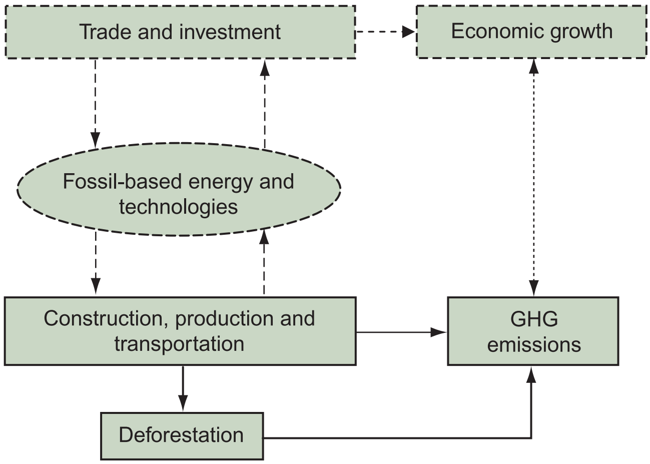
The linkages between trade, investment and environment, with a particular focus on the impact of trade and trade liberalization on climate change, have been comprehensively explored in the literature (e.g. WTO-UNEP, 2009; and Copeland and Taylor, 2004). This study will not repeat that overview in detail; however, a brief analysis of the main linkages is in order.

Trade and investment contribute to climate change indirectly through production and transportation based on fossil fuel

ESCAP's Asia-Pacific Trade and Investment Report 2009 showed that the linkages between trade, investment, and economic growth and development were not straightforward and that a positive link could only be established under certain conditions. The evidence in the Asia-Pacific region, however, shows that trade and investment played a decisive role in the economic development success of many economies in the region. Similarly, the linkages between trade, investment and climate change are not straightforward. Simply put, economic growth involves GHG emissions; since trade and investment are the principal drivers of economic growth, they also contribute to GHG emissions. However, trade and investment contribute to GHG emissions only indirectly through the way goods are produced and transported between producer and consumer. Investment also contributes to GHG emissions indirectly as it leads to the establishment of production capacity while investment in natural resource exploitation can also lead to GHG emissions, particularly when it involves deforestation, as forests act as carbon sinks. Trade and investment are intangible invisible processes. They are made tangible and visible through the actual construction, production and transportation processes they embody (figure I.1).

Figure I.1 also shows that to the extent that both transportation and production of goods take place mostly on the basis of fossil fuel-based energy sources and technologies, trade and investment contribute to global warming. Trade and investment also enable countries to gain access to energy sources, either through imports (trade) or exploitation of natural energy sources (investment). With the rapid increase of trade and investment in recent decades as a result of sustained liberalization, the ecological footprint – including

Figure I.1. Trade, investment and climate change linkages based on traditional energy sources and technologies: the scale effect



GHG emissions – has also risen sharply. This is what trade and environment economists call the "scale effect" (Grossman and Krueger, 1993; see also WTO-UNEP, 2009).[11]

The other two identified effects are the composition and technique effects.[12] The composition effect refers to the way trade liberalization[13] changes countries' comparative advantages towards emission-intensive or emission-friendly industries. For example, a changing comparative advantage as a result of trade liberalization may lead carbon-intensive industries to relocate from countries with strict regulations to countries (often developing countries) with less stringent regulations, which are known as "pollution havens" (and, thus, provide a large comparative advantage), leading to "carbon leakage".[14] The net global composition effect of trade opening on GHG emissions is therefore not necessarily positive.

[11] The scale effect actually refers to the link between expanded trade, expanded economic activity and increased greenhouse gas emissions. Expanded economic activity is conceptually different from an increase in economic growth. Since the link between trade liberalization and economic growth was discussed in some detail in ESCAP's Asia-Pacific Trade and Investment Report 2009, this study does not repeat that discussion.

[12] The three effects, first described by Grossman and Krueger (1993), are part of a conceptual framework developed by trade economists to measure the impact of trade opening on environment and was first used to measure these impacts for the North American Free Trade Agreement (WTO-UNEP, 2009).

[13] Trade liberalization can take place either multilaterally through the multilateral trade system (MTS), regionally or bilaterally through regional and bilateral trade agreements (RTAs) or unilaterally (autonomously). The current multilateral trade negotiations target the liberalization of environmental goods and services of which CSGTs and climate-smart services are important subsectors. These modalities are further explored in chapter 6 of this study. See also ESCAP (2009) for more information on various approaches to trade liberalization.

[14] However, the incidence of carbon leakage often seems to be exaggerated. See discussion in box I.1 below.

The technique effect refers to the manner in which technological improvements may be adopted to increase production efficiency and reduce emission intensity as a result of trade and trade liberalization. This may happen in two ways: (a) trade liberalization increases the availability of climate-smart technology; and (b) trade income increases incomes and wealth – people with more wealth tend to be more concerned about other aspects of well-being, including a clean environment (Grossmann and Krueger, 1993). Research has indeed found that, in most cases, countries that are more open to trade also tend to use cleaner technologies and engage in cleaner manufacturing. At the same time, more open trade leads to higher real incomes, which are often associated with increased demands for environmental quality (WTO, 2004; and World Bank, 2008). This would suggest a positive link with the scale effect as expanded economic activity would also result in rising incomes. However, evidence of an environmental Kuznets curve is not convincing.[15] There is also evidence to suggest that not only income growth but also the extent of income equality is important in determining the net effects; in countries with greater levels of income equality, literacy and political freedom, environmental quality also tends to be higher (WTO-UNEP, 2009; and Torras and Boyce, 1998).

These three factors determine what will be the effect of trade and trade liberalization on climate. While the scale effect can lead to an increase in energy consumption, the technique effect may reduce energy consumption. The composition effect depends on prevailing production structures and comparative advantages in each country. As a result, the net effect of trade liberalization on climate cannot be pre-determined. However, WTO-UNEP (2009) recognizes that the empirical literature suggests that the scale effect dominates, particularly in developing countries, while the technique effect plays a stronger role in developed countries.[16]

In this study it is argued that the scale effect can be reduced or even neutralized by switching energy sources for production and transportation from traditional fossil fuels to RE while pursuing energy efficiency. In that regard, trade and investment would be important solutions to mitigation of climate change while contributing to “climate-smart” economic growth. In particular, this study advocates the promotion of climate-smart trade and investment. Climate-smart trade and investment can be understood in a wider context to be trade and investment that leads to minimum or no GHG emissions. For the purpose of this study, climate-smart trade and investment are defined more narrowly with a focus on trade and investment in CSGTs (see annex 1 of chapter 3 for a detailed coverage and definition of CSGTs). Such goods and technologies would be used in production processes and transportation that are energy efficient and/or use RE. Trade and investment in CSGTs and climate-smart services would contribute to climate-smart economic growth (i.e. economic growth that takes place on the basis of minimum or no GHG emissions) and therefore to

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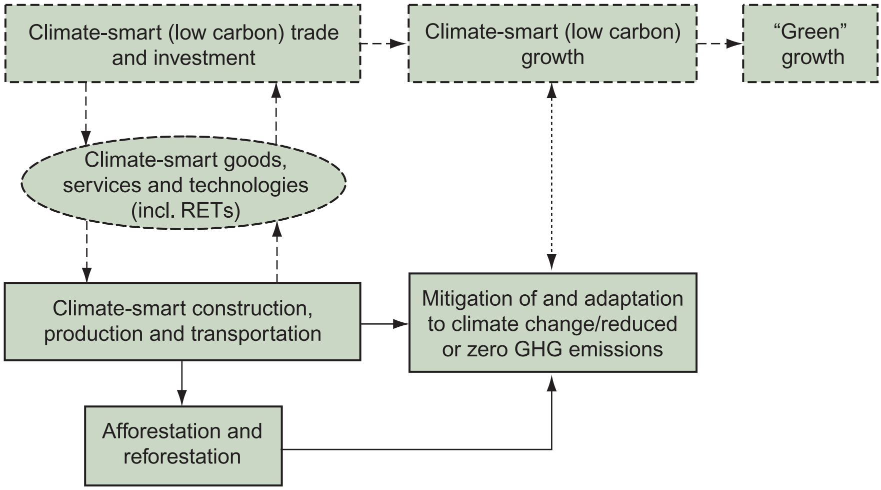
[15] Such an inverted U-shape curve would suggest that with increasing development, environmental pollution (including GHG emissions) would first rise but at increasingly lower rates, then level and start to fall at increasingly faster rates.

[16] See, for example, Cole and Elliott (2003), McCarney and Adamowicz (2005), and Managi, Hibiki and Tsurumi (2008) as quoted in WTO-UNEP (2009).

Figure I.2. Trade, investment and climate change linkages based on CSTs



"green" growth and overall sustainable development (figure I.2).[17] In order to promote trade and investment in CSGTs and climate-smart services, an appropriate policy framework needs to be designed.

2. Policies

Policies designed to promote climate-smart trade and investment are part of general climate changes policies which can be distinguished into policies that mitigate and those that adapt to climate change (e.g. WTO-UNEP, 2009; IPCC, 2007; and McKibben and Wilcoxen, 2004). Mitigation refers to policies and strategies for reducing GHG emissions and enhancing carbon sinks (such as forests and oceans). Adaptation stands for actions that ease the negative impacts of climate change or exploit potential benefits of it. Stated differently, mitigation reduces the rate and magnitude of climate change and its impacts, whereas adaptation increases the ability of people or natural systems to cope with the consequences of climate change (for example, extreme weather conditions). In addition to managing

[17] Climate-smart growth is not the same as "green" growth, although it is an important aspect of it. The concept of "green" growth was introduced as the basis of a new sustainable development strategy adopted by the Government of the Republic of Korea, and it has gained a certain level of international recognition and acceptance. Green growth has been cited by the United Nations Secretary-General in the context of climate change mitigation as an important pillar of achieving sustainable development. ESCAP is also actively promoting the concept defined by ministers at the Fifth Ministerial Conference on Environment and Development in Asia and the Pacific, Seoul, 28-29 March 2005, as "environmentally sustainable economic growth" (E/ESCAP/MCED(05)/Rep., 20 April 2005). ESCAP (2008) lists three principles of green growth: (a) quality of economic growth; (b) eco-efficiency of economic growth; and (c) environmental sustainability vis-à-vis environmental performance. OECD has adopted a Green Growth Strategy and defines green growth as "fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies" (OECD, 2011).

Box I.1. Competitiveness concerns and the issue of "carbon leakage"

It has been argued that industries subject to relatively stringent domestic emission standards and regulations (i.e. some developed countries) may lose competitiveness to imported products that may not face similar constraints in the countries where they are produced (typically developing countries) (Barrett, 1994; and Gaskins and Weyant, 1993). This concern is particularly strong in Europe.[a] This situation may prompt domestic enterprises in countries with relatively stringent emission standards to relocate to countries with less strict emission standards – the so-called "pollution havens". This would result in an increase in carbon emissions in one country as a result of lower emissions in another. This phenomenon is known as "carbon leakage".

Competitiveness concerns arise because of the increase in production costs that might occur as a result of the domestic carbon policies imposed by a country. Rising production costs could result in a loss of competitiveness vis-à-vis products imported from a country with less stringent norms and, consequently, lower production costs. As a result, enterprises in various developed countries have called for border tax adjustments to level the playing field. Another strand of literature (emanating from Porter and van der Linde, 1995) argues that properly designed policies regarding climate change mitigation (and environmental policies in general) can trigger innovation that may partially or more than fully offset the cost of complying with them. By stimulating innovation, strict policies such as environmental regulation can actually enhance competitiveness.

Apart from problems associated with determining the carbon content of imports and the potentially discriminatory effects of such measures, studies have found that carbon leakage is either non-existent or very small (see, for example, Kee, Ma and Mani, 2010; Wooders, Reinaud and Cosbey, 2009; OECD, 2009; Wooders and Cosbey, 2010, Mattoo and others, 2009; and Reinaud, 2008). In contrast, emission standards and other environmental policies may lead to the development of technologies that may be diffused to developing countries (spill-over effect) (Golombek and Hoel, 2004) and contribute to their climate mitigation goals.

[a] The concerns emanate from the European Emission Trading System. See, for example, www.euractiv.com/en/climate-change/carbon-leakage-challenge-eu-industry/article-176591.

different aspects of risks involved in climate change, mitigation and adaptation also differ in terms of time and geographical relevance. Although the costs of emission reductions are location-specific, the gains from mitigation are global, since these reductions contribute to decreasing overall atmospheric concentrations of GHGs. In addition, the mitigation benefits are relevant in the long term as most GHGs stay long in the atmosphere and their impact on the climate system is delayed. In contrast, adaptation efforts involve short- or medium-term benefits, and both costs and benefits are, to a great extent, local. The focus of this study is on climate-smart trade and investment policies that contribute to the mitigation of GHG emissions.

The design of national climate-smart trade and investment policies is a difficult task. Such policies can be structured into regulatory measures (including regulations, standards and labelling), and economic incentives (including taxes, tradable permits and subsidies). By definition, they would cover a broad spectrum of policies (including trade and investment, financial, energy and enterprise development policies) that have a direct impact on trade and investment, with the direct objective of promoting trade and investment in CSGTs and with the ultimate purpose of mitigating or adapting to climate change. Border tax adjustments or border carbon adjustments (BCAs) are a clear example of such policies as they affect imports directly and aim at levelling the playing field and address competitiveness concerns of domestic products (see chapter 6). However, most policies aimed at mitigating or adapting to climate change will be expected to have, either directly or indirectly, an effect on trade and investment. Part II of this study discusses a comprehensive climate-smart trade and investment policy framework.

The net impact of the scale, composition and technique effects on GHG emissions clearly depends on the mix of policies used. Any policy aimed at mitigating or adapting climate change which results in a restriction of trade may be subject to the rules of the multilateral trading system (MTS). As a general rule, care should be taken in the use of trade policies for environmental purposes, particularly if such policies seek to restrict trade. Multilateral actions are clearly preferable to unilateral ones. In Agenda 21[18] it is stated that: "Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade". Nevertheless, more recently "green" policies may have been abused for protectionist purposes to counteract the economic downturns in some countries. Such policies subsidize, for example, the manufacturing of environmental friendly goods, but only for local producers (Evenett and Whalley, 2009; and Evenett and Aggarwal, 2010).[19]

Trade and investment policies can contribute to mitigation of, and adaptation to climate change through the promotion and liberalizatio of trade and investment in climate-smart goods, services and technologies

While there may be justification for policies restricting or banning trade in goods that have a relatively high carbon footprint, this report does not encourage the use of such policies as they may unfairly target developing countries. Instead, this study argues that the best and least controversial trade and investment policies contributing to mitigating GHG emissions are those that seek to promote trade and investment in CSGTs and climate-smart services. Climate-smart technologies (CSTs) consist of technologies that improve efficiency and conservation of conventional (i.e. fossil-based) energy, and enable the commercial and efficient use of RE sources. A recent IPCC report estimated that under various scenarios the contribution of RE to total primary energy supply in 2050 lay somewhere between 17 per cent and 77 per cent (IPCC, 2011).

Obviously, the effective exploitation and use of RE relies on the development and availability at affordable costs of RE technologies (RETs). A targeted trade and investment liberalization policy aimed at promoting trade and investment in CSTs/RETs would therefore

[18] Agenda 21 (21 referring to the twenty-first century) was revealed at the United Nations Conference on Environment and Development (Earth Summit), held in Rio de Janeiro on 14 June 1992 and is a programme run by the United Nations related to sustainable development. It was the planet's first summit to discuss global warming related issues.

[19] See Low, Marceau and Reinaud, 2011, for a discussion on the extent to which trade measures address competitiveness and leakage concerns are consistent with WTO law.

contribute to both (climate-smart) economic growth and mitigation of GHG emissions, and would help countries adapt to climate change (figure I.2).[20] As shown in chapter 3, various Asian and Pacific countries have comparative and competitive advantages in these goods and technologies; therefore, their potential to expand trade and investment in CSGTs is significant.

B. Addressing the concerns of developing countries

As most policies aimed at mitigating and adapting to climate change have a clear impact on international trade and investment patterns, such policies should take the concerns of developing countries into full account to ensure that they are successful, i.e. contribute to a win-win-win (3W) scenario. This section briefly summarizes the main concerns of developing countries in this regard.

Any global or regional approach to promoting climate-smart trade and investment must take the concerns of developing countries into due account

It is important to recognize that there is no unifying position among developing countries, including among those in the Asia-Pacific region. Clearly, those that have no or negligible emissions, but are severely affected by them (i.e. selected island developing countries), are strongly in favour of any effort to mitigate climate change, including through the promotion of CSGTs, while large carbon-emitting countries or major oil and gas exporting countries obviously have less incentive to pursue such a trade and investment strategy. However, there are some aspects related to developing countries' positions in general that emphasize the North-South divide. For example, developing countries have traditionally been suspicious of global negotiation agendas, which they see as being driven by the interests and concerns of developed countries. Historically, developed countries have been responsible for most of the GHG emissions that have played a strong role in climate change. Developing countries feel that they should not be responsible for what they have not done (see, for example, Gupta, 1997). In addition, as far as the global climate negotiations are concerned, developing countries feel that they are on the losing end, lacking the negotiation power and information of developed countries (Richards, 2001). However, since the United States refused to sign the Kyoto Protocol unless developing countries joined, and since other developed countries refused to sign the Protocol unless the United States did so, developing countries have become under increasing pressure to commit to legal emission reduction bindings under a global climate change regime (Gupta, 2000).

Developing countries also fear that the implementation of mandatory climate change measures, including commitments on liberalization of trade and investment in CSGTs, will be costly and may affect their economic growth and export competitiveness, thus compromising their efforts to reach the Millennium Development Goals in 2015. Nevertheless, various developing countries have natural comparative advantages in many

[20] See for example, Kee, Ma and Mani, 2010; WTO-UNEP, 2009; Cosbey, 2008; Cosbey and others, 2008; and World Bank, 2008.

CSGTs, but may lack the capacity to exploit those advantages. The immediate priority for all developing countries remains economic growth, which would help them reduce poverty and therefore allow them to switch to more sustainable production processes. Thus, while developed countries' main concern in climate change negotiations is cost-effectiveness of mitigation measures, for developing countries the main concerns are equity, the costs of climate change adaptation and technology transfer. This makes cooperation difficult (Richards, 2001).

Developing countries are also concerned that the measures put in place in the name of environment by developed countries are just protectionist measures in disguise (Baldwin, 2004; Evenett and Whalley, 2009; and Evenett and Aggarwal, 2010). In addition, companies in developed countries are reluctant to transfer CSTs to developing countries that would help them reduce GHG emissions, and instead emphasize the importance of enforcing intellectual property rights (IPR). They argue that the high growth in some developing countries has been achieved at the cost of environmental sustainability and with low GHG emission standards, which put their own industries at a competitive disadvantage. In order to avoid this, they have no choice but to implement “greenhouse” tariffs and similar measures. However, without growth, developing countries would not be able to reduce poverty. Poverty reduction, in turn, is instrumental in effectively combating climate change, as the poor tend to use cheaper and therefore often dirtier technologies and energy sources (box I.2).

Box I.2. Making the poor pay for climate change

There is a growing notion that rich countries should slash imports from poor countries whose antiquated factories are heavy carbon emitters; however, this eco-protectionism would hit the poor hardest but may do little to reduce global GHG emissions. United Nations officials have evoked the spectre of “food miles” – a tax on imported food that becomes higher the greater the distance from the source of imports. In fact, carbon emissions are less, overall, by growing green beans in Kenya and flying them to Europe than if the beans are grown in Europe and sold locally.

Such protectionist measures would do little or nothing to reduce carbon emissions. What they would do is push up food prices at a time when high prices are causing street protests in many developing countries. Such trade sanctions would slow down worldwide economic growth but not climate change.

In general, trade barriers would not help industries in developed countries. After benefiting a few industries in the short term (perhaps at a cost to others), they would eventually raise costs for industry and consumers, thus stifling growth, innovation and competitiveness in world markets. Goals to reduce European Union emissions by 50-80 per cent by 2050 are pointless if this is done through pollution displacement, i.e. by increasingly importing CO_2-intensive products from the rest of the world.

Restricting growth would diminish the ability of the poorest to shield themselves from disease, extreme weather and other potential impacts of climate change. When countries are poor, their people use dirtier technologies, such as second- or third-hand vehicles or burning dung indoors for cooking. Right now, what kills many poor people is poverty – dirty water, malaria, malnutrition, air pollution in cities and indoor smoke from wood or dung – not climate change. These afflictions can only be solved by prosperity, meaning economic growth.

Box I.2. *(continued)*

Cutting exports by poor countries will depress their national income, thus undermining their capacity to import products from rich countries, including fuel-efficient cars, energy-efficient machinery and less-polluting production technologies – a neat vicious circle. Poor countries would suffer disproportionally more from measures to stop climate change, even though they have contributed the least to the problem. Eco-protectionism prompted by climate change concerns carries a great risk of further impoverishing developing countries.

Trade policies need to be inclusive and sustainable. They need to ensure that both development objectives and environmental sustainability, including reduction of GHG emissions, are achieved in a mutually coherent and reinforcing manner. This is a challenge, but not an unsurmountable one.

Source: Adapted from an article written by Nonoy Oplas for the *Frontier Post*, 15 April 2008 (accessed online at http://asinstitute.org/node/225).

While the concerns expressed by developing countries in general, and by those in the Asia-Pacific region in particular, have a certain degree of validity, there is no denying that the rise in GHG emissions in the next few decades will come primarily from developing countries, including emerging economies (such as China and India) in the Asia-Pacific region, according to the International Energy Agency (IEA, 2007a). This trend is further explored in chapter 2. Developing countries, therefore, will have to assume responsibilities to tackle the problem. These responsibilities are certainly recognized and various countries are already implementing measures to reduce GHG emissions. However limited these measures may be at the moment, awareness is growing and actions are increasing, and are likely to gain momentum in the longer term. In the absence of a comprehensive global climate change treaty, this is perhaps the best one can hope for. At the same time, many developing countries have a comparative advantage in the production and export of environmental goods. Rapid growth of the environmental industry is switching from the developed world to the developing world. The Asian environmental market is expected to grow to almost onetenth of the global market by 2010[21] – mainly for equipment and chemicals related to water and wastewater management, air pollution control, and solid waste management (Claro and Lucas, 2006)**.** However, opportunities for developing countries to expand trade and investment in climate-smart goods also exist. Chapters 3 and 4 explore these opportunities in some detail. The bottom line is that the quest for reducing GHG emissions should be turned from a threat to economic growth to a great opportunity for trade and investment, and business and employment growth.

C. Towards a 3W outcome

Messerlin (2010) argued that the main ingredient still lacking in the climate and trade debate was full recognition of the many things that the climate and trade communities had in common. First, they both deal with a global "public good". Climate change is a public good

[21] More precisely, its share will grow to 9 per cent.

and countries unwilling to contribute to climate change goals undermine the results of those making efforts. Freer trade is a public good – benefits are bigger and faster if all countries move together. Second, the two communities have common foes – firms trying to slow down climate change mitigation policies by calling for protectionism, and those trying to slow down trade liberalization by using climate change excuses. Third, they have emerging common friends – those firms willing to grasp the opportunities for delivering goods that are both cleaner (good for the climate) and cheaper (good for trade) as well as countries, such as Germany or China, that are creating comparative advantages in environmentally-friendly goods.

There is a need to ensure that climate-smart trade and investment policies achieve simultaneously economic growth, trade and investment growth and mitigation of GHG emissions (3W)

Ideally, the world climate regime has to develop in a multilateral framework, just as the trade regime did. However, recent global climate change conferences within the UNFCCC framework have made it clear that no country is ready to surrender its sovereign rights for the benefit of having an operational multilateral framework. A single world carbon price or tax is an objective that should be aimed for, but it will emerge in a future as distant as worldwide free trade. The existence of so many fundamental similarities strongly suggests that the multilateral climate regime should not be so different from the multilateral trade regime. Messerlin further argued that mutual support of the climate and trade regimes were highly desirable. Unfortunately, the multilateral trading system is also facing threats, not in the least from the inability or lack of political motivation to conclude the Doha Round of multilateral trade negotiations. It is not an exaggeration to observe that multilateralism is going through tough times.

In any case, it is clear that countries in the Asia-Pacific region need to start designing policies that mitigate GHG emissions. This is no longer a choice but an inevitable course of action to stave off the mid- to long-term negative impacts of climate change, which are almost certain to happen. These policies need not be protectionist and/or distort trade, but should act as drivers for new green businesses and industries, new green job creation and further promotion of trade in CSGTs and climate-smart services. Such policies would achieve a 3W outcome where economic growth, trade growth and reduction in GHG emissions are achieved simultaneously (Wermelinger and Barnes, 2010; and Messerlin, 2010). In particular, this report advocates the argument that if economic activity can be made sustainable and contribute to low-carbon or "green" growth, trade and investment can be turned into powerful engines of such growth and contribute to mitigation of climate change. Governments have a responsibility to create an enabling environment for the greening of business practices and to encourage new markets for new CSGTs while mitigating the impacts of climate change. There is also an urgent need throughout the region for further collaboration, dialogue and policy consultations among countries to discuss best practices in regards to promoting trade and investment in CSGTs. These issues are all explored in greater detail in part II of this study.

CHAPTER 2

TRADE, INVESTMENT AND CLIMATE CHANGE: EVIDENCE FROM THE REGION AND FUTURE SCENARIOS

A. Global and regional greenhouse gas emissions: an overview

Some of the world's fastest growing economies are in the Asia-Pacific region. Their growth has been triggered and sustained by high levels of trade and investment (ESCAP, 2009). These economies are also among the largest carbon emitters in the world. The region is home to important eco-systems, including tropical and mangrove forests, and coral reefs, which act as global carbon sinks but are increasingly under pressure due to the need to achieve high economic growth. This chapter looks at the contribution of the Asia-Pacific region to GHG emissions, with particular focus on the role of trade and investment. It will also briefly review the impacts of climate change on trade and investment and outline future scenarios if nothing is done to mitigate GHG emissions.

The Asia-Pacific region, led by China and India, has rapidly increased its GHG emissions over the last decade due to export-led growth of the region

According to the most recent available data from the World Resources Institute Climate Analysis Indicators Tool (CAIT) (2011), global GHG emissions grew from 30 billion tons in 1990 to 38 billion tons in 2005, an average annual growth rate of 1.8 per cent. However, GHG emissions from the Asia-Pacific region increased much faster, with an average annual growth rate of 2.8 per cent, to reach almost 17.5 billion tons in 2005 (figure I.3). The rate of GHG emissions has also accelerated since 2000, mirroring the trends in material use. In 2005, East and North-East Asia accounted for the largest share of the Asia-Pacific region's emissions at 53.3 per cent, followed by South and South-West Asia at 18.8 per cent. The share of North and Central Asia was 14.4 per cent and South-East Asia 9.7 per cent. The largest rise occurred during 2000-2005. North and Central Asia's GHG emissions fell dramatically from 1990 to 1995, due largely to the collapse of the former Soviet Union, and only started to rise again during 2000-2005.[22] China surpassed the United States to become the world's largest emitter of GHGs in 2005, the latest year for which data are available for all greenhouse gases.[23] Of 185 countries and economies, India was ranked fifth and Indonesia as twelfth (table I.1).[24]

[22] For coverage of the subregions, see annex table 2.2.

[23] GHG emissions include land use change and international bunkers and covers the 6 most common GHGs: CO_2, CH_4, N_2O, PFCs, HFCs and SF_6.

[24] These 185 countries/economies include the European Union and Taiwan Province of China. See annex table 2.1 for GHG emissions for all ESCAP regional members.

Table I.1. The world's top 20 GHG emitters in 2005 (ranked by share of global emissions)

Country	$MtCO_2e$/ (rank)	Share of world total (%)	$MtCO_2e$ per person/ (rank)
China	7 232.8 (1)	19.13	5.5 (84)
United States of America	6 914.2 (2)	18.29	23.4 (9)
European Union-27	5 043.1 (3)	13.34	10.3 (43)
Russian Federation	1 954.6 (4)	5.17	13.7 (21)
India	1 859.0 (5)	4.92	1.7 (149)
Japan	1 346.3 (6)	3.56	10.5 (40)
Brazil	1 011.6 (7)	2.68	5.4 (87)
Germany	977.5 (8)	2.59	11.9 (28)
Canada	739.4 (9)	1.96	22.9 (10)
Mexico	645.0 (10)	1.71	6.3 (75)
United Kingdom	644.1 (11)	1.70	10.7 (39)
Indonesia	583.2 (12)	1.54	2.7 (118)
Republic of Korea	568.9 (13)	1.50	11.8 (29)
Italy	562.4 (14)	1.49	9.6 (50)
Islamic Republic of Iran	559.2 (15)	1.48	8.1 (61)
Australia	557.6 (16)	1.47	27.3 (7)
France	550.4 (17)	1.46	9.0 (53)
Ukraine	493.9 (18)	1.31	10.5 (41)
Spain	436.7 (19)	1.15	10.1 (46)
South Africa	422.2 (20)	1.12	9.0 (54)
Other Asia-Pacific			
Turkey	390.6 (21)	1.03	5.5 (85)
Thailand	351.1 (24)	0.93	5.3 (88)
Pakistan	239.7 (29)	0.63	1.5 (154)
Malaysia[a]	235.9 (30)	0.62	9.2 (52)
Kazakhstan	202.5 (33)	0.54	13.4 (22)
Uzbekistan	180.9 (34)	0.48	6.9 (71)
Viet Nam	179.0 (35)	0.47	2.2 (134)
Bangladesh	142.2 (38)	0.38	0.9 (174)
Philippines	138.6 (41)	0.37	1.6 (151)
Democratic People's Republic of Korea	118.4 (48)	0.31	5.0 (90)
Myanmar	107.0 (49)	0.28	2.2 (132)
Turkmenistan	91.4 (52)	0.24	18.9 (13)
New Zealand	79.0 (59)	0.21	19.1 (11)
Singapore	48.5 (80)	0.13	11.4 (34)
Azerbaijan	47.8 (81)	0.13	5.7 (82)
Nepal	40.4 (86)	0.11	1.5 (158)
Mongolia	30.3 (93)	0.08	11.9 (27)
Sri Lanka[a]	26.1 (99)	0.07	1.3 (164)

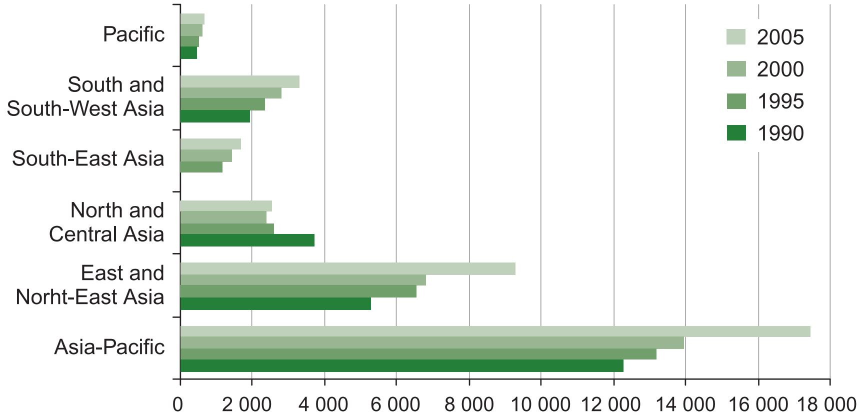
Source: World Resources Institute CAIT, Version 8.0.

Note: See also annex table 1 of this chapter.

[a] PFC, HFC and SF_6 data are not available.

Figure I.3. GHG emissions, by region and subregion, 1990-2005

(Measured in $MtCO_2e$)



Source: World Resources Institute CAIT (2011), Version 8.0.

Note: Asia-Pacific – regional members of ESCAP.

Data are more recent with regard only to CO_2 emissions. In 2007, the Asia-Pacific region emitted 14.6 billion tons of CO_2, an increase of 45 per cent from 2000 (ESCAP, 2010). The region saw a rise in the share of global CO_2 emissions from 47 per cent in 1990 to almost 50 per cent in 2007 (figure I.4; see also annex table 1 of this chapter). East and North-East Asia again accounted for the largest share of CO_2 emissions at almost 58 per cent in 2007, up from 42 per cent in 1990. The second largest subregion in terms of CO_2 emissions was South and South-West Asia at 18 per cent in 2007, up from 12 per cent in 1990 because of India's booming economy, but far behind East and North-East China. Another report claims that global CO_2 emissions did not grow in 2009, largely as a result of the global recession, but with increases noted in countries such as China and India, which nullified the reductions in the developed world (Olivier and Peters, 2010).

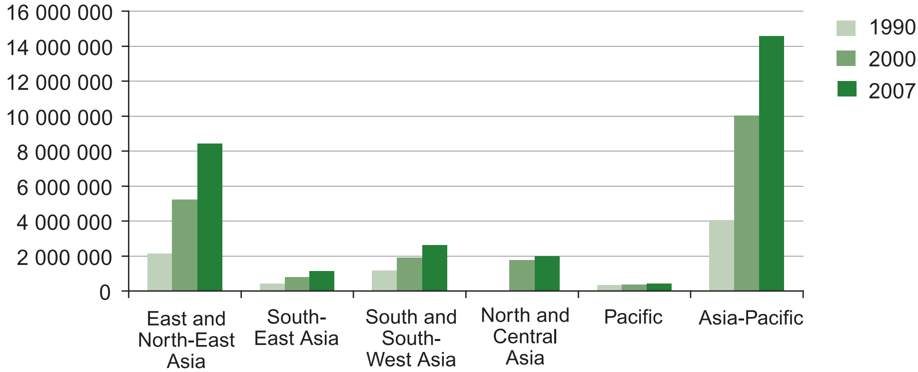
While overall GHG emissions from the Asia-Pacific region have risen sharply, the CO_2 emission intensity has dropped for most Asian economies

Even though absolute increases in CO_2 emissions as a whole have been high during the past two decades, per capita emissions are still relatively low; per capita CO_2 emissions of the Asia-Pacific region were 3.6 tons in 2007, one fifth of that of North America (19.2 per cent) and less than half of the emissions by Europe (8.6 per cent) but close to 75 per cent of the global average (4.5 per cent). According to CAIT data, measured in terms of CO_2e per capita, China ranked 71st and India 123rd. In 2007, these ranks were 66 and 122, respectively.[25] Also worth noting is that the CO_2 emission intensities (the level per economic

[25] While GHG emission data are only available for 2005 as the most recent year, CAIT 8.0 provides data on CO_2 emissions for 2007.

Figure I.4. CO_2 emissions for Asia and the Pacific, and its subregions, selected years

(Thousands of metric tons)



Source: World Resources Institute CAIT (2011), Version 8.0.

output or CO_2/GDP) dropped for most Asian economies during 1992-2006 as their economies grew faster than their CO_2 emissions, indicating a decoupling of CO_2 emissions from economic growth. This drop is particularly impressive for China, India and the Russian Federation; however, in Indonesia, Islamic Republic of Iran and Thailand the CO_2 intensity rose substantially (table I.2).[26]

Table I.2. CO_2 intensity changes 1992-2006, selected economies

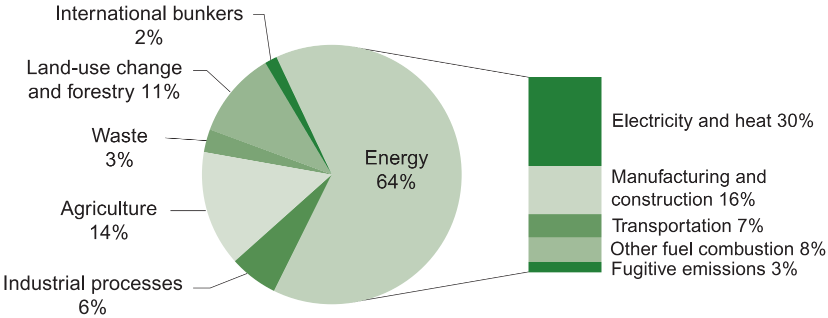
Economy	Change (per cent)
China	-36.8
India	-22.5
Indonesia	+20.1
Islamic Republic of Iran	+19.5
Japan	-7.0
Republic of Korea	-17.5
Russian Federation	-33.8
Thailand	+24.7
United States	-24.4

Source: World Resources Institute CAIT (2010), Version 8.0.

Figure I.5 shows the GHG emissions by sector. In 2005, the energy sector accounted for 64 per cent of total GHG emissions from all Asia-Pacific economies.

[26] Care should be taken in interpreting these figures. CO_2 intensities are not directly correlated with changes in activity levels (GDP and population).

Figure I.5. Shares of individual sectors in Asia-Pacific economies' GHG emissions, 2005



Source: World Resources Institute, CAIT, Version 8.0.

Electricity and heat contribute the largest share to the energy sector (accounting for almost the half of the emissions from this sector, or 30 per cent of the total. Moreover, from 1990 to 2005, emissions from electricity and heat, manufacturing and construction grew the most. Manufacturing and construction accounted for 16 per cent of total energy-related GHG emissions while 7 per cent was due to transportation. According to IEA (2010c), China contributes 36 per cent to projected growth in global energy use with demand rising by 75 per cent during 2008-2035. India is the second largest contributor to the rise in global energy demand to 2035, accounting for 18 per cent of that rise.

Agriculture (14 per cent), and land-use change and forestry (11 per cent) were the next two largest non-energy emitting sectors. Worldwide, these sectors, together with livestock, are an important contributor to GHG emissions (see box I.3).

Box I.3. Contribution by the farm sector to GHG emissions

Worldwide, farms and related facilities contribute approximately 20 per cent of the annual increase in anthropogenic GHG emissions. A 2006 FAO report (Steinfeld and others, 2006) estimated that the contribution of the animal agriculture sector – comprising the production of feed crops, the manufacturing of fertilizer, and the shipment of meat, eggs, and milk – was responsible for 18 per cent of all GHG emissions, measured in CO_2 equivalent. In fact, the farm animal sector annually accounts for 9 per cent of human-induced emissions of carbon dioxide (CO_2), 37 per cent of emissions of methane (CH_4) and 65 per cent of emissions of nitrous oxide (N_2O). These estimates are rather low and often do not include other environmental problems associated with agriculture and the livestock industry, such as deforestation to clear land for agricultural use, animal waste disposal, livestock respiration and flatulence, and grazing, which dries up land and therefore leads to GHG emissions. Another report released by the World Watch Institute estimated that the contribution of livestock and its byproducts to global GHG emissions alone could actually be as much as 51 per cent (Goodland and Anhang, 2009).

With regard to livestock, some countries that are otherwise not major GHG emitters due to industrial activity and energy use may, nonetheless, be important GHG emitters after all due to their extensive livestock holdings. For example, some areas in China have the highest pig and fowl per human ratio in the world while Mongolia has among the world's highest cattle to human ratio (which, admittedly, is largely due to the relatively small population of Mongolia). In fact, due to changing diets, the region has had the fastest developing livestock industry, in part helped by trade liberalization.

Sector shares of emissions vary across subregions, with land-use change and forestry in South-East Asia, for example, accounting for 63 per cent of total emissions from the subregion. This was largely due to rapid deforestation and forest degradation in Indonesia.

Since trade involves transportation, it is necessary to examine this sector's contribution to GHG emissions in more detail. Table I.3 shows a sectoral breakdown for CO_2 emissions for selected countries of the Asia-Pacific region. It shows that the shares of the transport sector in emissions vary from country to country; some countries (e.g. Bangladesh, China, India and Mongolia) have smaller shares, while other countries (e.g. the Philippines and Sri Lanka) have high shares. While all countries increased their total CO_2 emissions from 1980 to 2005, the transport sector shares of total national CO_2 emissions increased in the Republic of Korea, the Philippines and Viet Nam while the emissions decreased in India, Indonesia, Pakistan and Sri Lanka, and remained more or less stable in Bangladesh, China, Malaysia, Mongolia and Thailand. Because the transport, power and industry sectors are the three main contributors to national CO_2 emissions, changes in the magnitude of the emissions from the other two sectors, particularly the power sector, have a considerable impact on the transport sector's share of national CO_2 emissions. For example, despite the increase in transport sector emissions, the share of the sector in the national total in China and India are significantly smaller than in most countries in the region, mainly because power generation in those countries is heavily reliant on emission intensive fuels, mainly coal (Timilsina and Shrestha, 2009).

Table I.3. CO_2 emission mix, by sector, in selected countries in Asia and the Pacific, 1980 and 2005

Country	1980					2005				
	Total (Mt of CO_2)	Power (%)	Industry (%)	Transport (%)	Other (%)	Total (Mt of CO_2)	Power (%)	Industry (%)	Transport (%)	Other (%)
Bangladesh	7	21	41	14	24	36	35	29	12	24
China	1 403	20	51	6	23	5 060	48	37	7	9
India	292	26	39	19	16	1 147	52	30	8	10
Indonesia	69	10	39	26	26	341	28	39	22	11
Republic of Korea	122	20	32	12	37	449	35	31	19	15
Malaysia	23	32	34	28	6	138	33	35	28	3
Mongolia[a]	12	48	25	11	16	10	70	8	12	10
Pakistan	26	16	37	25	22	118	30	37	22	11
Philippines	32	27	39	15	18	76	37	19	37	7
Sri Lanka	4	8	22	55	16	12	28	16	45	11
Thailand	34	33	23	28	16	214	30	37	26	7
Viet Nam	14	24	36	14	26	80	24	37	25	14

Source: Timilsina and Shrestha, 2009.

[a] Data for 1985 are used instead of 1980 data. The data in this table are older and are therefore not comparable with those provided by CAIT Version 8.0.

Among the different transportation subsectors, on-road transport is by far the largest contributor to carbon emissions (box I.4).

Box I.4. Automobiles and CO_2 emissions

The transport sector, mainly on-road transport, is the second largest contributing sector to global GHG emissions after the power sector, as it contributed 23 per cent of global energy-related CO_2 emissions in 2007 (IEA, 2009b). According to Unger and others (2010), automobiles are the largest contributor to climate change, followed by the burning of household biofuels (i.e. wood and animal dung) and raising livestock. One of the major changes that can be observed in the global automotive sector is the increasing production capacity in Asia and the Pacific. Several developing countries in the region have recently exceeded 1 million vehicles in annual production. Emerging car producing countries in the region include China, India, the Islamic Republic of Iran, the Russian Federation, Thailand and Turkey. As a result, more than one in two new cars in the world is currently produced in the Asia-Pacific region.

Automobiles, including both passenger and commercial vehicles, are the principle player in the transport sector, producing CO_2 emissions globally. CO_2 emissions from automobiles have grown significantly in the past few decades. IEA (2009a) estimated that 73 per cent of CO_2 emissions in the transport sector in 2007 could be attributed to on-road transport, with maritime and air transport at much lower levels of approximately 9 per cent and 11 per cent, respectively. Approximately 16-17 per cent of global man-made CO_2 emissions came from the use of automobiles in 2005. In particular, household car use alone accounts for much of the automotive carbon emissions. Automotive CO_2 emissions have been growing approximately 1.5 per cent per year since 1971 (IEA, 2007b).

As more and more people in developing countries demand more and better mobility together with their socio-economic development, the number of motor vehicles in the world as well as in the Asia-Pacific region, is projected to rise rapidly, offsetting progress already made in reducing fuel consumption and therefore in reducing CO_2 emissions from motor vehicles. Thus, there is an urgent need to develop automobiles that run on carbon-free or efficient energy such as hybrid and electrical cars. Various countries in the region, particularly Japan, the Republic of Korea and, more recently, China have taken a lead in this emerging industry.

Source: Abe, 2010.

Various Asian and Pacific countries are major producers and have comparative advantages in some of the most carbon-intense industries, such as iron and steel, pulp and paper, forestry and furniture, and cement as well as fossil fuels. For example, iron and steel are important industries in the main Asian GHG-emitting countries. More than 90 per cent of global steel industry emissions come from iron production in nine countries or regions: Brazil, China, European Union-27, India, Japan, Republic of Korea, Russian Federation, Ukraine and the United States.[27] According to IEA (2009b), the industry accounted for 31 per cent of global energy-related CO_2 emissions from all industries and 5 per cent of total energy-related CO_2 emissions in 2007 (CO_2 comprises 99 per cent of all GHG emissions in the iron and steel industry). Together the steel and cement industries are responsible for more than 3.2 billion tons of CO_2e emissions annually, or approximately 6 per cent of global anthropogenic emissions. Emissions from both industries are increasing rapidly due to development, with cement and steel production concentrated in China.[28] However, providing

[27] International Iron and Steel Institute, 2007. (Note: In 2008 IISI changed its name to the World Steel Association.)

[28] See www.carbonwarroom.com/battle/cement-and-steel.

a comprehensive analysis of the impact of various industrial sectors in the region on GHG emissions is beyond the scope of this report. Box I.5 takes a closer look at the impact of the pulp and paper industry in China on GHG emissions.

Box I.5. CO_2 emissions and the pulp and paper industry: the case of China

Paper consumption in Asia and the Pacific has experienced substantial expansion over the past 20 years. As consumption increases, it is logical that the region should be experiencing growth in local production of paper. China, in particular, the sector's growth is expected to outstrip the North American and European pulp and paper manufacturing sector. The rapid growth of the paper manufacturing industry in the region is predicated to a large extent on imports of recovered paper from the global market. China also relies on recovered paper because the country lacks mature forestry resources.

China's pulp and paper industry is the largest CO_2 emitter among Asian pulp and paper industries, amounting to almost 30 million tons in 2009. It is also among the largest CO_2 emitting industries in China compared with other polluting industries such as steel and cement. Most of the emissions come from paper production.

However, determining the impact of the sector on CO_2 emissions in the region is far from simple. The manufacturing processes involve heavy CO_2 emissions, but forestry resources are potentially large CO_2 sequesters. There is evidence that the rapid increase in plantation forests in the region may offset the CO_2 emissions from manufacturing processes in the pulp and paper industry, although growth cycles of trees are relatively long. The increase in plantation forests will also compensate for the fall in availability of waste and recovered paper due to shrinking production in the north. In any case, the use of such paper for recycling may lead to more CO_2 emissions than the use of virgin or plantation forests.

B. Assessing emissions associated with trade[29]

The rapid internationalization of production and services activities has severely complicated the task of identifying responsibilities for the build-up of GHG emissions in the atmosphere. Traditionally, the methodology employed for inventorying GHG emissions followed a local production-based approach, whereby responsibility for emissions was restricted to the geographical region (i.e. country) in which the goods causing production-related emissions were assumed to also be consumed, therefore ignoring the existence of trade and associated transportation. This assumption is also adopted in the methodology used under the Kyoto Protocol. It is, however, evident that, at least in Asia and the Pacific, trade dependence (trade as a share of GDP) often approaches a range of 60 per cent-80 per cent, and in smaller economies is a multiple of their GDP, signalling that most of the country's economic activity is linked to exports and imports. This makes it necessary to estimate that portion of emissions that is caused by export and import activities.

[29] It is not possible to directly estimate investment-related emissions due to the lack of data. However, investment-related emissions are indirectly covered, as investment is required for the production of export goods.

As in other quantitative analysis in this area, there are many restrictions due to the lack of data. Therefore, the estimates provided below should be taken only as best approximations. It is, however, important to disclose such results even if they are just partial estimates. They help to better understand the positions of developing countries and the burden they are facing to collectively address the climate change challenge. For example, the analysis might help determine who should be responsible for GHG missions derived from international transport (or international bunker fuel emissions). Another question relates to whether developing countries, whose emissions were largely produced during the process of manufacturing goods for exports to be consumed in other countries, should be left to foot the entire bill. These and other similar methodological obstacles were insufficiently addressed in the Kyoto Protocol.[30] However, as developed countries are increasingly inclined to apply border carbon adjustments on imports from mostly developing countries, and put increasing pressure on emerging economies (e.g. China and India) to commit to absolute emissions reduction targets, it is important to further analyse the level of emissions embodied in trade (known as “virtual carbon”).

In order to obtain an accurate picture of total carbon emissions, the emissions associated with exports and imports have to be taken into account

Carnegie Institution scientists found that of the 26.9 gigatons of CO_2 emitted globally into the atmosphere in 2004, 6.2 gigatons, or 23 per cent, was (virtually) traded internationally, i.e. was embedded in the trade of goods and their transportation (see box I.6 for the concept of consumption-based accounting). They stated that the majority of this virtual trade in emissions occurred in exports from developing countries (e.g. China) to mainly developed countries and markets (e.g. the European Union, Japan and the United States) (Davis and Caldeira, 2010). Figure I.6 shows the largest interregional flows of emissions embodied in international trade.

To be able to add more details on how trade patterns of selected countries in the Asia-Pacific region are linked to emissions, this report calculates so-called emission intensity indices of exports and imports.[31] The values of these indices range from 0 to infinite,[32] but the important benchmark is a value equal to 1. For example, if the emission intensity index of imports is larger than 1, emissions embodied in goods produced overseas and transported to a destination are larger than the emissions that would have been caused by local production in that destination[33] of the same amount of goods. In other words, from a climate

[30] For example, UNFCCC reporting guidelines on annual GHG inventories requires signatory countries to calculate emissions derived from international bunkers, but Annex I Parties are not required to include these in national totals, which are subject to reduction commitments.

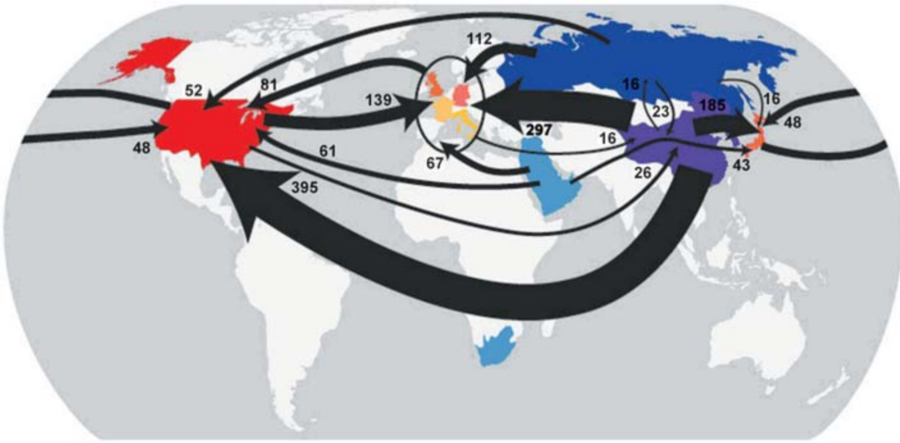
[31] The mathematical derivation of the indices and other details are available in Truong and Mikic, 2010.

[32] An index of zero would exist when there are no CO_2 emissions in the production and transportation of exports and imports, while an infinite index would imply zero CO_2 emissions in local production replacing imports. Neither of these two extreme values is very likely in reality.

[33] The calculation of local production-related emissions is based on the use of energy in the production of a particular commodity in a specific country. The calculation of transport-related CO_2 emissions is based on strong assumptions and accounts only for maritime transport (see details in Truong and Mikic, 2010).

Figure I.6. Largest interregional flows of emissions embodied in trade, 2004

(Megatons of CO_2/year)



Source: Davis and Caldeira, 2010.

Note: Largest interregional fluxes of emissions embodied in trade (mt CO_2/year) from dominant net exporting countries (blue) to the dominant net importing countries (red). Fluxes to and from Western Europe are aggregated to include France, Germany, Italy, Luxembourg, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom.

Box I.6. Consumption-based accounting of CO_2 emissions

Much attention has been focused on the CO_2 directly emitted by each country, but relatively little attention has been paid to the amount of emissions associated with the consumption of goods and services in each country. Consumption-based accounting of CO_2 emissions differs from traditional, production-based inventories because of imports and exports of goods and services that, either directly or indirectly, involve CO_2 emissions. In a recent study conducted by Davis and Caldeira (2010), it was found that for a large number of Europeans, per capita consumption of imported CO_2 emissions reached more than 4 mt in 2004. Americans were not far behind with 2.5 mt per person. Some countries, such as Switzerland, outsource over half of their CO_2 emissions, while the United States outsources about 11 per cent of total consumption-based emissions, primarily to the developing world. The two highest net importers in Asia and the Pacific were Japan and Hong Kong, China, with 284 and 64 million mt respectively. European countries such as France, Sweden, Switzerland and the United Kingdom imported more than 30 per cent of their consumption-based emissions. Major net-exporters in the region included China, India, Malaysia, the Russian Federation, Taiwan Province of China and Thailand among others. China topped the list, exporting goods that embodied almost one fourth of its emissions.

Disparities in the carbon intensity of trade based on the consumption-based approach between developing countries and developed countries are noted. These disparities are largely due to the fact that major developing countries use carbon-intensive energy sources and low value-added of energy-intensive exports (high carbon-intensity of trade) while developed countries use cleaner supplies of energy and export higher value-added goods. Such dissimilarity existed between China and Japan in 2004. Japan's major imported emissions were from apparel, transport services,

Box I.6. *(continued)*

electronics, machinery and chemicals. Conversely, apart from transport services, China supplied much of these products to the world with machinery, electronics, apparel and textiles accounting for a combined 368 million mt of net-exported virtual carbon dioxide.

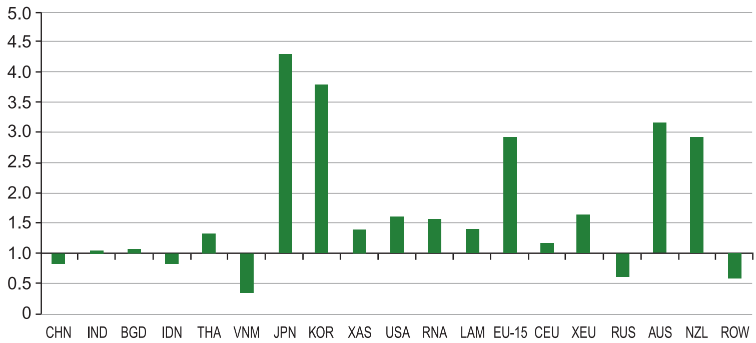
Consumption-based accounting of CO_2 emissions demonstrates the potential for international carbon leakage. Sharing responsibility for emissions among producers and consumers could facilitate international agreement on global climate policy that is now hindered by concerns over the regional and historical inequity of emissions.

Source: Davis and Caldeira, 2010.

change perspective, it would have been less damaging to produce these goods locally than to import them. In the opposite case, when the index is less than 1, the environment is less damaged by trade than when no trade takes place. The index value of 1 indicates that emissions associated with imports of goods are the same as those associated with local production replacing trade. Figures I.7 and I.8 show the import and export (CO_2) emission intensity indices, respectively, for selected Asia-Pacific economies in 2004.

GHG emissions are not necessary lower when a product is produced locally instead of imported. Thus, a careful analysis of the impact of trade on GHG emissions is in order

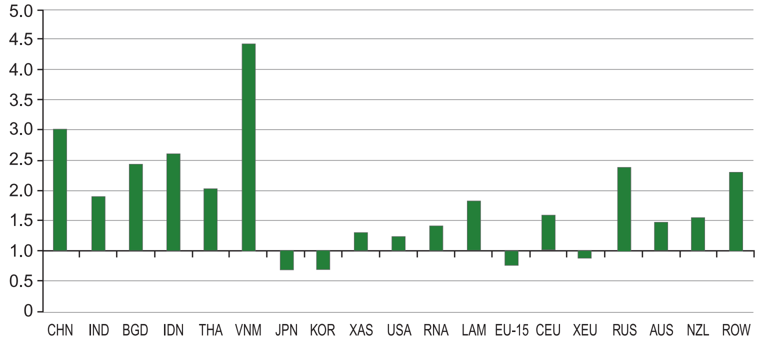
Figure I.7. Import (CO_2) emissions intensity index (base year: 2004)



Source: Truong and Mikic, 2010.

Note: CHN: China and Hong Kong, China; IND: India; BGD: Bangladesh; IDN: Indonesia; THA: Thailand; VNM: Viet Nam; JPN: Japan; KOR: Republic of Korea; XAS: Rest of South and East Asia; USA: United States of America; RNA: Canada, Rest of North America; LAM: Latin America; EU-15: European Union-15 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, United Kingdom); CEU: Central and Eastern Europe; XEU: Rest of Europe; RUS: Russian Federation; AUS: Australia; NZL: New Zealand; and ROW: rest of the world (Middle East, Africa, Western Asia).

Figure I.8. Export (CO_2) emissions intensity index (base year: 2004)



Source: Truong and Mikic, 2010. For legend, see figure I.7.

Figure I.7 shows that China, Indonesia and Viet Nam import commodities that are produced overseas with lower emissions than if they were produced locally (import emission indices are less than 1) while the reverse holds true for Bangladesh, India and Thailand. This implies that China, Indonesia and Viet Nam are importing from regions that use cleaner production techniques than would be used domestically to produce these goods. It is interesting to note also that most other regions (with the exception of the Russian Federation and rest of the world) are also importing from regions that use "dirtier" production techniques.

Similarly, figure I.8 shows that all of the studied countries (Bangladesh, China, India, Indonesia, Thailand and Viet Nam) export commodities that are locally produced with more emissions than the emissions that would have resulted from production locally in the destination countries. For example, the index with value of 3 for China means that emissions embedded in production and transportation of exported goods in China generate three times more emissions than what would have resulted if those destinations had produced the goods themselves. The same applies to North and Latin America, Central and Eastern Europe, the Russian Federation, and Australia and New Zealand, even though their indices are lower in value than those for developing Asian economies. The opposite is true for Japan, the Republic of Korea and the European Union-15, implying that countries importing from these countries are making the right choice because if they were to produce such goods themselves they would emit more CO_2 than that currently being emitted by Japan, the Republic of Korea or European Union-15. Therefore, there is clearly room for improvement of the technologies used for production of export commodities in the studied countries and/or the pattern of export trade to reduce the total level of CO_2 emissions for the world as a whole.

In summary, emissions from trade (covering production and transportation) are not necessarily higher than emissions from local production replacing trade. This finding is based on partial accounting for transportation-related emissions and on the fossil fuel energy use in production, but should improve when more recent and more comprehensive data become available. However, based on currently available data, it is obvious that the solution to climate change mitigation is not a reduction in trade but rather the replacement of conventional fossil fuel-based technologies by climate-smart technologies. This would allow countries to benefit from trade-led growth with no (or little) adverse impact on climate and environment.

C. Consequences of “business as usual”: the impact of climate change on trade and investment

1. General impacts

The Asia-Pacific region is prone to natural disasters, many of which are related to extreme weather events such as flooding and drought. Such events may not be the sole results of climate change, but there are indications that climate change plays an important part. These extreme weather fluctuations are expected to worsen in the future. It is therefore obvious that a business-as-usual scenario is not acceptable, as it would lead to a rapid rise in GHG emissions and global warming with dire consequences for trade and investment or, in wider terms, for production and various individual industries. Generally, the impacts of climate change can be categorized as direct effects on factors of production and environment (for example, soil quality, labour force, availability of natural resources etc.) and derived impacts on trade and investment (see table I.4).

Table I.4. Some likely impacts of climate change on trade and investment

Direct effect of climate change	Derived impact on trade and investment
Severe weather patterns: flooding, drought and desertification.	Loss of productivity, particularly agriculture in (sub) tropical areas; potential increase in agricultural productivity in temperate areas; decrease/increase in food production, depending on locations; increase in forest fires affects wood-based industries.
Rising sea levels: inundation of coastal communities.	Loss of coastal production and loss or damage of infrastructure necessary for trade (i.e. ports); loss of recreational beach tourism; possible disappearance of whole island developing countries.
Other damage to eco-systems: loss of biodiversity and glaciers; coral bleaching.	Loss of products and local livelihoods (i.e. medicines based on traditional knowledge); coral bleaching leading to loss of fisheries products; disappearance of glaciers leads to shortages of freshwater for both agriculture and industry.
Increase in diseases and injuries due to storms and increased air pollution.	Lower labour productivity.

While it can be argued that climate change will trigger changes in comparative advantages that lead to potentially new but long-term trade and investment opportunities (WTO-UNEP, 2009), in general, most reports refer to the potentially huge damage effects of climate change on developing countries leading to increased vulnerabilities in important economic sectors, particularly in the Asia-Pacific region (e.g. Preston and others, 2006).

Climate change disproportionally affects trade and investment in the Asia-Pacific region. As trade and investment are the engines of growth in the region, collective action is required to mitigate and adapt to climate change

Climate change disproportionally affects sectors such as agriculture, tourism, forestry and fisheries that provide livelihoods to millions of people in many countries of the region. This is compounded by the fact that developing countries are often less able to cope with adverse climate impacts. Estimates are that they would bear some 75 per cent to 80 per cent of the costs of damage caused by climate change. Even a 2ºC warming above pre-industrial temperatures – the minimum the world is likely to experience – could result in permanent reductions in GDP of between 4 per cent and 5 per cent for Africa and South Asia (Nordhaus and Boyer, 2000). The cost of climate change in India and South-East Asia could be as high as a 9 per cent to13 per cent loss in GDP by 2100 compared with what could have been achieved in a world without climate change. Up to an additional 145 million to 220 million people could be living on less than $2 a day and there could be an additional 165,000 to 250,000 child deaths per year in South Asia and sub-Saharan Africa by 2100 (Stern, 2007).[34] According to an ADB report, if the world continues with business as usual, Indonesia, the Philippines, Thailand and Viet Nam could experience combined damage equivalent to more than 6 per cent of their countries' GDP every year by the end of this century, dwarfing the costs of the current financial crisis (ADB, 2009).

2. Impact on forest resources and land use

The Asia-Pacific region is home to some of the world's largest forest reserves. Forests are cut for various purposes, i.e. to clear land for agricultural purposes (exacerbated by the rush towards biofuels) and/or harvest the wood derived from trees as inputs for industries such as pulp and paper, furniture, construction etc. Unsustainable deforestation will ultimately affect productivity in these industries, both directly and indirectly, through the global warming it causes. Global warming in turn, will induce severe weather patterns leading to higher frequency of disasters such as floods and droughts that in turn, will affect productivity and transport, and hence, trade and investment. Excessive rain will sweep away fertile soil, undermining reforestation projects. In other areas, drought will lead to an increased risk in forest fires in many areas. In some northern regions of Asia, such as Tibet and Siberia, climate change may have a positive effect on land use (although increased release of methane from melting permafrost may accelerate GHG emissions), while in arid regions and boreal forests of China, desertification will be a major problem and affect production in those areas.

3. Impact on coastal communities and fisheries resources

Most Asian and Pacific economies have vast coastal lines, and communities living in these areas depend to a varying extent, directly or indirectly, on the seas and oceans. These areas would be particularly affected by severe weather fluctuations caused by climate

[34] "Impact of climate change on growth and development", Part II, Stern Review, 2006; available at www.hm-treasury.gov.uk/stern_review_report.htm.

change. Already, the Asia-Pacific region is witnessing increasingly severe storms and cyclones. For example, the number of recorded floods/storms in the Philippines rose from just under 20 during 1960-1969 to nearly 120 by 2000-2008 (ADB, 2009). Tens of millions of people in Bangladesh would be displaced by a rise in sea level of 1 metre. Whole Pacific island countries are threatened by submersion. In addition, climate change will lead to coral bleaching and the extinction of many species of fish that depend on the coral eco-systems. Recent risk analysis of coral reefs suggests that between 24 per cent and 30 per cent of the reefs in Asia are likely to be lost during the next 10 years and 30 years, respectively.[35] Overfishing is already a problem, and is leading to the depletion of world fish stocks, and climate change is expected to make the problem worse. Intrusion of sea water in freshwater areas, such as rivers and lakes, would affect aquaculture. In addition, the disappearance of mangrove forests as natural barriers against floods will lead to increased flooding and erosion of coastal areas and, eventually, their disappearance as a result of rising seawater. Up to 13 per cent of mangrove wetlands may disappear, together with the biodiversity these wetlands contain (Preston and others, 2006). This will drive millions of people inland with the potential for causing conflict.

Obviously, the disappearance of coastal systems will affect both trade and investment in the natural resources generated by those systems, not in the least fish, and the service industry associated with those industries (i.e. boat-building and repair, fish net manufacturing and repair etc., as well as retail shops and entertainment services such as restaurants catering to coastal communities). Moreover, most trade-related infrastructure is located in coastal areas and would therefore disappear or be seriously affected. This is related to the fact that many of Asia's mega-cities are located along rivers or on the coast. These cities are important production centres and the hub of many complex supply chains, and are therefore at the forefront of trade and investment in the region. Entire nations (e.g. some of the Pacific islands) risk disappearance, although the resulting displacement will affect far less people than in the case of urban and coastal Asia. In any case, the possible disaster scenarios of the flooding or submerging of cities and entire islands leave little to the imagination.

4. Impact on agriculture

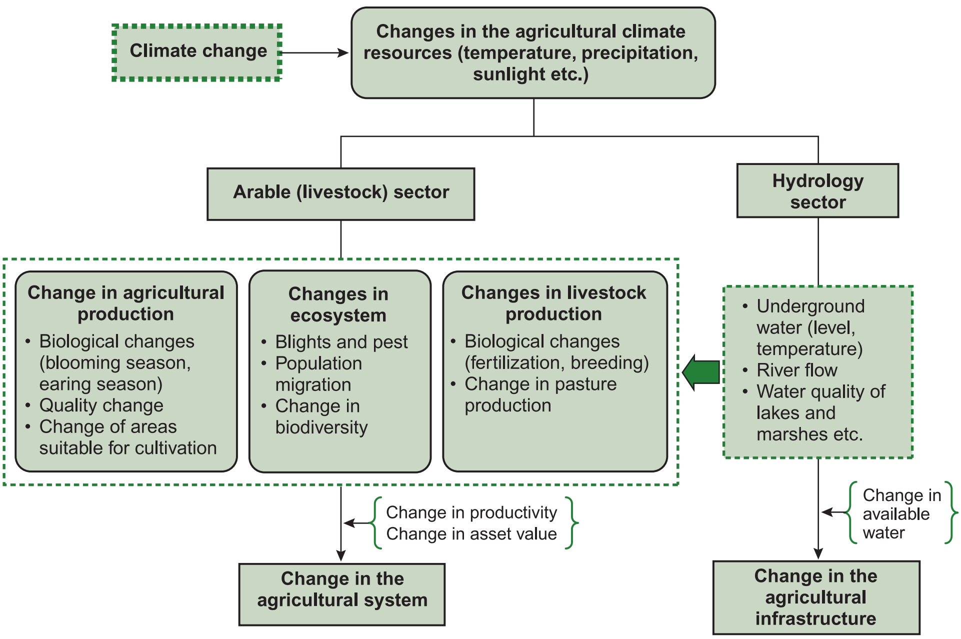
Together with forestry and fishing, agriculture is another dominant economic sector for many developing and least developed countries. The impact of global warming on agricultural production and trade is expected to be particularly severe (Luo and Lin, 1999). Temperature increases can have both positive and negative effects on crop yields, but generally their net effects appear to be reduced yields and quality of many crops, particularly cereal and feed grains (Adams and others, 1998). A decrease of about 2.5 per cent to 10 per cent in crop yield is projected for parts of Asia in the 2020s and a 5 per cent to 30 per cent decrease in the 2050s compared with 1990 levels without CO_2 effects (IPCC, 2007). Increased flooding along major rivers in Asia and/or drying up of rivers in the longer term will most certainly affect agricultural production that depends on the irrigation from these rivers. Agricultural production and, hence, food production will be further affected by increasing erosion and loss of fertile soil. Increased drought in certain areas will make agricultural

[35] IPCC Working Group II contribution to IPCC, 2007.

production impossible, leading to migration of people from those areas to less affected areas. This, in turn, will lead to overcrowding. Competing claims on land use for agriculture and biofuel, particularly when there is no security of land tenure, may further complicate matters, with possible conflict, migration and starvation as a result.

The flow of the impacts of climate change on the agricultural sector is illustrated in figure I.9. First, the impacts of climate change on the arable and livestock sector are made known by biological changes, including the change of flowering and harvesting seasons, quality change and shifting of areas suitable for cultivation.[36] Climate change affects the agricultural ecosystem, giving rise to blights and pests as well as causing population movement and change in biodiversity. In the livestock sector, climate change will bring about biological changes in areas such as fertilization and breeding while also affecting the growing pattern of pastures.

Figure I.9. Flow of the impact of climate change on the agricultural sector



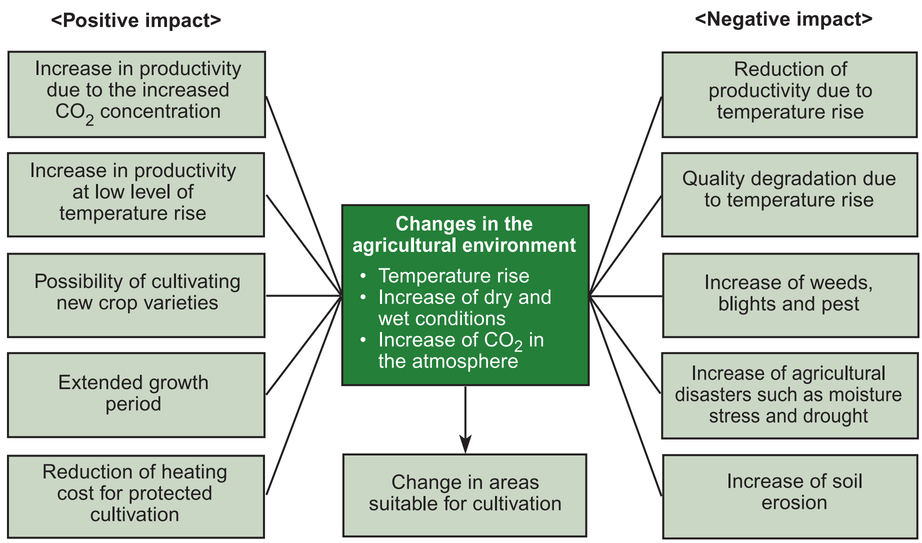
Source: Kim, Chang-Gil, 2009.

[36] The impacts of climate change on agricultural production are divided into primary impacts and secondary impacts. The primary impacts refer to the changes in the composition of the atmosphere due to increased greenhouse gases, and changes in crop growth response, and in energy and moisture balance in the farmland. The secondary impact is caused by the change in agricultural climate resources affected by the primary impacts, including the shift in suitable places for cultivation, and physical and chemical changes in agricultural soil (Na and others, 2007).

Climate change affects hydrology, including underground water level, water temperature, river flow, and water quality of lakes and marshes, by its impact on precipitation, evaporation and soil moisture content. In particular, the increase of precipitation by climate change leads to an increase of outflow while the temperature rise increases evaporation, resulting in the reduction of outflow. In order to understand the quantitative impacts of climate change on water resources, a deterministic hydrology model, based on the general circulation model, is used. Climate change has a wide range of impacts on the rural economy including agricultural productivity, revenues of the farm household and asset values, and it affects agricultural infrastructure through the change in water sources available for agriculture.

Not all impacts are negative (figure I.10). The positive impacts of global warming include the increase in crop productivity due to the fertilization effect caused by the increase in carbon dioxide concentration in the atmosphere, the expansion of areas available for production of tropical and/or subtropical crops, the expansion of two-crop farming due to the increased cultivation period, a reduction of damage to winter crops by low temperature, and a reduction of heating costs for agricultural crops grown in the protected cultivation facilities.

Figure I.10. Potential impacts of global warming on the agricultural sector



Source: Kim, Chang-Gil, 2009.

5. Impact on freshwater resources and public health

A principal concern not only for agriculture, but also for industrial sectors, is the expected loss of freshwater resources. Production and transportation, the direct offshoots of investment and trade, require massive amounts of water in many sectors, not only in agriculture but in many manufacturing industries, either as an input (e.g. in soft drinks) or for cooling. However, climate change will lead to a sharp reduction in available freshwater resources as glaciers melt and the rivers that they engender eventually dry up. Increased rainfall in some areas may offset temperature rises and the loss of rivers to some extent, but this is not expected to compensate for the massive melting of glaciers that will turn freshwater into the saltwater of the rising oceans. Instead, excessive rain may actually cause waterlogging and undermine agricultural production. Increased drought in other areas will increase the demand for irrigation when less water will be available. Decreasing trends in annual mean rainfall are being observed in the Russian Federation, north-eastern and northern China, the coastal belts and arid plains of Pakistan, parts of north-eastern India, Indonesia, the Philippines and some areas in Japan (IPCC, 2007). Coastal and delta communities will be particularly affected. According to the IPCC, it is estimated that under the full range of emission scenarios, 120 million to 1.2 billion people worldwide will experience increased water stress by the 2020s, and 185 million to 981 million people by the 2050s (IPCC, 2007). It needs no explaining that trade and investment in all water-dependent industries, particularly agriculture, will be severely affected by the net loss of freshwater reserves, which are already disappearing rapidly due to population growth and out-of-control urbanization.

The loss of freshwater resources will also affect sanitation and increase the risk of diseases among the workforce. Most studies analysing the impact of climate change indicate that public health will be severely affected. For example, Woodward and others (1998) distinguished direct and indirect effects. Direct effects include injuries due to storms, flooding, drought and other extreme weather effects, and death and illnesses due to thermal extremes (i.e. higher temperatures in some areas and cold-weather related diseases in others. Indirect effects include a wider spread of vector-borne infections such as malaria and dengue, an increase in other infectious diseases and the respiratory effects of worsening air pollution, poor nutrition due to agricultural disruption, and ill-health due to social dislocation and migration. These effects will compromise the health of the workforce in many industries and will make many areas unproductive.

D. Consequences of "business as usual": forecasting future emission scenarios

On the basis of the information presented in the previous sections, the question arises of what is the future scenario for carbon emissions in the region? The accurate modelling of future scenarios of CO_2 and other GHG emissions is extremely complex and difficult, and varies widely depending on assumptions of, inter alia, future population and economic growth, energy demand and the carbon intensity of the energy supply. Box I.7 discusses the energy challenge in more detail. Nevertheless, it is critically important to undertake such an exercise in order for national level policymakers to have a reference point for designing and implementing policies that will assist in the global effort to successfully limit global GHG atmospheric concentrations to 450 ppm. There are currently numerous models mapping various emissions scenarios. Despite individual drawbacks, this paper draws on forecasts from IEA, the Energy Information Administration (EIA) of the United States, the World Bank and ADB, as appropriate and where data are available, to estimate future emissions of Asia and the Pacific as well as its subregions and member countries.

As the energy requirements of the Asia-Pacific region are forecast to grow rapidly during the next few decades, reliance on "business-as-usual" is no longer an option to ensure sustainable development

Box I.7. The energy challenge

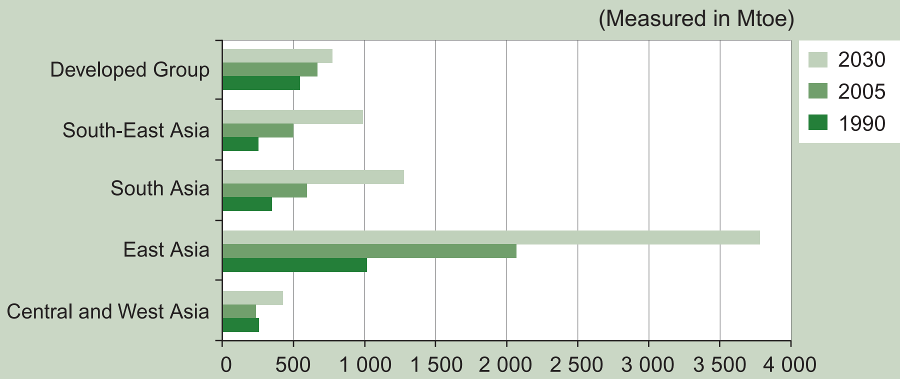
One of the reasons that global and regional GHG emissions are projected to increase substantially over the next few decades is the hunger for energy, particularly in rapidly growing economies in the Asia-Pacific region. Globally, 1.6 billion people still lack access to energy (United Nations, 2010). By 2030, primary energy demand in Asia and the Pacific is expected to have grown by more than 79 per cent compared with 2005 if recent trends in energy development and use persist (ADB, 2009).[a] This translates into an additional 7.7 trillion tons of CO_2 emissions entering the atmosphere, and positions Asia and the Pacific markedly ahead of OECD in terms of aggregate emissions. Expanding access and supply to meet increasing future energy demand, and support economic growth without compromising climate change mitigation efforts, thus poses an enormous challenge to policymakers.

Primary energy mixes vary widely across the Asia-Pacific region. For example, a large percentage of energy needs in China and Mongolia are currently met by coal, whereas Indonesia, Malaysia and Viet Nam rely proportionately more on oil and gas. The reliance on oil by many low-income countries, including Cambodia, the Lao People's Democratic Republic, Papua New Guinea, the Pacific Island countries and Timor-Leste, particularly through imports, is very high. This makes them exceedingly vulnerable to global oil price volatility and shocks. It is estimated that net imports of fossil fuels will have to double in order to meet rising energy demand in 2030 (see figure I.11). Net energy imports will continue to grow rapidly into 2030 in East, South-East and South Asia, and decline in the Developed Group comprising Australia, Japan and New Zealand. East Asia's net imports are forecast to grow annually by 4.2 per cent, tripling by 2030 at 970.3 Mtoe compared with the 2005 level. The Pacific is expected to become a net importer of oil, but a net exporter of gas. Central and West Asia's net exports of energy could grow substantially due mainly to increased oil and gas production capacity in Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan (ADB, 2009).

The largest increase in primary energy demand will, by far, come from East Asia, whose growth is estimated to increase more than threefold in the next 20 years (ADB, 2009). Under the World Bank's reference (REF) scenario for East Asia, which are historically net energy exporters Malaysia and Viet Nam are expected to become net importers (World Bank, 2010b). The Philippines and Thailand will meet 70 per cent and 60 per cent, respectively, of their energy demands from imports in 2030. China is projected to become the number one oil importer in the world, importing 75 per cent of its demand (World Bank, 2010b). Against this background, the success of global climate change action rests largely on the energy strategy adopted by East Asia. As a recent World Bank report pointed out, it is "within the reach of East Asia's governments to maintain economic growth, mitigate climate change, and improve energy security" by transferring to a sustainable energy path (World Bank, 2010b). Realizing this goal will necessitate immediate action on behalf of governments to implement policy and institutional reforms that promote markedly higher levels of energy efficiency and deployment of climate-smart technologies. Delayed action could have profound adverse effects, as continued investment in fossil fuel-based energy production has the potential to lock countries into carbon-intensive trajectories of development for decades. Against this background, rapidly scaling up investment and trade in CSTs will be critical to success.

Box I.7. *(continued)*

Figure I.11. Primary energy demand, by subregion



Source: ADB, 2009.

Note: The Pacific region's primary energy demand is 1.7 (1990), 3 (2005) and 9 (2030).

[a] ADB classification of countries by region and subregion varies slightly from that of ESCAP. Consequently, some member countries are not included. In addition, some numbers do not reflect the entire amount, due to unavailability of data. Subregional classifications are: Central and West Asia – Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan and Uzbekistan; East Asia – China; Hong Kong, China; Republic of Korea; Mongolia; and Taiwan Province of China; the Pacific – Cook Islands, Fiji, Kiribati, Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga and Vanuatu; South Asia – Bangladesh, Bhutan, India, Maldives, Nepal and Sri Lanka; South-East Asia – Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam; and the Developed Group – Australia, Japan and New Zealand.

According to IEA *World Energy Outlook 2009*, if the world continues with existing policy measures (modelled in the IEA WEO Reference Scenario), global energy-related CO_2 emissions are expected to increase by 39.5 per cent by 2030 compared with 2007 levels (2007: 28,826 mt, 2030: 40,226 mt), resulting in a global average temperature rise by as much as 6ºC. Restricting the global average temperature rise to 2ºC (atmospheric concentration of 450 ppm), the target set at the recent Copenhagen Accord, would require emissions to be reduced below 2007 levels by 2030. All of the forecast growth in energy-related emissions to 2030 derives from non-OECD countries, with India and China alone accounting for 54.5 per cent.

Table I.5 shows the CO_2 emission scenario for Asia under the Reference Case of the EIA, the only agency which shows a breakdown for Asia. Again it is clear that China and India are the largest emitters and show the fastest rising emissions if no urgent action is taken towards mitigation.

Transferring to a low-carbon path of development is feasible, however. Under the IEA's 450 scenario, such a shift would necessitate policy changes in non-OECD countries

Table I.5. Energy related CO_2 emissions scenario for the Asia-Pacific region (measured in millions of metric tons of CO_2), EIA reference case

Region/economy	2007	2020	2030	2035	Av. annual change (%)
Australia/New Zealand	495	517	546	567	0.5
Japan	1 262	1 114	1 085	1 064	-0.6
Republic of Korea	516	570	687	757	1.4
Russian Federation	1 663	1 648	1 715	1 811	0.3
China	6 284	9 057	11 945	13 326	2.7
India	1 399	1 751	2 079	2 296	1.8
Other Asia-Pacific	1 743	2 163	2 882	3 362	2.4
Total Asia-Pacific	12 867	2 733	20 393	22 616	1.0
World	29 694	33 812	39 268	42 392	1.3

Source: EIA, 2010.

Notes: Other Asia-Pacific comprises non-OECD Asia, which accounts for 53 per cent of the 2010 world population): Afghanistan; American Samoa; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Cook Islands; Democratic People's Republic of Korea, Fiji; French Polynesia; Guam; Hong Kong, China; India; Indonesia; Kiribati; Lao People's Democratic Republic; Macao, China; Malaysia; Maldives; Mongolia; Myanmar; Nauru; Nepal; New Caledonia; Niue; Pakistan; Papua New Guinea; Philippines; Samoa; Singapore; Solomon Islands; Sri Lanka; Taiwan Province of China; Thailand; Timor-Leste; Tonga; United States Pacific Islands; Vanuatu; Viet Nam; and Wake Islands.

Total Asia-Pacific comprises OECD Asia (Australia, New Zealand, Japan and Republic of Korea), Russian Federation and non-OECD Asia.

that produce major improvements in energy efficiency and deployment of renewables, biofuels, nuclear energy, and carbon capture and storage (CCS) technologies (IEA, 2009b). Potential CO_2 emissions savings from decreases in energy demand and adoption of various climate-smart energy technologies for China, India, Japan and the Russian Federation are listed in annex table 3 of this chapter.

E. Conclusion

This chapter has shown that the Asia-Pacific region is a major and growing source of GHG emissions, and will also experience a disproportional impact from such emissions in the future unless decisive actions are taken towards mitigation. The increases in emissions are mainly the result of continued reliance on fossil fuels used in production and transportation. If alternative energy sources could be further developed and commercialized, GHG emissions could also be substantially reduced without compromising growth.

As explained in this chapter and in chapter 1, this requires further development of already existing technologies as well as increased trade and investment in climate-smart goods, technologies and services. Chapters 3 and 4 explore the opportunities for trade and investment in such goods and technologies in the region.

Annex

Annex table 1. Total GHG emissions of ESCAP regional members, 2005

Country/ economy	$MtCO_2e$	ESCAP rank	World rank	Per cent of world total	$MtCO_2e$ per person	ESCAP rank	World rank
China	7 232.8	1	1	19.13	5.5	18	84
Russian Federation	1 954.6	2	4	5.17	13.7	5	21
India[a]	1 859.0	3	5	4.92	1.7	37	149
Japan[a]	1 346.3	4	6	3.56	10.5	11	40
Indonesia	583.2	5	12	1.54	2.7	26	118
Republic of Korea[a]	568.9	6	13	1.50	11.8	8	29
Iran, Islamic Republic of[a]	559.2	7	15	1.48	8.1	15	61
Australia[a]	557.6	8	16	1.47	27.3	2	7
Turkey	390.6	9	21	1.03	5.5	19	85
Thailand[a]	351.1	10	24	0.93	5.3	20	88
Pakistan[a]	239.7	11	29	0.63	1.5	40	154
Malaysia	235.9	12	30	0.62	9.2	13	52
Kazakhstan[a]	202.5	13	33	0.54	13.4	6	22
Uzbekistan[a]	180.9	14	34	0.48	6.9	16	71
Viet Nam[a]	179.0	15	35	0.47	2.2	32	134
Bangladesh[a]	142.2	16	38	0.30	0.9	45	174
Philippines	138.6	17	41	0.37	1.6	39	151
Democratic People's Republic of Korea[a]	118.4	18	48	0.31	5.0	21	90
Turkmenistan[a]	91.4	19	52	0.24	18.9	4	13
New Zealand[a]	79.0	20	59	0.21	19.1	3	11
Singapore[a]	48.5	21	80	0.13	11.4	9	34
Azerbaijan[a]	47.8	22	81	0.13	5.7	17	82
Nepal[a]	40.4	23	86	0.11	1.5	42	158
Mongolia[a]	30.3	24	93	0.08	11.9	7	27
Sri Lanka[a]	26.1	25	99	0.07	1.3	44	164
Cambodia	22.8	26	102	0.06	1.6	38	150
Lao People's Democratic Republic[a]	17.4	27	116	0.05	3.0	24	112
Afghanistan[a]	14.0	28	119	0.04	0.5	46	182
Brunei Darussalam[a]	12.2	29	125	0.03	33.1	1	4
Tajikistan[a]	9.9	30	134	0.03	1.5	41	156
Kyrgyzstan[a]	9.7	31	136	0.03	1.9	35	145

Country/ economy	$MtCO_2e$	ESCAP rank	World rank	Per cent of world total	$MtCO_2e$ per person	ESCAP rank	World rank
Papua New Guinea	8.6	32	141	0.02	1.4	43	159
Armenia[a]	7.4	33	142	0.02	2.4	29	126
Solomon Islands[a]	4.2	34	148	0.01	8.9	14	55
Fiji[a]	2.7	35	157	0.01	3.3	22	106
Vanuatu[a]	0.5	36	172	0.00	2.1	33	135
Palau[a]	0.2	37	180	0.00	9.9	12	47
Nauru[a]	0.1	38	183	0.00	11.2	10	35
Cook Islands[a]	0.1	39	184	0.00	3.2	23	108
Kiribati[a]	0.0	40	185	0.00	0.5	47	184

Source: World Resources Institute CAIT, Version 8.0.

[a] PFC, HFC & SF6 data are not available.

Annex table 2. CO_2 emissions from Asia and the Pacific, by subregion and economy, various years

(Thousands of metric tons)

Country/area	1990	1995	2000	2005	2006	2007
East and North-East Asia	**4 139 232**	**5 237 734**	**5 203 627**	**7 454 227**	**7 954 538**	**8 419 043**
China	2 460 744	3 320 285	3 405 096	5 614 071	6 113 278	6 538 367
DPR Korea	244 835	259 349	76 967	83 476	85 034	70 711
Hong Kong, China	27 660	31 621	40 583	40 550	38 555	39 963
Japan	1 153 205	1 245 071	1 229 794	1 242 427	1 235 977	1 254 543
Mongolia	10 044	7 924	7 506	8 808	9 443	10 583
Macao, China	1 034	1 243	1 635	1 837	1 632	1 555
Republic of Korea	241 710	372 241	442 046	463 058	470 619	503 321
South-East Asia	**426 256**	**681 825**	**789 834**	**1 064 155**	**1 060 290**	**1 132 570**
Brunei Darussalam	6 421	5 515	6 527	5 688	5 471	7 605
Cambodia	451	1 437	2 255	3 722	4 074	4 441
Indonesia	149 566	224 941	258 120	341 093	342 828	397 143
Lao PDR	235	315	1 060	1 426	1 518	1 536
Malaysia	56 593	121 132	126 603	183 445	185 418	194 476
Myanmar	4 276	6 960	8 889	14 536	13 025	13 190
Philippines	44 532	63 105	78 888	80 612	67 579	70 916
Singapore	46 941	47 110	52 346	59 563	56 222	54 191
Thailand	95 833	181 461	201 549	270 430	279 143	277 511
Timor-Leste				176	180	183
Viet Nam	21 408	29 849	53 597	103 464	104 832	111 378
South and South-West Asia	**1 160 015**	**1 498 597**	**1 891 439**	**2 269 022**	**2 452 548**	**2 615 106**
Afghanistan	2 677	1 269	781	700	697	715
Bangladesh	15 530	22 816	27 862	40 113	41 613	43 751
Bhutan	128	249	400	565	546	579
India	690 577	920 047	1 186 663	1 411 128	1 504 346	1 612 362
Iran (Islamic Rep. of)	227 185	284 919	339 242	426 956	481 976	495 987
Maldives	154	275	499	678	869	898
Nepal	634	2 035	3 234	3 234	3 333	3 425
Pakistan	68 566	84 484	106 449	136 636	145 855	156 394
Sri Lanka	3 773	5 798	10 161	11 643	11 742	12 314
Turkey	150 791	176 705	216 148	237 369	261 571	288 681
North and Central Asia		**1 911 085**	**1 773 444**	**1 902 751**	**1 973 485**	**1 982 821**
Armenia		3 491	3 465	4 349	4 378	5 057
Azerbaijan		33 586	30 546	35 192	35 068	31 775
Georgia		2 303	4 536	4 771	5 504	6 032
Kazakhstan		166 731	127 769	177 233	192 129	227 394
Kyrgyzstan		4 664	4 646	5 570	5 567	6 080
Russian Federation		1 559 439	1 443 716	1 515 567	1 564 727	1 537 357
Tajikistan		5 339	4 268	5 805	6 392	7 228
Turkmenistan		34 620	35 647	41 760	44 107	45 808
Uzbekistan		100 912	118 851	112 504	115 613	116 090

Source: Carbon Dioxide Information Analysis Centre (CDIAC) MDG 7.A; MDG Indicator database.

Annex table 3. Power generation in the 450 Scenario – potential (CO_2) savings and abatement costs for selected countries

	Russian Federation		China		India		Japan	
	CO_2 savings $MtCO_2$	Abatement cost $ per mt CO_2	CO_2 savings $MtCO_2$	Abatement cost $ per mt CO_2	CO_2 savings $MtCO_2$	Abatement cost $ per mt CO_2	CO_2 savings $MtCO_2$	Abatement cost $ per mt CO_2
Changes in demand	**163.6**		**1 696.4**		**267.7**		**64.5**	
Savings from lower emitting technologies	**282.9**	**41.7**	**1 542.8**	**41.6**	**608.4**	**37.2**	**191.1**	**33.1**
More efficient coal plant (excl. CCS)	4.1	4.6	310.6	-14.7	42.3	-5.6	9.5	16.5
More efficient gas plant (excl. CCS)	–	–	–	–	0.8	84.2	–	–
Utilizing spare gas capacity over coal	–	–	–	–	14.2	94.6	–	–
Through use of CCS	51.3	52.8	210.1	38.2	23.0	37.2	12.8	59.8
– CCS Coal (oxyfuel)	19.8	48.9	82.6	42.2	9.3	35.3	3.1	42.5
– CCS Coal (IGCC)	22.7	55.3	124.6	34.0	13.7	38.6	4.2	48.0
– CCS gas	8.8	55.0	2.9	106.8	–	–	5.5	78.6
Nuclear	33.8	11.7	353.7	23.5	130.9	17.1	104.6	15.9
Renewable energy	193.6	44.8	668.5	71.5	397.2	45.7	64.2	58.2
– Hydro-power conventional	97.9	34.5	140.7	46.5	246.1	33.6	7.6	12.8
– Bio-energy	39.1	63.9	148.1	70.4	62.5	54.9	14.1	35.8
– Wind onshore	42.1	50.4	179.0	59.4	40.5	45.1	8.7	25.2
– Wind offshore	2.0	68.6	125.9	74.2	27.9	58.2	16.2	39.4
– Geothermal	11.2	23.3	5.8	37.3	1.3	25.5	2.9	4.0
– Solar PV	1.3	229.2	40.2	205.1	16.0	174.6	13.4	165.0
– Concentrating solar power	–	–	28.5	82.0	2.8	65.2	0.0	46.9
– Tide/wave	0.1	65.8	0.1	72.0	0.1	56.3	1.3	37.3
Total savings	**446.5**		**3 239.3**		**876.1**		**255.6**	

Source: IEA, 2009b. Available at www.worldenergyoutlook.org/investments.asp.

Note: CCS – carbon capture and storage.

CHAPTER 3

TRADE IN CLIMATE-SMART GOODS AND TECHNOLOGIES: TRENDS AND OPPORTUNITIES

Introduction

If trade and investment in CSGTs need to be promoted it is necessary to review the current status in the region. Due to the absence of adequate data on climate-smart services, this chapter reviews recent trends and opportunities in trade of climate-smart goods and technologies only, based on a list compiled by ESCAP (annex 1 of this chapter). Opportunities for trade, with a focus on intraregional commerce, are explored on the basis of an analysis of competitiveness, revealed comparative advantage and regional orientation centring on four core climate-smart energy technologies – solar photovoltaic systems (PVs), wind generation, clean coal and energy-efficient lighting. This chapter also contains an estimate of the export gap in this group of goods as well as a brief analysis of the relative importance of various factors in promoting trade in CSGTs.

A. Trends in trade in climate-smart goods and technologies

1. Global trends

Global and regional trade in CSGTs is rising, but is still only some 3 per cent of both global and regional trade, respectively

The EGS industry was worth $650 billion in 2008, and trade in EGS was estimated to be approximately onetenth of that amount (Jha, 2008).[37] In that year, the share of exports of CSGTs in total world exports was 2.7 per cent (up only slightly from 2.5 per cent in 2002) at a value of $416 billion. Similarly, world imports of CSGTs as a share of total world imports rose marginally from 2.4 per cent in 2002 to 2.6 per cent in 2008 at a value of $410 billion. While the availability and effective use of CSGTs are essential to mitigate climate change, exports of these goods are rising very slowly; they are still only one third of the exports of automotive products (measured in terms of share of world exports) – which are products associated with a relatively high level of emissions – but accounted for around 7.6 per cent

[37] Jha reviewed trade in EGS on the basis of the list of EGs provided by WTO JOB(07)/54 Continued Work under Paragraph 31 (iii) of The Doha Ministerial Declaration (Geneva). Only two categories in the WTO “153” list have been excluded from the analysis. These are the categories of “Cleaner or more resource-efficient technologies and products” and “Environmental monitoring, analysis and assessment equipment.” This is because there is very little trade in these items and sufficient data for all countries are lacking. Jha noted that imports by developing countries of these 153 products did not necessarily end up in areas that required them the most. A similar conclusion could be drawn with regard to the ESCAP list of CSGTs (see annex 1 of this chapter for details on the ESCAP list).

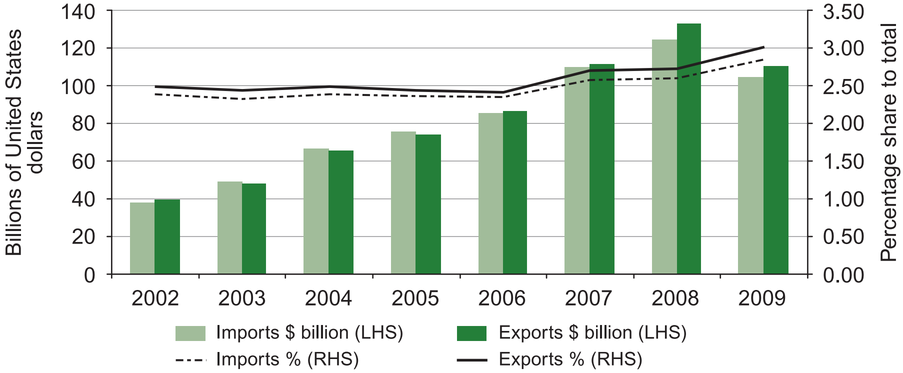
of world merchandise exports in 2008. A major problem associated with the relatively low level of trade in CSGTs, and trade in EGS in general, is the absence of a viable market (Jha, 2008).

2. Regional trends

The Asia-Pacific region[38] is known as the most dynamic region in the world with regard to trade in almost all categories of goods and services, and CSGTs are not an exception. In 2009, the region accounted for about 34.4 per cent of world trade in CSGTs. Figure I.12 shows that the value of CSGT exports and imports tripled during 2002-2009, but the share of CSGTs in total Asia-Pacific trade remained relatively flat and did not exceed 3 per cent. During 2002 and 2008, regional economies' exports of CSGTs (mainly from China) increased from $39.3 to $132 billion, at an average annual growth rate of 22.7 per cent.[39] During the same period, imports of CSGTs also showed a significant increase at an annual average of 22.3 per cent. Although CSGT exports and imports declined by 16.7 per cent and 15.9 per cent, respectively, during the global economic crisis in 2009, a consistently good export performance allowed the Asia-Pacific region to strengthen its CSGT net exporting position from the early 2000s.

The Asia-Pacific region is emerging as the most dynamic region with regard to trade in CSGTs, with China and Japan as the top two exporting countries

Figure I.12. CSGT exports and imports in the Asia-Pacific region, 2002-2009



Source: Calculated from Comtrade data downloaded from the World Integrated Trade Solution (WITS) database.

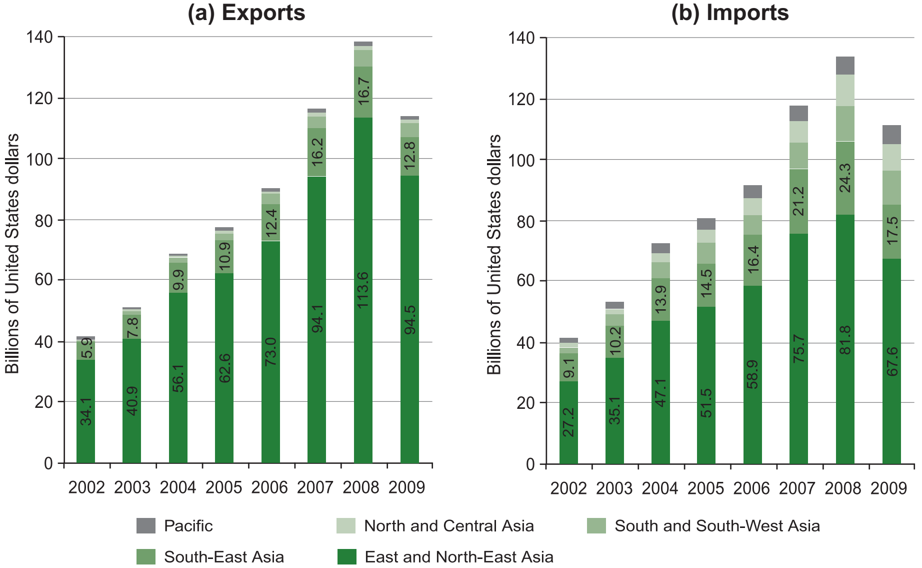
[38] Unless otherwise specified, the analysis in this chapter considers 57 regional members of ESCAP, excluding Timor-Leste due to non-availability of data for this country for the period covered.

[39] Based on available Comtrade data downloaded from WITS on 30 June 2011, exports and imports of CSGTs from the Asia-Pacific region to the world fell in 2009 – exports by 16 per cent and imports by 14 per cent – compared to 2008. It would appear that stimulus packages put in place in 2009 did not boost demand for tradable CSGTs.

Figures I.13a and I.13b reflect the contribution of the various subregions in Asia and the Pacific to the region's total export and import of CSGTs. East and North-East Asia and South-East Asia account for the largest share of Asia-Pacific region's total CSGT trade, in terms of both exports and imports (more than 90 per cent), and thus drive the CSGT trade of whole region. However, only East and North-East Asia were transformed from a net importer to a net exporter during 2002-2009. North and Central Asia as well as the Pacific contribute much less to overall regional trade in CSGTs, while their share is relatively larger on the import than on the export side. In fact, North and Central Asia posted the largest increase in imports of CSGTs of all Asia-Pacific subregions, as their imports increased by more than six times in the observed period. Similarly, starting from a very low base in 2002, South and South-West Asia were able to increase their exports of CSGTs by 10 times during the same period.

Figure I.13. Total CSGT exports and imports, by Asia-Pacific subregion, 2002-2009

(Billions of United States dollars)



Source: Calculated from Comtrade data downloaded from WITS and data provided by ESCAP Statistics Division.

China and Japan are the region's largest exporters of CSGTs (table I.6). China is also the number one importer of CSGTs, followed by the Republic of Korea. Regional exports and imports of CSGTs are geographically very concentrated as the top 10 exporters account for 98.2 per cent of all CSGT exports from the Asia-Pacific region (with the top two exporters, China and Japan, alone representing 67 per cent of the total) and for 89.5 per cent of total imports (with the top three importers, China, the Republic of Korea and Japan, absorbing 51.5 per cent).

Table I.6. Top 10 traders of CSGTs in 2009 (ranked by percentage share in total exports and imports of CSGTs of Asia and the Pacific)

Rank	Economy	Exports (per cent)	Economy	Imports (per cent)
1	China	42.1	China	28.5
2	Japan	28.9	Republic of Korea	13.1
3	Republic of Korea	10.0	Japan	9.9
4	Singapore	4.5	Hong Kong, China	7.9
5	Malaysia	3.6	Russian Federation	6.4
6	India	3.0	India	5.1
7	Thailand	2.7	Singapore	5.1
8	Turkey	1.5	Australia	4.8
9	Russian Federation	1.0	Thailand	4.6
10	Philippines	0.9	Turkey	4.2

Source: Calculated by ESCAP secretariat based on WITS database, downloaded June 2011.

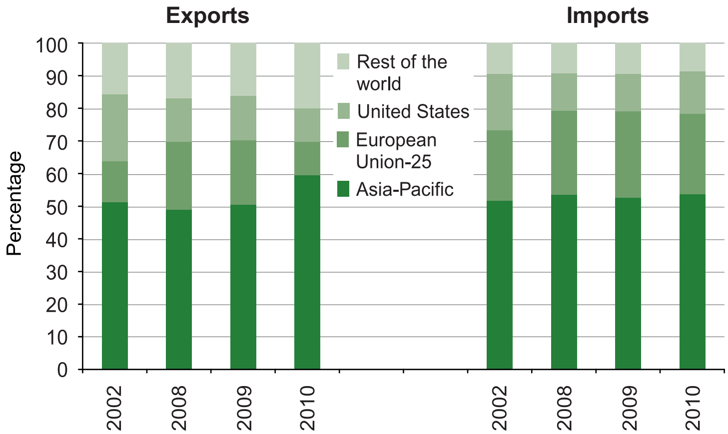
As noted above, trade in CSGTs is still a small percentage of total trade at the national, regional and global levels. With regard to the shares of exports of CSGTs in total national exports in 2009, Japan led with 5.4 per cent. Compared with the share of CSGT trade in world trade (2.9 per cent in 2009), it appears that Japan as well as several other regional economies (most notably China and the Republic of Korea) have, on average, a higher propensity to export CSGTs than the world as a whole. On the import side, the countries that had the highest share of CSGTs in their total imports were Azerbaijan (7.1 per cent), Kazakhstan and Armenia (4.7 per cent), and the Republic of Korea (4.4 per cent) (see also tables 2 and 3 in annex 2 of this chapter). It is noteworthy that almost all economies of the region recorded an increase in the share of CSGT exports in their total exports during 2002-2009. It is important to analyse whether this is just a consequence of the traditionally fast export growth of this region, or the result of policies that various countries have implemented to help mitigate climate change, which, in turn, has affected changes in trade patterns. Some preliminary findings based on analysis done by ESCAP are presented later in this chapter.

Asia-Pacific's intraregional trade in CSGTs is about 50 per cent of their total trade in these goods

Asia-Pacific's intraregional trade in CSGTs (as a share of their total trade in CSGTs) remained relatively stable at around 50 per cent between 2002 and 2009 (figure I.14). Trade in CSGTs with partners outside the region (as a share of total Asia-Pacific CSGT flows), however, has changed markedly. The region's trade in CSGT with the European Union-25 as a proportion of the region's total trade in these goods has been steadily increasing (from 12 per cent in 2002 to 19 per cent in 2009 for CSGT exports and from 22 per cent to 26 per cent in the same years for CSGT imports). At the same time, the share of trade with the

United States in CSGTs has been decreasing (from 21 per cent in 2002 to 14 per cent in 2009 for exports and from 17 per cent to 12 per cent for imports in the same years).[40] While the re-orientation away from trade with the United States can also be witnessed for most other manufacturing goods, the region's CSGT trade shows a strong bias towards Europe. This is probably the result of the rapid adoption of climate-smart development legislation and policies in many European countries, such as feed-in tariffs, in contrast to the United States.

Figure I.14. Regional distribution of CSGT exports and imports, 2002-2010



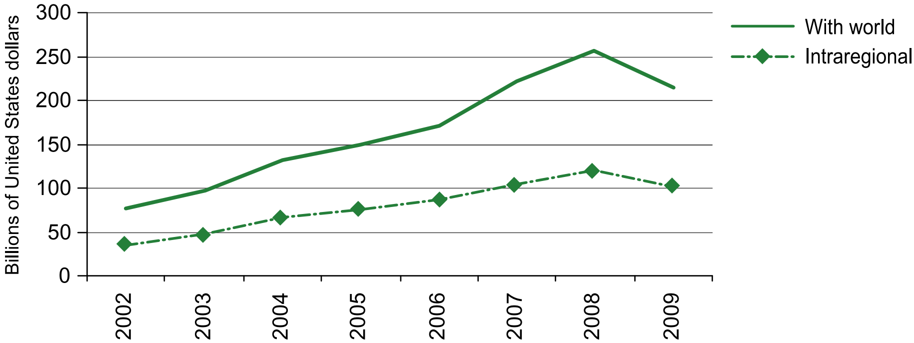
Source: Calculated from Comtrade data downloaded from WITS.

Based on nominal trade values, it appears that the region's intraregional trade in CSGTs has been increasing at a slower rate than its trade in these products with the world as a whole (figure I.15). However, annual percentage changes show that in 2003 and 2004 the growth in intraregional trade in CSGTs was stronger than the growth rate of such trade between Asia-Pacific and the world as a whole (figure I.16). However, growth came to a halt in 2005 and 2006 but resumed in 2007 when trade with the world was stronger than intraregional trade in CSGTs, while in 2008 intraregional trade suffered a milder decline then trade with the world. In 2009, both fell sharply as the global recession gained momentum.

However, as many countries in the region continue to design policies that are more conducive to climate-smart development (discussed in part II), their domestic capacity to meet the increased domestic and foreign demand for climate-smart goods and services should increase. Depending on the relative strength of incentives provided in the region compared to the strength of incentives provided outside, the region's trade flows and patterns may change with a possible reorientation towards increased intraregional trade. Section C of this chapter explores factors that might contribute to such a reorientation. First, though, section B provides more detail on trade flows and current level of tariff protection in an important subset of CSGTs, i.e. climate-smart energy technologies (CSTs).

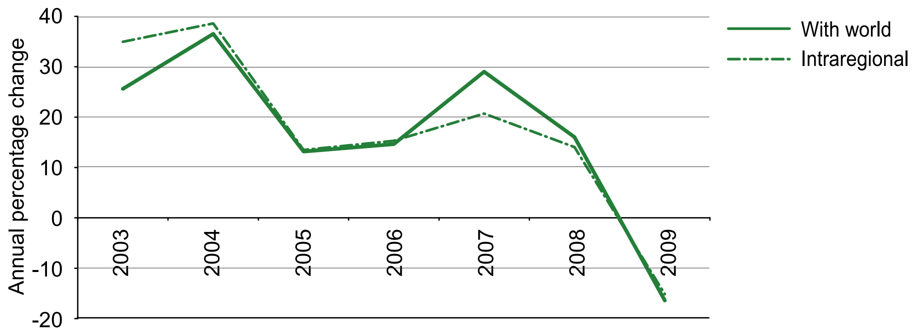
[40] Since shares of the rest of the world are calculated as the difference between total value and the sum of the values for trade flows with the European Union, the United States and the Asia-Pacific region, these shares also differ significantly depending on the source of data.

Figure I.15. Trends in Asia-Pacific intraregional and total trade in CSGTs



Source: Calculated from Comtrade data downloaded from WITS.

Figure I.16. Annual percentage changes in Asia-Pacific intraregional and total trade in CSGTs



Source: Calculated from Comtrade data downloaded from WITS.

B. Special focus: trade in climate-smart energy technologies

The CSGT group contains four categories of climate-smart energy technologies – solar PV systems, wind power generation, clean coal technologies, and energy-efficient lighting.[41] These four categories of technologies do not exhaust the CSGT group (in fact, most of the 64 products on the ESCAP list of 6-digit HS codes remain outside these four

[41] Essentially, the category of CSTs comprises goods (embodying a particular technology) essential for production processes with minimum or no GHG emissions. Climate-smart energy technologies are essentially the four categories covered in this chapter. RETs are climate-smart energy technologies excluding clean coal technologies, as coal is a fossil fuel and not a renewable energy product. For more details on the disaggregation of CSGTs in the ESCAP list, see annex 1 of this chapter. Given the current international trading framework and available data, it is very difficult to accurately measure trade in energy-efficient technologies. In an attempt to circumvent such obstacles, the trade in fluorescent light bulbs (HS code 853931) is used as a proxy.

categories).[42] However, as the adoption and effective use of these technologies are critical in any climate-smart development strategy, it is opportune to examine their current trade flows and opportunities. This section reviews and compares the trends in trade in these four climate-smart energy technologies for the Asia-Pacific region as a whole, and identifies the top regional exporters and importers. While identifying possible reasons for the repositioning of individual countries towards trade in climate-smart energy technologies, special attention is given to the current level of tariff protection on trade in these technologies.

1. Import-export coverage of climate-smart energy technologies

Figure I.17 illustrates changes in import-export coverage (the ratio of imports to exports) in each of the four technologies from 1996 to 2009.[43] It appears that the Asia-Pacific region as a whole was a net exporter of solar PV systems and energy-efficient lighting throughout that period.[44] In contrast, the region was a net importer of both wind power generation and clean coal technologies. However, there are sharp differences with regard to the development of trade performance in these two technologies. First, while the region is a net importer of both wind power generation and clean coal technologies, the import-export coverage is much higher for wind power generation technology than for clean coal technology. Second, as the import-export coverage for clean coal technology sharply improved during 1995-2001 (which could be partly explained by the drop in production and associated demand for energy as a result of the Asian financial crisis of 1997), the gap between the ratios for wind power generation and clean coal technologies has become much smaller since 2002.

The Asia-Pacific region as a whole is a net exporter of solar PV systems and energy-efficient lighting but a net importer of both wind power generation and clean coal technologies

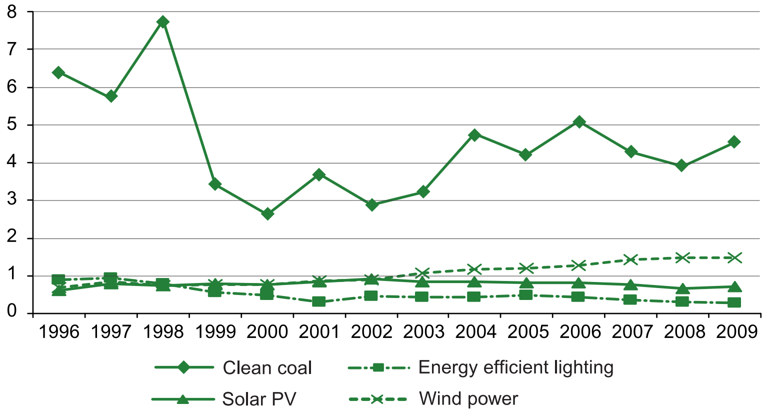
The success witnessed so far in solar PV systems trade can be explained by the rise of various developing countries in the region, particularly China, as successful global competitors in the solar PV market. Supported by aggressive domestic government policies towards the production of RET, China and other selected emerging economies managed to respond quickly to the rapidly increasing demand for solar PV systems (as a result of very generous feed-in tariffs) in European Union member countries, such as Spain and Germany, by providing such systems at a significantly lower price than the ones provided by traditional exporting countries such as Germany. In addition, those emerging economies also managed

[42] As the classification of goods at the 6-digit level may also include some non-climate-smart energy technologies (especially in the section on clean coal), it should be noted that there is a risk of overestimation. While a comparison at a more disaggregated level, for example, at the 8 or 10-digit level, would be better for isolating specific technologies, this is not feasible as codes are only aligned, and thus comparable, across countries at the 6-digit level.

[43] The index value of greater (less) than 1 indicates net imports (exports).

[44] There are, of course, large differences among individual countries with regard to their import-export coverage ratios in these four technology groups. These details are available in Mathur, 2011.

Figure I.17. Import-export coverage of the four climate-smart energy technologies in the Asia-Pacific region, 1996-2009



Source: Calculated from Comtrade data (HS1996) downloaded from WITS (June 2011).

to expand their own domestic markets for solar PV systems, which are being increasingly supplied by other developing countries in the region.

Similarly, the market for energy-efficient (fluorescent) lighting is dominated by exporters from developing countries such as China, India and Thailand, which are suppliers to both the domestic and the regional markets. The exports of compact fluorescent lamps (CFLs) from developing countries of the region may receive another boost as a result of Australia's 2009 law mandating the phasing out of inefficient light bulbs, and may improve the import-export coverage even further.

2. Top regional traders in climate-smart energy technologies

Tables I.7 and I.8 list the top 10 regional importers and exporters, respectively, of the four climate-smart energy technologies in 2009. China and Japan appear frequently as the top two exporters in all categories except for clean coal technology. Other economies that appear in the top three exporters for at least one technology include Malaysia, Singapore and Thailand. In the case of imports, China, Japan and Republic of Korea appear frequently as the top two importers, while Hong Kong, China as well as Singapore, Turkey and the Russian Federation are in the top three importers of at least one category.

China has become the world's largest solar PV manufacturing base; however, around 95 per cent of China's solar cell production was exported in 2007, largely due to feed-in tariffs and other financial incentives that were provided to support solar power in major foreign solar markets (Wong, 2009). China's solar industry, however, did not solidify on its own. Aggressive financial and policy support for the solar PV sector have been the key foundations and catalysts for China's sustained growth in international trade of solar PV systems, and its subsequent rise to the top of the list. Nevertheless, such support has not come without repercussions (box I.8).

Table I.7. Top 10 regional importers of four climate-smart energy technologies, 2009

Rank	Solar PV	Wind power	Clean coal	Energy-efficient lighting
1	China	China	Republic of Korea	Japan
2	Republic of Korea	Republic of Korea	Singapore	Turkey
3	Hong Kong, China	Japan	Japan	Russian Federation
4	Japan	Australia	Turkey	Hong Kong, China
5	Thailand	India	Russian Federation	Republic of Korea
6	Singapore	Singapore	India	Australia
7	Russian Federation	Turkey	China	Thailand
8	Malaysia	Russian Federation	Australia	India
9	Australia	Thailand	Pakistan	Singapore
10	India	Malaysia	Thailand	Malaysia

Source: Calculated by ESCAP based on WITS database, downloaded June 2011.

Table I.8. Top 10 regional exporters of four climate-smart energy technologies, 2009

Rank	Solar PV	Wind power	Clean coal	Energy-efficient lighting
1	China	Japan	Japan	China
2	Japan	China	Singapore	Thailand
3	Malaysia	Republic of Korea	India	Japan
4	Republic of Korea	Singapore	China	India
5	Singapore	India	Russian Federation	Republic of Korea
6	Thailand	Turkey	Thailand	Russian Federation
7	India	Australia	Australia	Turkey
8	Australia	Russian Federation	Malaysia	Singapore
9	Russian Federation	Thailand	Turkey	Viet Nam
10	Turkey	Malaysia	Republic of Korea	Malaysia

Source: Calculated by ESCAP based on WITS database, downloaded June 2011.

Malaysia rose to the number three spot in solar PV exports in 2009. Most of the solar PV technology in Malaysia has been deployed in rural areas such as Sabah and Sarawak, where on-grid electrification is not cost-effective. A number of solar PV companies emerged during the past decade. Unfortunately, however, due to high subsidies for fossil fuels and, at the time of writing, no feed-in tariff in place, solar PV systems have been less competitive financially in urban settings; thus, most of their production has been targeted at rural off-grid areas or for export. It is expected that that this situation may change for the better if the policies for developing Malaysia's green technology and for the diversification of the economy, which were put in place by the Government of Malaysia in 2010, begin to show results.

Box I.8. Sustaining China's solar PV system production

China's booming solar PV industry has hit some snags in recent years. The industry is characterized by cut-throat competition and suffers from lagging demand in its traditional export markets in Europe due to the global economic crisis. It is also facing claims of illegal government support. The United States has actually retaliated against China's financial support of its domestic solar industry by increasing import tariffs on solar PV panels (Palmer, 2009), while other dispute settlement actions are being taken or considered as a challenge to China's subsidies for, and protection of these technologies. Production was also been affected by the rising price of polysilicon feedstock, an important material in the production of solar PV systems, during 2005-2008, although the price has since come down. China is currently reducing its subsidies to prevent the market from overheating. Furthermore, the costs of solar energy can be up to four times as much as that of fossil fuels. However, the opportunities for using solar energy in the domestic market are huge. China obtained 80 per cent of its electricity generation from coal in 2007, which contributes heavily to global GHG emissions. Most domestic PV installations are dedicated to rural electrification or are used in off-grid systems. The on-grid solar PV market is still at a relatively early stage. Wong (2009) noted that: "By promoting China's domestic solar market, however, the Chinese Government is presented with a unique opportunity to sustain the domestic solar industry, create more jobs, and enhance energy and environmental security".

Unlike solar PVs, most of China's production of wind turbines has been destined for the domestic market even though China ranks number two in the region in the export of wind energy technologies. China also topped the list of the largest importers of wind energy technologies in the region. However, as China's manufacturers recently entered the top ranks of global wind producers, and as the global wind market is continuing to expand rapidly, China's producers may choose to focus more on the export markets. Other markets in the region, such as India – the world's fourth largest in terms of installed capacity in 2009 – are also growing rapidly.

Many countries in the list of top 10 exporters of wind energy technologies were in East and South-East Asia. Japan, traditionally a top leader in the region in the export of environmental and climate-smart technologies, maintained first place. This situation may also change in the near future, however. The next two contenders – China and the Republic of Korea – have been moving up the charts rapidly, largely due to favourable domestic investment climates and progressive policies such as feed-in tariffs and reduced import tariffs for wind energy technology. These countries are continually fine-tuning both market and regulatory incentives to further stimulate the development of, and trade in wind energy technologies Surprisingly, Australia – one of the few Asia-Pacific OECD members – only scored seventh on the list of top 10 exporters. However, it ranked fourth among the region's importers of wind energy technology. Australia has relatively high import tariffs, almost double its industrial goods average, and also higher than the average wind power tariffs of the region's top 20 GHG emitting economies (table I.9).

With regard to the top 10 regional trading economies in clean coal technology components in 2009, two countries – Japan and Singapore – took the top two spots for both exports and imports. These countries are not only large traders in these technologies, but

Table I.9. Average effectively applied tariffs on climate-smart energy technologies in the top 20 GHG-emitting countries of Asia and the Pacific

GHG emissions regional rank (2005)	Country	Year (most recent year available)	All industrial goods average (per cent)	Solar PV (per cent)	Wind power (per cent)	Clean coal (per cent)	Energy-efficient lighting (per cent)
1	China	2008	8.97	4.36	8.00	14.00	8.00
2	Indonesia	2009	5.01	4.94	4.14	0.00	7.37
3	Russian Federation	2008	8.19	4.33	4.14	8.85	0.00
4	India	2008	8.19	5.29	7.50	7.50	10.00
5	Japan	2009	2.26	0.00	0.00	0.00	0.00
6	Republic of Korea	2010	6.68	5.32	6.19	8.00	7.698
7	Australia	2010	2.94	1.83	3.77	3.79	3.797
8	Islamic Republic of Iran	2008	24.78	33.19	5.78	6.38	29.80
9	Turkey	2008	1.28	0.25	0.35	0.28	0.61
10	Thailand	2009	9.95	6.38	4.98	1.00	10.00
11	Malaysia	2009	5.60	6.1	4.09	0.00	12.73
12	Myanmar	2008	3.89	2.58	1.00	1.00	1.00
13	Pakistan	2009	14.34	18.6	31.81	5.00	20.00
14	Philippines	2007	5.00	4.97	0.84	2.07	9.88
15	Kazakhstan	2008	3.91	1.27	4.60	0.00	0.00
16	Viet Nam	2008	7.34	11.52	6.36	0.00	29.38
17	Bangladesh	2008	13.51	6.31	3.00	3.00	18.24
18	Singapore	2009	0.00	0.00	0.00	0.00	0.00
19	Cambodia[a]	2008	11.98	22.27	12.33	10.00	6.29
20	Turkmenistan[a]	2002	5.43	3.62	0.00	0.00	0.00
	Average		7.46	7.16	5.44	3.54	8.74

Source: Calculated by ESCAP based on WITS database, downloaded June 2011.

Notes: Ranking of countries by GHG emissions is based on 2005 data from Climate Analysis Indicators Tool (CAIT) Version 7.0 (World Resources Institute, 2011).

[a] Cambodia and Turkmenistan are actually ranked twentieth and twenty-first, respectively, while the Democratic People's Republic of Korea ranked nineteenth. However, due the lack of tariff data for the Democratic People's Republic of Korea, Cambodia and Turkmenistan were both moved up a rank.

are also starting to deploy them domestically. India and China scored higher in exports (third and fourth rank, respectively) than in imports (sixth and seventh rank, respectively). Even though both are adding an enormous amount to coal-generated electricity capacity each year, more of their technology demand appears to be met by domestic production. As it is difficult to distinguish between traditional coal and "clean" coal technologies at the HS 6-digit level, a fair amount of the trade analysed here may, in fact, still be traditional "dirty" coal technologies. Further examination at a more disaggregated HS level, and of regional trade trends in this industry, is needed for a more accurate evaluation.

Among the top 10 Asia-Pacific economies importing energy-efficient lighting in 2009, Japan topped the list, while India ranked ninth. On the other hand, China is the largest exporter, followed by Thailand. Japan and India ranked third and fourth, respectively, indicating that in this category, as in the other categories analysed in this report, a significant level of intra-industry trade might exist.

3. Levels of tariff protection

In order to explain the current levels of trade in climate-smart energy technologies as well as estimate the potential for expanding such trade, the current levels of effectively applied tariffs are mapped for all four categories of technologies and for the top 20 GHG-emitting economies in the Asia-Pacific region (table I.9).

Although import tariffs on key groups of climate-smart technologies have come down in most countries of the region, in others tariffs remain high in both absolute terms and relative to their average tariff for all industrial goods

Fourteen of the top 20 GHG emitting countries' import tariffs on solar PV were lower than their average tariff rates on all industrial goods. This demonstrates the increased importance given to providing incentives for trade in solar PV and climate change mitigation in the region. Nonetheless, tariffs on solar PV in the Islamic Republic of Iran (33.19 per cent), Cambodia (22.27 per cent), Pakistan (18.6 per cent) and Viet Nam (11.52 per cent) were especially high in both absolute terms and relative to their corresponding industrial goods average. Considering the fact that these countries are high GHG emitters and do not have developed domestic solar industries, such high import tariffs could pose a serious impediment to, or at least raise the cost of mitigation and the provision of RE. As these countries have abundant sunshine, opportunities for developing a domestic solar PV market are potentially large.

India's average applied tariff rate on wind power technologies was 7.5 per cent in 2008. While this tariff rate was lower than India's average tariff rate of 8.19 per cent for industrial goods, indicating a positive incentive for wind technology, it does not quite tell the whole story. Like many other countries, India further disaggregates its classification of imports and associated applied custom duties. In the case of wind energy equipment, it applies even lower duties for many relevant goods, and in 2009 it lowered the rates for most of such goods to 5 per cent.

Average applied tariffs for clean coal were by far the lowest among the climate-smart energy technologies, averaging only 3.54 per cent among the top 20 GHG emitting countries of the region. China levies the highest rate among all surveyed economies at 14 per cent, while 10 countries apply rates of between zero and 1 per cent. This analysis may indicate that significant GHG emission reductions can be achieved in the coal energy sector. However, as stated above, there is not much differentiation between "dirty" and "clean" coal technologies at the HS 6-digit level; thus, the low level of tariffs observed at this level of disaggregation may not actually provide sufficient incentives for trade and investment in clean coal technologies over dirty ones.

Average applied tariffs on imports of energy-efficient lighting for the top 20 GHG emitting countries in Asia and the Pacific ranged from zero in Japan, Kazakhstan, the Russian Federation, Singapore and Turkmenistan, to a high of 29.38 per cent in Viet Nam. The average for tariffs applied to energy-efficient lighting (8.74 per cent) among the top 20 GHG emitting countries in the region was higher than the average tariff for all industrial goods (7.46 per cent). Improving energy efficiency is one of the most cost-effective ways of enhancing energy security and climate change mitigation. Such high import tariffs undermine the cost savings that could be accrued from adopting energy-efficient lighting, and represent significant barriers to trade and deployment of this technology.

Tariffs, of course, only present a partial picture. NTBs are also substantial in preventing effective trade in climate-smart energy technologies and CSGTs in general, but it is difficult to quantify their impact. Among the most common NTBs are stringent standards and regulations, although anti-dumping is also gaining in popularity. While such NTBs may be the result of policies to promote domestic investment in CSGTs, they can be considered as "green" protectionism and should not lead to a distortion of trade. This issue is further discussed in the relevant chapters in part II.

C. Gauging trade opportunities in climate-smart goods and technologies

This section maps the trade performance of Asia-Pacific regional members and associate members and for three regional trade agreements, i.e. APTA, AFTA and SAFTA in CSGTs from 2002 to 2009.[45] The trade performance in CSGTs is evaluated using the following trade indices – the competitiveness index (CI), revealed comparative advantage (RCA) index and regional orientation index (ROI).[46] These indices contribute to an assessment of the level of and change in competitiveness, trade patterns, comparative advantage and regional bias in trade in CSGTs for individual economies and trade groupings.[47] The analysis shows that trade in CSGTs has a regional bias for most of the economies in the region and that almost all CSGT net-importing economies import predominantly from Japan and Hong Kong, China as well as, more recently, China.[48] The analysis also shows that not all economies are globally or regionally competitive in CSGTs, but could be potentially competitive if appropriate policies are implemented.

Second, a gravity model analysis is undertaken to explain the importance of various determinants of the import of CSGTs for Asia-Pacific economies from other economies of the region as well as from the United States and selected European Union member countries.

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[45] All members of ASEAN, APTA and SAFTA are from the Asia-Pacific region (see details on these trade agreements at www.unescap.org/tid/aptiad). For the purpose of comparison, this report considers Asia and the Pacific as one region.

[46] For a mathematical description and details of all these indices, see Mikic and Gilbert, 2009.

[47] The trade performance of individual Asia-Pacific economies and trade groups in the four climate-smart energy technology categories is explained in Mathur (2011).

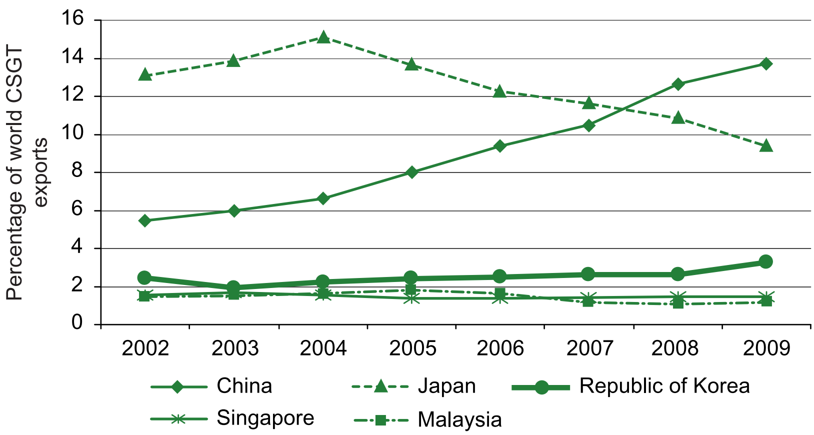
[48] The re-exporting role of Hong Kong, China has to be taken into account.

Trade in CSGTs has a regional bias for most of the economies in the region. Furthermore, while not all economies are globally or regionally competitive in CSGTs they could be potentially competitive if appropriate policies are implemented

1. Competitiveness

The CI of CSGTs for a country is simply defined as the share of that country's exports of CSGTs in the world's export of CSGT. In other words, it is the market share of a country's CSGT exports in the world CSGT market. This index is an indirect measure of international market power as it tracks a country's share of the world market in a selected product or a group of products (an industry). The index takes a value of between zero and 100 per cent, with higher values indicating greater market power of the country in question. In 2009, China, Japan, the Republic of Korea, Singapore and Malaysia were the most competitive (i.e. had the highest CI) in CSGTs among all Asian and Pacific economies, with CIs of 13.7 per cent, 9.4 per cent, 3.25 per cent, 1.5 per cent and 1.2 per cent, respectively (figure I.18a). On the other hand, Asia and the Pacific as a "regional bloc" registered a share of 18.2 per cent while other more formal regional blocs performed very differently (figure I.18b). For example, APTA as a group captured 16.5 per cent share of the world market in CSGTs – double its rate in 2002 (and much higher than its CI of 9.7 per cent for total merchandise exports) – due to the fact that China and the Republic of Korea are APTA members.[49] ASEAN and SAFTA, on the other hand, have much lower shares in the CSGT world market, although SAFTA's share is increasing rapidly. This is due, to a large extent, to the fact that India, together with China and the Republic of Korea, has improved its competitiveness in CSGTs since 2002.

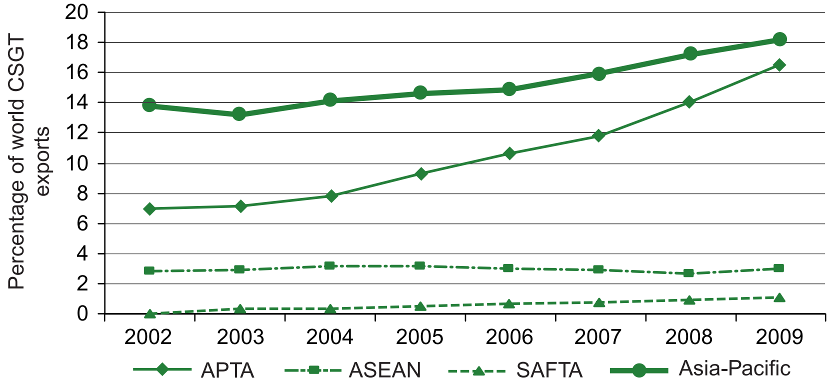
Figure I.18a. Competitiveness in CSGTs among selected Asia-Pacific exporters, 2002-2009



Source: Calculated by ESCAP based on WITS database, downloaded June 2011.

[49] The calculation of shares for regional blocs excluded intra-bloc trade.

Figure I.18b. Competitiveness in CSGTs among selected regional groupings, and Asia and the Pacific as a group, 2002-2009



Source: Calculated by ESCAP based on WITS database, downloaded June 2011.

2. Comparative advantage

Comparative advantage conceptually means that a country has the ability to produce the same product at lower relative cost (and price) than its trading partners. Since adequate information is unavailable for measuring the exact comparative advantage (i.e. analysts do not have information on relative costs or prices in an autarky scenario), an empirically comparative advantage is approximated by a ratio of a country's export share (in the country's total exports) to the world's export share (in the world's total exports) for a specific product; this is called the revealed comparative advantage (RCA) index. If a country demonstrates a larger share of a certain product in its exports than the world's export share in that product of total world exports on average (which would push the value of the index above one), the country is said to have an RCA in that product. Values of below one are indicative of comparative disadvantage.

RCA indices are also used to assess export potential.[50] For example, similar RCA indices between a pair of countries would indicate little potential for additional trade as countries would appear to have a comparative advantage in similar goods. Thus, unless trade is of the intra-industry type, opportunities for (inter-industry) trade lie between countries which have RCAs in very different commodity groups. Tracking RCA over time may help in determining to what extent a country's export profile is static, even though such an exercise would not provide information about which products have been added to or taken off the export menu list over time. Also, a change in the RCA index in terms of value (say from 1.2 to 2.7) should not be interpreted as a strengthened competitive position in that commodity.

Figure I.19a tracks the RCA in CSGTs of the top five performing Asia-Pacific economies in the period 2002-2008, namely Japan, China, Republic of Korea, Malaysia and

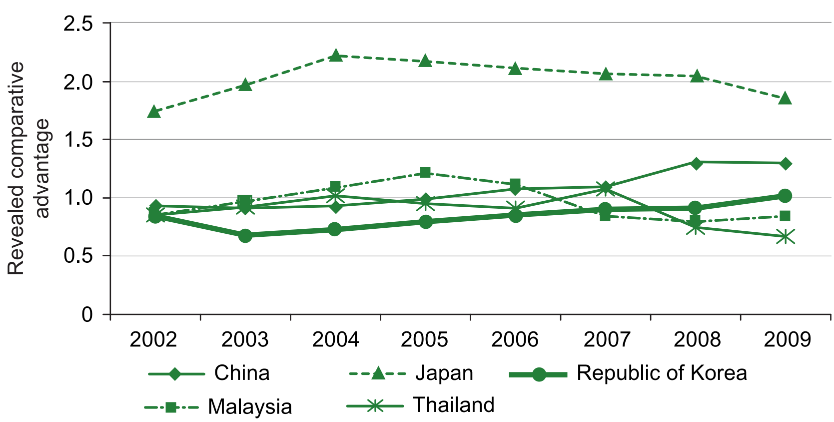
[50] However, this would require a fairly disaggregated analysis, hopefully at the level of the product. For a more detailed analysis, see Mathur (2011).

Thailand. Japan has RCA indices greater than one in all years from 2002 to 2009 and thus reveals a strong comparative advantage in the production and export of CSGTs in the observed period. The data reflect once again the rise of China. China's RCA has been above 1 since 2006. In contrast, the Republic of Korea's RCA has increased slowly to slightly above one in 2009. Malaysia and Thailand, however, reveal a comparative disadvantage with respect to exporting CSGTs, especially in recent years.

The RCA index of Asia and the Pacific region as a whole remains just above one, possibly supported by strong positions of Japan and China (figure I.19b). The only regional grouping which has switched from a revealed comparative disadvantage to a revealed comparative advantage in CSGTs is APTA which, with the adoption of the third round of tariff concessions in 2005, started to record RCA values greater than one. SAFTA may also have an RCA index valued greater than one in the near future as the share of CSGTs in overall exports from India and selected other South Asian countries is increasing.

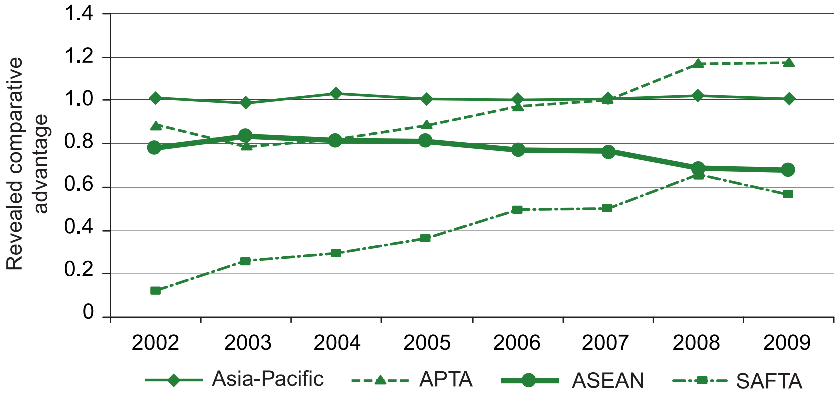
In addition to the RCA indicators for the whole group of CSGTs, policymakers and analysts are keenly interested in more disaggregated information to help gauge their country's trade potential for specific products in the world market. Table I.10 provides additional information for more narrowly defined product groupings of CSGTs. Based on the levels of trade (and trading conditions) in 2008, RCA indices for climate-smart energy technologies and remaining items in the CSGT group ("other CSGT") were calculated to help identify those economies that currently have a strong export position in one or more product groups. As expected from the analysis of the top exporters of these technologies, Japan and China are in the list of countries with a revealed comparative advantage in several product groups. However, there are some "unexpected winners", such as Sri Lanka (efficient lightning), Malaysia (solar PV systems) and Macao, China (solar and lightning technologies).

Figure I.19a. Revealed comparative advantage in CSGT exports by selected countries in Asia and the Pacific, 2002-2009



Source: Calculated by ESCAP based on WITS database, downloaded June 2011.

Figure I.19b. Revealed comparative advantage index for regional groupings



Source: Calculated by ESCAP based on WITS database, downloaded June 2011.

Table I.10. Revealed comparative advantage index of Asia-Pacific economies for climate-smart energy technologies, 2008

Group	HS 2000	Economy (country/area)	RCA	Description
Solar PV	850720	Viet Nam	4.36	Other lead-acid accumulators
		China	3.36	
		Malaysia	1.16	
	853710	Malaysia	2.90	For a voltage not exceeding 1,000 V
		Japan	1.73	
		Thailand	1.63	
	854140	China	3.15	Photosensitive semiconductor devices, including photovoltaic cells Whether or not assembled in modules or made up into panels; light emitting diodes
		Japan	3.04	
		Macao, China	2.50	
		Hong Kong, China	1.51	
		Malaysia	1.44	
		India	1.11	
Wind power	848340	Japan	1.90	Gears and gearing, other than toothed wheels, chain sprockets and other transmission elements presented separately; ball or roller screws; gear boxes and other speed changers, including torque converters
	848360	Japan	1.37	Clutches and shaft couplings (including universal joints)

Table I.10. *(continued)*

Group	HS2000	Economy (country/area)	RCA	Description
Clean coal	840510	New Zealand	5.18	Producer gas or water gas generators, with or without their purifiers; acetylene gas generators and similar water process gas generators, with or without their purifiers
		Singapore	2.58	
Efficient lightning	853931	China	6.59	Fluorescent, hot cathode
		Sri Lanka	2.11	
		Macao, China	1.38	
		Thailand	1.07	
		Hong Kong, China	1.01	

Source: Calculated by ESCAP based on WITS database, downloaded May 2011.

Even if policymakers in these economies do not engage in the formulation of industrial policy in general, it is likely that more active policies will be put in place in areas deemed important for climate change mitigation. In particular, economies will be pushed to reorient their production, using technologies that are more climate-friendly, towards a mix of goods (and services) that, when consumed either as intermediate of final products, will contribute to lower emissions. For that purpose, apart from the private sector, policymakers also need information on the level of performance of their economy in the global market of a particular product.[51]

3. Regional orientation

The regional orientation index shows whether a country/economy or group of economies has a propensity to export/import more to/from one particular economy or group of economies rather than to/from some other economy or group of economies (including the rest of the world).[52] ROI takes values between zero and infinity. A value greater than one for a particular economy or group of economies implies that exports to, or imports from a defined region (which includes the reporting economy or group of economies) are favoured in exporting to/importing from the rest of the world. ROI values for exports of CSGTs for selected economies to "regions" comprising APTA, ASEAN and SAFTA (of which they are members) for 2002 and 2008 are shown in table I.11.

[51] For example, the International Trade Centre provides free access for developing countries to a useful Market Analysis Tool that enables interested parties to make a relatively thorough analysis with regard to trade potential.

[52] The index is the ratio of two shares. The numerator is the share of a country's exports of a given product, to the region of interest, in total exports to the region. The denominator is the share of exports of the product to other countries in total exports (i.e. rest of the world).

Most economies that are members of ASEAN and APTA have a “regional” bias for exporting CSGTs to these regional groupings. Although some members of ASEAN and APTA may not have a comparative advantage in CSGTs and may, in fact, be net importers of CSGTs, it appears that most of them are importing from other economies within their own groupings. However, there are a few exceptions; for example, India and the Philippines tend to export CSGTs more to countries outside the regional groupings than inside those groupings of which they are members.

Table I.11. Regional orientation index of selected countries and regional groups in CSGTs, 2002 and 2008

Country/regional group	ASEAN		APTA		SAFTA	
	2002	2008	2002	2008	2002	2008
Malaysia	1.08	1.14				
Philippines	0.95[a]	0.62				
Singapore	2.12	1.81				
Thailand	1.13	1.37				
Viet Nam	1.60[b]	1.15				
China			0.73	1.28		
Republic of Korea			1.30	1.74		
Sri Lanka			2.25	2.26	1.37	1.88
India			0.85[c]	0.39	1.16[c]	0.62
Pakistan					9.46[c]	1.02
ASEAN	1.47	1.22				
APTA			1.01	1.13		
SAFTA					2.21	0.58

Source: Calculated by ESCAP, based on UNCOMTRADE database downloaded from WITS.

[a] 2007.

[b] 2004.

[c] 2003.

From the perspective of each grouping as a “bloc”, there is also a clear propensity to export CSGTs intraregionally rather than outside the grouping. However, while this is true for all examined economies in 2002 (i.e. ROI was above one), by 2008, with the exception of APTA, ROI for each grouping was falling, i.e. there was a weakening of the propensity to export CSGTs within the group. SAFTA experienced the sharpest decline with its ROI falling below one in 2007 and continuing to decline since then.

4. Trade potentials and obstacles in exploiting them

Apart from the above analysis of trade potential in CSGTs based on trade performance indices, further analysis can be made to gauge the export potential of these goods in the region. Based on gravity model[53] predictions of export levels, a ratio of trade potential was calculated. This ratio compares predicted to actual level of exports in CSGTs. In cases where the ratio is higher than one, there is an unexploited potential to increase the level of trade to at least the average. Again, this study does not offer a comprehensive analysis of all countries in the region and their trading partners, but focuses only on those that have been identified as having either a competitive or comparative advantage in CSGTs.

The estimated export potential in 2008 for CSGTs in Asia and the Pacific was $30 billion to $35 billion

A simple gravity model is used to estimate "trade potential" based on 2008 trade data (see annex 2 of this chapter for technical details).[54] The estimated export potential in 2008 for CSGTs in Asia and the Pacific was $30 billion to $35 billion. If Asian and Pacific economies had been able to utilize this potential, their export of CSGTs would have increased by nearly $7.34 billion in that year. Among these economies, India ($4.2 billion) was top, followed by the Russian Federation ($1.51 billion), Pakistan ($980 million), Hong Kong, China ($590 million) and Azerbaijan ($6.7 million). Intraregional demand for CSGTs was also very high in 2008, but many economies could not meet import demand. The actual level of intraregional imports was $61.2 billion in 2008 and these economies could have increased their imports of CSGTs by nearly $20 billion just through intraregional trade. The major economies with CSGT import potential were the Republic of Korea ($15.78 billion), Pakistan ($2.79 billion), Armenia ($7.37 million) and Bangladesh ($1.26 billion).

[53] The gravity model has been used extensively in empirical international trade since it was introduced by Tinbergen (1962), who pointed out that empirically trade between two countries was determined by their relative masses and their distance from each other. Over time, this model has been used largely in explaining the effects of different policies and other determinants of trade flows, with the key variables of economic size and distance. Its popularity in empirical research increased rapidly with the introduction of "theoretical" gravity by Anderson and van Wincoop (2003), which has become the de facto standard in empirical work. For more details, see De, 2009.

[54] Gravity analysis has significant limitations. Climate-smart goods defined even at the HS 6-digit level still encompass broad categories. There may be products within the group that may or may not be used for climate change mitigation, or there may be items with "dual use". Tariff liberalization may tend to liberalize goods trade for all subcategories within these broad groups, which may not be desirable for many countries. It is sometimes suggested that tariff liberalization could focus on products with predominantly single environmental use, with a view to minimizing problems related to multiple-use products. Countries that do not have capacities to produce the entire range of CSGTs may focus on liberalizing imports of finished products (such as solar PV modules and wind turbines) that have clear environmental benefits. The present analysis does not take into account input processes used to produce observed clean technologies and components. For example, aluminium pipes can be based on coal-generated electricity or entirely on coal-based processes.

Since tariff reductions are often taken as providing the most important impetus to trade, it makes sense to analyse the impact on CSGT trade (in the region as well as between the region and the rest of the world) of a reduction in tariff rates on CSGTs. Regression results reveal that tariffs tend not to have a significant impact on imports. However, this result does not tell the whole story. Trade in CSGTs in its nature is predominantly a components trade (inputs to cleaner technologies) and thus is also associated with the transfer of, and investment in new technologies. Those developing countries that have a sufficiently large domestic market to develop cost-effective manufacturing capacities at different stages of the supply chain may be more interested in liberalizing imports of certain intermediate products (such as solar cells, silicon ingots, gear boxes and electronic control equipment).

Economic size, distance, resource endowments and tariffs are traditionally listed as the most important factors in determining trade patterns between countries. Higher incomes are traditionally used as indicators of higher level of development and often are associated with more mature institutions and governance and, therefore, governments that are able to design (more effective) legislation to mitigate climate change. Higher incomes imply larger demand for climate-smart components of cleaner technologies (based on knowledge from research on the environmental Kuznets curve). Higher incomes also allow for more resources being available for cleaner technologies, higher R&D expenditure for clean technologies and better infrastructure. Economies with higher incomes as well as the right policy and regulatory environment are also attractive as destinations for climate-smart FDI. However, in many developing countries a number of non-technological and economic factors stand in the way of deployment of cleaner technologies. These include insufficient technical knowledge and absorption capacity to produce innovative technologies locally, insufficient market size to justify local production units, and insufficient purchasing power and financial resources to acquire these innovative products (Jha, 2008).

The extended gravity model (Mathur, 2011) shows a weak positive impact of regional trade agreements, mitigation policy and infrastructure on import of CSGTs. Perhaps an inclusion of variables such as carbon taxation and domestic regulations would improve the model's explanatory power. Other possible variables including environmental subsidies, funding of environmental research projects, degree of industrialization, privatization and deregulation of markets, domestic standards and certification requirements, and domestic policies related to IPR, all of which could potentially improve the model. However data on such possibly useful variables are not available for a sufficient number of countries in the region. In addition, from the analysis it appears that language, domestic regulations, and the level of certifications and standards could play a particularly important role in stimulating trade in CSGTs. However, the analysis also shows that tariffs do not appear to play a huge role in determining trade in CSGTs.

Annexes

Annex 1. ESCAP list of climate-smart goods and technologies

A global consensus on a list of climate-friendly or climate-smart goods and services has proved elusive so far. The debate is currently part of a wider debate on defining environmental goods and services within the framework of the Doha Round of multilateral trade negotiations under WTO. The genesis of WTO work on liberalizing trade in CSGs lies in the 1994 Ministerial Decision on Trade and Environment, which established the WTO Committee on Trade and Environment that is currently considering issues relevant to expanding trade in environmental and climate-smart goods. Issues pertaining to environmental services have been dealt with separately in the WTO Council for Trade in Services.

On 14 November 2001, the Doha Ministerial Declaration was adopted. Under its Trade and Environment section, paragraph 31, an agreement was made to negotiate "the reduction or, as appropriate, elimination of tariff and non-tariff barriers to environmental goods and services" (WTO, 2001). In September 2002, the Non-Agricultural Market Access Negotiating Group, and, soon after, the Committee on Trade and Environment Special Session meeting received two lists identifying specific environmental goods. OECD and APEC had developed these lists separately – although some coordination took place – for different purposes during the 1990s.

The OECD list was created by the OECD/Eurostat Informal Working Group and the Joint Working Party on Trade and Environment in an effort to analytically identify the "scope of the environmental industry" (Steenblik, 2005; page 3). Work on the list was finished in 1998 and it was published in 1999 in the Joint Working Party on Trade and Environment Working Paper as well as the final report of the OECD/Eurostat Informal Working Group. The first agreed-upon definition of the environmental industry was:

> "The environmental goods and services industry consists of activities that produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk, and minimize pollution and resource use."

Due to a lack of a consensus on the methodology for measuring the environmental contribution of cleaner technologies, products and services at the time, the list did not comprise goods defined on their relevance to enhancing energy efficiency. It did, however, classify goods according to 6-digit HS trade nomenclature product codes. This classification could be used for the development of modalities for trade liberalization. There were three main groups: (a) pollution management (air pollution control, wastewater management, solid waste management, remediation and cleanup, noise and vibration abatement, environmental monitoring, analysis and assessment); (b) cleaner technologies and products (cleaner/resource efficient technologies and processes, cleaner/resource efficient products); and

(c) resources management (indoor air pollution control, water supply, recycled materials, RE plants, heat/energy savings and management, sustainable agriculture and fisheries, sustainable forestry, natural risk management, eco-tourism and others). In total, the OECD list contained 164 HS sub-headings, of which 132 were unique.

Utilizing a methodology similar to request-offer procedures conducted in international trade negotiations, the APEC list initially called for nominations for specific environmental goods that would eventually be entered into an agreed-upon classification system. The aim of this exercise was to achieve more favourable tariff treatment of goods contained in the list. As such, the APEC list was inherently more politically acceptable and relevant to trade liberalization than the OECD list. However, despite the lack of political consensus, the OECD list still probably provides a more comprehensive coverage of environmental products, and has often been used as a point of reference in the creation of more recent proposed lists.

With specific reference to the need to address climate change based on UNFCCC and IEA findings, in January 2003 the State of Qatar submitted a list for discussion in WTO that contained natural gas fuel cell technologies, chemical gas to liquid fuels and gas turbines combined cycle power generation.

As an alternative to the list approach to liberalization, in June 2005 India proposed a project-based method, whereby projects would have to be reviewed and individually approved by a designated national authority to ensure that they met specified criteria set by the WTO Committee on Trade and Environment. Later in the same year, Argentina put forth an integrated approach, which was similar in nature to the project-based approach but which also required the identification the goods to be utilized in each project.

In April of 2007, the Friends of Environmental Goods and Services Group – which includes Canada, the European Union, Japan, New Zealand, Norway, the Republic of Korea, Switzerland, Taiwan Province of China and the United States – submitted a list of 153 environmental goods for examination in WTO. This list included items relevant to climate change mitigation such as heat/energy management and RE products. Within the same year, two members of FEGSG (the United States and the European Union) proposed the elimination of tariffs by 2013 on 43 products that had been identified by the World Bank as climate-friendly (relevant to climate change mitigation) and had been derived from the previously submitted FEGSG 153-product list. The rational for such a list was that “a narrower choice of climate-friendly products… would be… (more)… acceptable to a broader range of countries, rather than a broader range of goods that would be acceptable to only a few countries” (World Bank, 2008). In line with the principle of special and differential treatment, under this proposal developing countries would be allowed longer phase-in periods, and least developed countries the possibility to opt out. The list covered an extensive array of products that could contribute to climate change mitigation, e.g. towers for wind turbines, solar driven stoves and hydraulic turbines. Subsequent to this submission, the European Union and the United States also advocated an Environmental Goods and Services Agreement, under a framework similar to the Information Technology Agreement, which encompassed a large array of both climate change and non-climate change-related goods and services.

As there has been little progress in concluding an agreement in the Doha Round on liberalizing environmental or climate-friendly goods and services, various discussions on bilateral and/or multilateral proposals for liberalization have been gaining momentum, most notably between the European Union and the United States. If WTO negotiations are unable to overcome this stalemate, bilateral and multilateral liberalization may be the second-best option. Nevertheless, the myriad submissions at the WTO Special Session of the Committee on Trade and Environment from member countries such as Argentina, Brazil, Qatar and Singapore in early July 2010 speaks of the desire to salvage the Doha Round and push forward with liberalization.

ICTSD has been spearheading the thematic research on issues pertaining to liberalizing climate-friendly environmental goods and services. Its work – in close coordination with WTO, WCO and UNFCCC – has sought to map technologies by HS code for specific climate-relevant sectors, including RE, buildings and, most recently, transport. Regardless of the outcome of WTO negotiations, this work provides policymakers with a reference point for identifying CSGTs.[55]

Without prejudging the outcome of the negotiations on liberalizing environmental goods in general, and climate-smart goods in particular, this study offers a new list of CSGTs for the simple purpose of facilitating the analysis of trade and climate-change linkages. The list is produced by defining concordance series from lists prepared by APEC, ICTSD, OECD, the World Bank and WTO. The ESCAP list proposes an additional 21 products that appeared on one of the recent ICTSD lists (renewables and buildings) and also on one (or more) of the APEC, OECD or WTO lists. In total, the list comprises 64 CSGTs classified by the Harmonized Commodity Description and Coding System (HS) 2002 codes at the 6-digit level of the Harmonized System.[56] The table below provides a detailed description of each good and its corresponding HS code.

Following the World Bank (2008) approach, these 64 CSGTs comprise four groups of climate-smart energy technologies: clean coal technologies (containing HS code 840510, 841181 and 841182); energy-efficient lighting (HS code 853931); and two RETs – wind power generation technologies (HS code 848340 and 848360) and solar photovoltaic systems (HS code 850720, 853710 and 854140). A remaining category of CSGTs called “other codes” includes all HS codes not included in the four groups above. The 64 CSGTs are used for trade analysis only. With regard to investment (chapter 4), the analysis was made for a slightly larger group of CSTs.

The term “climate-smart” was chosen over the more common term “climate-friendly” to show that many goods/technologies contained within the ESCAP list are not only “friendly” to climate (i.e. assist in climate change mitigation efforts by reducing GHG emissions), but also have no negative effects on the environment and/or help to address environmental problems such as conserving water or the need to improve access to energy. They are also smart in that they are (at least, potentially) economically efficient and acceptable, and are

[55] For example, see Vossenaar and Jha, 2010.

[56] HS 2002 nomenclature is used for the analysis of trade trends for 2002-2008.

therefore traded. Biofuels are not considered climate-smart as they may negatively affect food supplies while their production may involve GHG emissions. However, as biofuels are popular in various Asian-Pacific countries as an alternative to fossil fuels, and are therefore widely promoted, a small section in chapter 4 is devoted to this category of energy sources.

No.	HS 6-digit (2002)	Definition
1	380210	Activated carbon
2	392690	Articles of plastics and arts. of other materials of 39.01-39.14, n.e.s. in Ch. 39
3	392010	PVC or polyethylene plastic membrane systems to provide an impermeable base for landfill sites and protect soil under gas stations, oil refineries, etc. from infiltration by pollutants and for reinforcement of soil.
4	560314	Non-wovens, whether or not impregnated, coated, covered or laminated, of manmade filaments; weighing more than 150 g/m^2 for filtering wastewater.
5	701931	Thin sheets (voiles), webs, mats, mattresses, boards and similar non-woven products.
6	730820	Towers and lattice masts for wind turbines.
7	730900	Containers of any material, of any form, for liquid or solid waste, including municipal or dangerous waste.
8	732111	Solar-driven stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.
9	732190	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.
10	732490	Water-saving showers.
11	761100	Aluminium reservoirs, tanks, vats and similar containers for any material (specifically tanks or vats for anaerobic digesters for biomass gasification).
12	761290	Containers of any material, of any form, for liquid or solid waste, including municipal or dangerous waste.
13	840219	Vapour-generating boilers, not elsewhere specified or included, hybrids.
14	840290	Super-heated water boilers and parts of steam-generating boilers.
15	840410	Auxiliary plants for steam, water and central boilers.
16	840490	Parts for auxiliary plant for boilers, condensers for steam, vapour power unit.
17	840510	Producer of gas or water gas generators, with or without purifiers.
18	840681	Turbines, steam and other vapours, more than 40 MW, not elsewhere specified or included.
19	841011	Hydraulic turbines and water wheels of a power not exceeding 1,000 kW.

No.	HS 6-digit (2002)	Definition
20	841090	Hydraulic turbines and water wheels; parts, including regulators.
21	841181	Gas turbines of a power not exceeding 5,000 kW.
22	841182	Gas turbines of a power exceeding 5,000 kW.
23	841581	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps).
24	841861	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps).
25	841869	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps).
26	841919	Solar boiler (water heater).
27	841940	Distilling or rectifying plants.
28	841950	Solar collector and solar system controller, heat exchanger.
29	841989	Machinery, plant or laboratory equipment whether or not electrically heated (excluding furnaces, ovens etc.) for treatment of materials by a process involving a change of temperature.
30	841990	Medical, surgical or laboratory stabilizers.
31	848340	Gears and gearing and other speed changers (specifically for wind turbines).
32	848360	Clutches and universal joints (specifically for wind turbines).
33	850161	AC generators not exceeding 75 kVA (specifically for all electricity-generating renewable energy plants).
34	850162	AC generators exceeding 75 kVA but not 375 kVA (specifically for all electricity-generating renewable energy plants).
35	850163	AC generators not exceeding 375 kVA but not 750 kVA (specifically for all electricity-generating renewable energy plants).
36	850164	AC generators exceeding 750 kVA (specifically for all electricity-generating renewable energy plants).
37	850231	Electric generating sets and rotary converters; wind-powered.
38	850680	Fuel cells using hydrogen or hydrogen-containing fuels such as methane to produce an electric current, through an electrochemical process rather than combustion.
39	850720	Other lead acid accumulators.
40	853710	Photovoltaic system controller.
41	853931	Discharge lamps (excluding ultraviolet), fluorescent.
42	854140	Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes.
43	900190	Mirrors of other than glass (specifically for solar concentrator systems).
44	900290	Mirrors of glass (specifically for solar concentrator systems).
45	903210	Thermostats.
46	903220	Manostats.
47	700800	Multiple-walled insulating units of glass.

No.	HS 6-digit (2002)	Definition
48	730431	Tubes, pipes and hollow profiles (excl. of 7304.10-7304.29), seamless, of circular cross-section, of cold-drawn/cold-rolled (cold-reduced) steel.
49	730441	Tubes, pipes and hollow profiles (excl. of 7304.10-7304.39), seamless, of circular cross-section, of stainless steel, cold-drawn/cold-rolled (cold-reduced).
50	730451	Tubes, pipes and hollow profiles (excl. of 7304.10-7304.49), seamless, of circular cross-section, of alloy steel other than stainless steel, cold-drawn/cold-rolled (cold-reduced).
51	840682	Steam turbines and other vapour turbines (excl. those for marine propulsion), of an output not >40 MW.
52	841012	Hydraulic turbines and water wheels, of a power >1,000 kW but not >10,000 kW.
53	841013	Hydraulic turbines and water wheels, of a power >10,000 kW.
54	850239	Electric generating sets n.e.s. in 85.02.
55	850300	Parts suitable for use solely/principally with the machines of 85.01/ 85.02.
56	850440	Static converters.
57	902830	Electricity meters, incl. calibrating meters therefore.
58	903020	Cathode-ray oscilloscopes and cathode-ray oscillographs.
59	903031	Multimeters.
60	903039	Instruments and app. for measuring/checking voltage/current/resistance/ power (excl. 9030.31), without a recording device.
61	890790	Floating structures other than inflatable rafts (e.g. rafts (excl. inflatable), tanks, coffer-dams, landing-stages, buoys and beacons).
62	847989	Machines and mech. applications having individual functions, n.e.s./included in Ch. 84.
63	842129	Filtering/purifying mach. and app. for liquids (excl. of 8421. 21-8421.23).
64	842139	Filtering/purifying mach. and app. for gases, other than intake air filters for int. comb. engines.

Annex 2. Gravity model methodology and data used

ESCAP has created a simple gravity model to estimate the export potential trade of CSGTs in the Asia-Pacific region. The following gravity model was used for the analysis:

$$X_{ij} = \beta_0 + \beta_1 GDP_i + \beta_2 GDP_j + \beta_3 PCGDP_i + \beta_4 PCGDP_j + \beta_5 DT_{ij} + \beta_6 D_{contig}$$
$$+ \beta_7 D_{comlang} + \beta_8 D_{comlang\_ethno} + \beta_9 D_{colony} + \beta_{10} D_{comcol} + \beta_{11} D_{col45} + \beta_{12} D_{smctry} + \varepsilon_{ij}$$

where: X_{ij} denotes the value of country *i* exports to country *j*, GDP_i and $PCGDP_i$ denote the exporting country's GDP and per capita GDP, respectively; GDP_j and $PCGDP_j$ denote the GDP and per capita GDP of the partner of the exporting country, respectively; DT_{ij} denotes the distance between the exporting economy and its partner; D_{contig} , $D_{comlang}$, $D_{comlang\_ethno}$, D_{colony} , D_{comcol} , D_{col45} *and* D_{smctry} are the dummy variables for contiguity, common language, colony, common colony, colony from 1945 and small country, respectively. All of these variables (except for dummies) are in log values to overcome a heteroscedasticity problem.

Trade data for CSGTs (in thousands of United States dollars) are taken from the United Nations Comtrade database (www.comtrade.un.org) for 2008. GDP and per capita GDP data are taken from the World Bank Development Indicators (www.worldbank.org\data) for the same year. Distance between countries and other dummy variables are taken from the dist_cepii.xls file of CEPII database (www.cepii.fr). The total observation is reduced after combining all the variables for each pair of trading partners.[57] This filtered data set is used in the empirical analysis. The estimated coefficients and their statistic results are presented in annex table 1.

[57] This study considers fully-matched data only.

Annex table 1. Results of the trade gravity model for exports of climate-smart goods in 2008

	Coefficients	Standard error	T	P-value
Intercept	**-49.2722**[a]	1.717189	**-28.6935**	6.7E-156
GDP_reporter	**1.605207**[a]	0.045923	**34.95458**	1.1E-216
GDP_partner	**0.940022**[a]	0.035135	**26.75493**	3.3E-138
pcgdp_reporter	**-0.28074**[a]	0.052835	**-5.31359**	1.17E-07
pcgdp_partner	-0.07698	0.051787	-1.48651	0.137275
distw	**-0.9346**[a]	0.105363	**-8.87032**	1.39E-18
contig	0.142705	0.439915	0.324391	0.74567
comlang_off	0.017709	0.356485	0.049675	0.960385
comlang_ethno	0.576956[c]	0.314579	1.83406	0.066769
colony	0.83704	0.786272	1.064568	0.287179
comcol	**0.689932**[a]	0.246621	**2.797538**	0.00519
col45	1.12345	0.947884	1.185219	0.236048
smctry	**2.995375**[a]	0.79718	**3.757463**	0.000176

[a] = 1 per cent, [b] = 5 per cent and [c] = 10 per cent.

Considering only statistically significant coefficients, the estimated export of CSGTs is:

$$X_{ij} = -49.27 + 1.605\ GDP_i + 0.94\ GDP_j - 0.28\ pcgdp_i - 0.93\ DT_{ij}$$
$$+ 0.69\ D_{comcol} + 2.99\ D_{smctry}$$

This estimated gravity equation is then used to get the predicted export value of the reporting economy in the data period. The difference between the actual exports and the predicted value is considered as the “trade potential” of the observed period. A positive trade potential suggests that there is scope for an economy to increase its exports of CSGTs with a particular trading partner during that period.

Annex table 2. Share of total CSGT exports by Asia-Pacific economies, 2002 and 2009

Economy	Export share 2002 (per cent)	CSGT exports to world, 2002 ($ million)	Rank 2002
Japan	4.01	1 670.89	1
Hong Kong, China	2.56	516.73	2
China	2.27	739.43	3
Republic of Korea	2.06	334.21	4
Singapore	1.65	207.03	5
Malaysia	1.63	153.32	6
Thailand	1.59	108.32	7
New Zealand	1.10	15.79	8
Turkey	1.08	38.47	9
Sri Lanka	0.59	2.80	10
Russian Federation	0.57	60.42	11
Australia	0.51	33.03	12
Fiji	0.38	0.20	13
Macao, China	0.23	0.53	14
Papua New Guinea	0.15	0.25	15
Bangladesh	0.08	0.41	16
Mongolia	0.00	0.00	17
Asia and the Pacific	2.51	36 309.45	
APTA	2.20	10 947.39	
ASEAN	1.94	5 563.57	
SAARC	0.31	31.06	

Economy	Export share 2009 (per cent)	CSGT exports to world, 2009 ($ million)	Rank 2009
Japan	5.35	31 083.46	1
China	3.78	45 375.88	2
Republic of Korea	2.96	10 767.70	3
Philippines	2.52	968.00	4
Malaysia	2.45	3 854.03	5
New Caledonia	2.30	47.96	6
Thailand	1.93	2 947.32	7
India	1.83	31 083.46	8
Singapore	1.81	4 892.00	9
Turkey	1.56	1 596.95	10
Viet Nam	1.11	632.39	11
Macao, China	0.90	3.36	12
New Zealand	0.87	207.15	13
Sri Lanka	0.85	60.58	14
Australia	0.57	878.36	15
Kyrgyzstan	0.54	6.35	16
Armenia	0.50	2.94	17
French Polynesia	0.45	0.67	18
Hong Kong, China	0.44	73.76	19
Russian Federation	0.35	1 043.15	20
Fiji	0.13	0.60	21
Nepal	0.12	1.03	22
Pakistan	0.10	17.93	23
Kazakhstan	0.06	24.94	24
Samoa	0.01	0.01	25
Azerbaijan	0.01	1.36	26
Bhutan	0.00	0.00	
Asia and the Pacific	2.92	107 723.40	
APTA	3.40	59 439.68	
ASEAN	1.97	13 293.74	
SAARC	1.63	3 315.07	

Source: ESCAP calculations from United Nations Commodity Trade Statistics in WITS. Note that the table does not show total exports from each country and region.

Annex table 3. Share of total imports of CSGTs of Asia-Pacific economies, 2002 and 2009

Economy	Import share 2002 (per cent)	CSGT imports 2002 ($ million)	Rank 2002	Economy	Import share 2009 (per cent)	CSGT imports 2009 ($ million)	Rank 2009
Papua New Guinea	4.05	4.80	1	Azerbaijan	7.07	432.62	1
China	3.60	1 063.79	2	Kazakhstan	4.66	1 325.11	2
Thailand	3.25	210.37	3	Armenia	4.65	146.83	3
Turkey	3.25	166.73	4	Republic of Korea	4.42	14 289.78	4
Republic of Korea	2.96	451.00	5	Russian Federation	4.06	6 938.96	5
Malaysia	2.95	231.88	6	Thailand	3.77	4 965.71	6
Singapore	2.73	318.19	7	Pakistan	3.75	1 185.23	7
Russian Federation	2.47	114.08	8	Viet Nam	3.70	2 585.86	8
Australia	2.33	160.98	9	China	3.38	31 076.04	9
Hong Kong, China	2.30	478.38	10	Australia	3.30	5 226.92	10
Macao, China	2.00	5.06	11	Turkey	3.25	4 577.76	11
Sri Lanka	1.94	11.73	12	Malaysia	3.02	373.77	12
New Zealand	1.92	28.89	13	New Zealand	2.97	758.86	13
Fiji	1.89	1.50	14	Bhutan	2.90	15.33	14
Japan	1.80	606.92	15	French Polynesia	2.89	49.62	15
Bangladesh	1.18	10.85	16	New Caledonia	2.85	71.44	16
Asia and the Pacific	2.82	40 560.33		Hong Kong, China	2.45	8 627.16	17
APTA	3.55	15 909.43		Singapore	2.26	5 563.39	18
ASEAN	3.18	8 237.20		Nepal	2.14	80.21	19
SAARC	1.55	236.63		India	2.09	5 574.79	20
				Japan	1.96	10 792.16	21
				Fiji	1.85	26.61	22
				Sri Lanka	1.72	162.43	23
				Philippines	1.60	0.00	24
				Samoa	1.25	2.89	25
				Macao, China	1.19	54.97	26
				Kyrgyzstan	0.92	27.26	27
				Kiribati	0.57	0.39	28
				Afghanistan	0.22	7.20	29
				Asia and the Pacific	3.01	109 035.70	
				APTA	3.37	51 103.04	
				ASEAN	2.85	17 585.17	
				SAARC	2.23	7 025.19	

Source: ESCAP calculations from United Nations Commodity Trade Statistics in WITS. Note that the table does not show total imports by each country and region.

CHAPTER 4

INVESTMENT IN CLIMATE-SMART GOODS AND TECHNOLOGIES: TRENDS AND OPPORTUNITIES

Introduction

As noted in chapter 2, most global and regional GHG emissions consist of CO_2 emitted from the energy sector (production and use of energy for heating, cooling, electricity and transportation), amounting to 64 per cent of global GHG emissions. However, if emissions from electricity generation and heat are allocated to the consuming (rather than producing) sectors, then the manufacturing and construction sectors clearly emerge as the largest emitters, at 37 per cent of global CO_2 emissions in 2008. Transport is the second highest emitter, with 23 per cent of global emissions, mostly from on-road transport, followed by residential use at 18 per cent (IEA, 2010a).

Reducing emissions will require major investments in power generation, manufacturing, transport and buildings

It is obvious that reducing emissions will require major investments in power generation and distribution, manufacturing, transport and buildings. Investments to improve energy efficiency will form a large part of this. While preferably all such investments should be tracked, due to limitations in the availability of data, the overview of current investment levels in section A only covers new financial investments in sustainable energy, including: RE investment (but excludes investment in large hydro-power energy); financial investments (venture capital and private equity) in energy efficiency; and corporate and public R&D. However, it does not include energy efficiency projects by governments, companies and public financing institutions.[58] There are no available data on FDI at this level of detail. Thus, the analysis in this chapter only focuses on overall (financial) investment levels, detailed as much as possible by region or country.

Section A provides an overview of the current trends in RE investment, both globally and regionally. Section B provides a more in-depth analysis of investment trends in selected RETs. Section C, which takes a wider approach to investment and looks at investment in all sectors, outlines the scale of future investment needs, both globally and in the Asia-Pacific region. The focus is on additional investment needs, above and beyond current investments. Section D discusses the need for urgent action while section E discusses the likely business opportunities arising from the need to de-carbonize the power, industry, transport and buildings sectors.

[58] Thus, although difficult to measure, actual investments in energy efficiency should be much higher than recorded here.

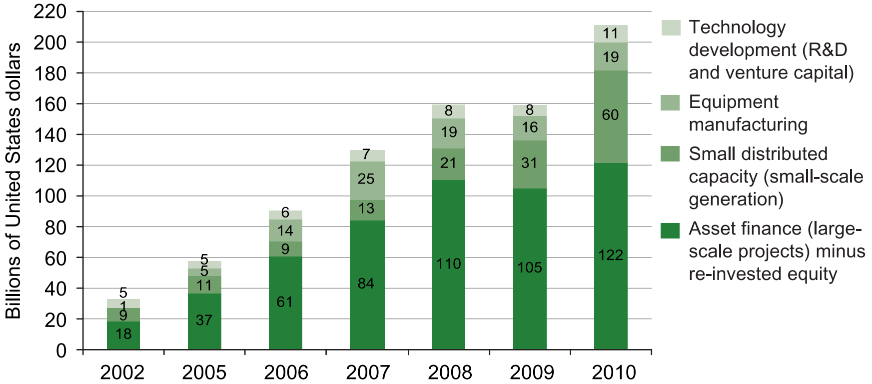
A. Trends in investment in renewable energy

1. Global trends in renewable energy investments[59]

Global investments in RE reached $211 billion in 2010, up from $160 billion in 2009, representing a nearly seven-fold increase since 2004 (figure I.20).

Figure I.20. Global new investment in renewable energy

(Billions of United States dollars per year)



Source: UNEP/Bloomberg New Energy Finance, 2011.

Notes: Large hydro-power projects not included. Total values include estimates for undisclosed deals.

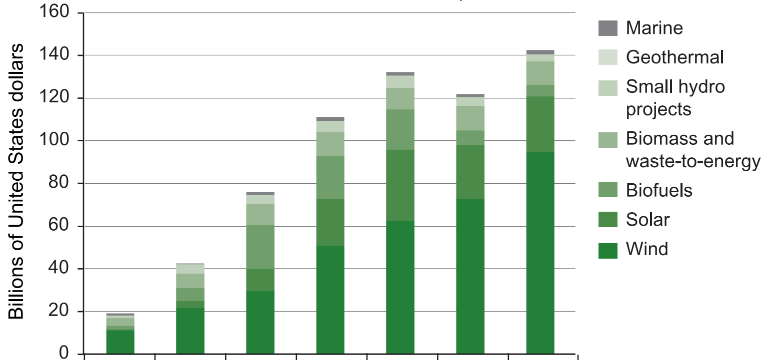
As figure I.21 shows, the majority of global new investments in RE projects (excluding small distributed capacity) in 2010 went to the wind sector (66 per cent of investments), followed by solar energy (18 per cent), and biomass and waste (8 per cent). If small-scale generated capacity is added, the proportion of solar energy in total RE investments rises substantially to $86 billion in 2010 (43 per cent).

One explanation for the high share of investments in wind energy is that it is already commercially competitive today in places where wind is strong and the cost of carbon is reflected in market prices. In the future, the costs of wind energy production are expected to

[59] Most of the data in this section have been sourced from two publications, UNEP/Bloomberg New Energy Finance (2011) and The Pew Charitable Trusts (2011). Both publications are based on data derived from Bloomberg New Energy Finance database of investors, projects and transactions in renewable/clean energy. The coverage of the database includes all biomass, geothermal and wind generation projects of more than 1 MW, all hydro projects of between 0.5 and 50 MW (i.e. excluding large hydropower), all solar projects of more than 0.3 MW, all marine energy projects, and all biofuel projects with a capacity of 1 million litres or more per year. The main reason why the figures used in these two publications differ when reported per country and/or technology is that The Pew Charitable Trusts includes small distributed capacity in country and technology totals, whereas UNEP/Bloomberg New Energy Finance excludes that from the data reported by country and technology. For more detailed information on the data sources and methodology employed, reference is made to the two publications.

Figure I.21. New financial investment by technology

(Billions of United States dollars)



	2004	2005	2006	2007	2008	2009	2010
Marine	0.0	0.0	0.5	0.4	0.1	0.2	0.1
Geothermal	1.0	0.4	1.3	1.9	1.6	1.4	2.0
Small hydro projects	1.1	4.4	4.2	5.0	5.8	4.1	3.2
Biomass and waste-to-energy	3.7	6.7	10.0	11.4	10.1	11.5	11.0
Biofuels	1.6	6.0	20.4	20.0	18.7	6.9	5.5
Solar	0.5	3.2	10.4	21.8	33.3	25.3	26.1
Wind	11.3	21.9	29.7	51.1	62.7	72.7	94.7

Source: UNEP/SEFI/Bloomberg New Energy Finance, 2010.

Notes: Large hydro-power projects are not included. New investment volume adjusts for reinvested equity. Total values include estimates for undisclosed deals. The numbers in this figure refer to financing of projects and equipment manufacturing, but exclude small distributed capacity (i.e. small-scale projects) and technology development (R&D).

decrease further as a result of technology development and economies of scale. At the same time, and for similar reasons, the costs of solar energy are also expected to come down dramatically during the next decade, with solar energy expected to achieve "grid parity" (i.e. parity with electricity retail prices) by 2020 (IEA, 2010b).

Wind power accounts for the majority of renewable energy investments, followed by solar energy

Although first-generation biofuels witnessed a significant reduction in investment, investment in second-generation biofuels, such as algae, has grown (The Pew Charitable Trusts, 2010). This is probably due to the recent criticism that first-generation biofuels, such as ethanol, drive food prices up; in addition, in some cases, such biofuels can be more carbon-intensive than fossil fuels, in part as a result from the land-use change incurred in plantation expansion. However, most investment in second-generation biofuels tends to rely heavily on government spending.

As shown in table I.12, several ESCAP members were among the major investors in RE globally. The best performer overall was China, which topped the list in overall investment in installed RE capacity as well as in the five-year growth in installed RE capacity. China also came third in investment intensity (defined as RE investments as share of GDP) and fifth in five-year growth in RE investment. Together with China, both India and Japan are among the world's top seven countries in terms of installed RE capacity. Other countries in Asia and the Pacific region that are included in the top 10 G-20 performers include Australia, Indonesia, the Republic of Korea and Turkey.

Table I.12. G-20 top 10 performers in investment in renewable energy, 2010

Investment (billions of United States dollars)		Investment intensity (percentage of GDP)		Five-year growth in RE investment 2005-2010 (percentage)		Installed RE capacity (GW)		Five-year growth in RE capacity (percentage)	
China	**54.4**	Germany	1.40	**Turkey**	**190**	**China**	**103.36**	**China**	**106**
Germany	41.2	Italy	0.79	Argentina	115	United States	57.99	**Republic of Korea**	**88**
United States	34.0	**China**	**0.55**	South Africa	94	Germany	48.86	**Turkey**	**85**
Italy	13.9	Canada	0.42	**Indonesia**	**89**	RoEU-27	39.80	Germany	67
RoEU-27	13.4	**Australia**	**0.37**	**China**	**88**	Spain	27.78	RoEU-27	45
Brazil	7.6	Spain	0.36	Brazil	81	**Japan**	**25.96**	Italy	45
Canada	5.6	Brazil	0.35	Mexico	74	**India**	**18.65**	**Japan**	**45**
Spain	4.9	RoEU-27	**0.30**	Italy	71	Italy	16.66	Brazil	42
France	4.0	United States	0.23	**Republic of Korea**	**62**	Brazil	13.84	France	42
India	**4.0**	France	0.15	RoEU-27	62	France	9.57	Spain	39

Source: Adapted from The Pew Charitable Trusts, 2011.

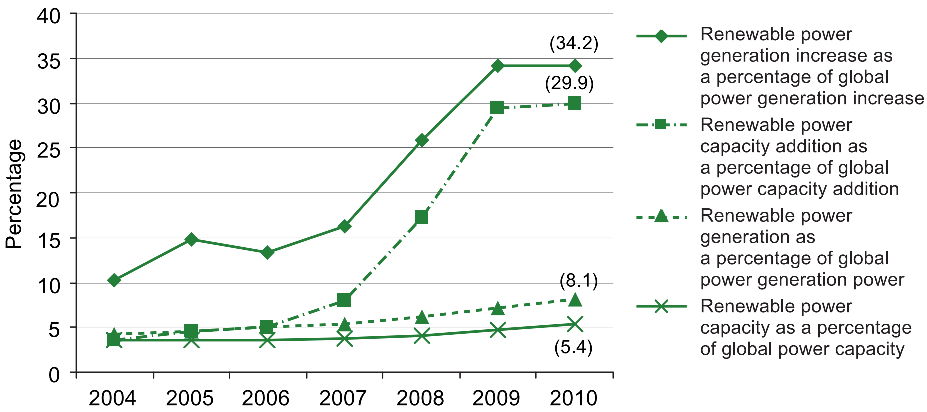
Notes: RoEU-27 refers to the rest of the European Union-27.

Total investment figures in this publication vary from the ones in UNEP/Bloomberg New Energy Finance, 2011, although they use the same database. The difference is likely due to the inclusion of small distributed capacity (small-scale projects) in this source, while they were excluded from the figures reported above in UNEP/Bloomberg New Energy Finance.

Renewable energy still accounts for a small share of overall energy capacity both globally and regionally, but its share is growing

Consistently high levels of investments in the RE sector have been driving global capacity expansion, which rose by 60 GW in 2010, representing approximately 34 per cent of global power capacity additions. This compares well with increases in other energy sources, which in 2010 stood at 92 GW for conventional thermal (coal, gas and oil), 5 GW for nuclear and 24 GW for hydroelectric including pumped storage. Total RE capacity (excluding large hydro-power projects) currently stands at approximately 388 GW worldwide. More than half of the installed clean energy capacity globally, as of 2010, was in wind energy (193 GW), followed by small hydro-power projects (80 GW), bio-mass and waste-to-energy (i.e. energy from waste) (65 GW) and solar energy (43 GW) (UNEP/Bloomberg New Energy Finance, 2011; and The Pew Charitable Trusts, 2011). As a result of this continuous expansion, renewable power generation currently accounts for about 8 per cent of global power generation, up from 5 per cent in 2006, while RE capacity stands at 5.4 per cent of global power capacity (figure I.22).

Figure I.22. Renewable power generation[a] and capacity as a proportion of global power generation



Source: UNEP/Bloomberg New Energy Finance, 2011.

[a] Excluding large hydro-power projects. Renewable energy capacity figures are based on Bloomberg New Energy Finance global totals.

2. Regional trends in renewable energy investments

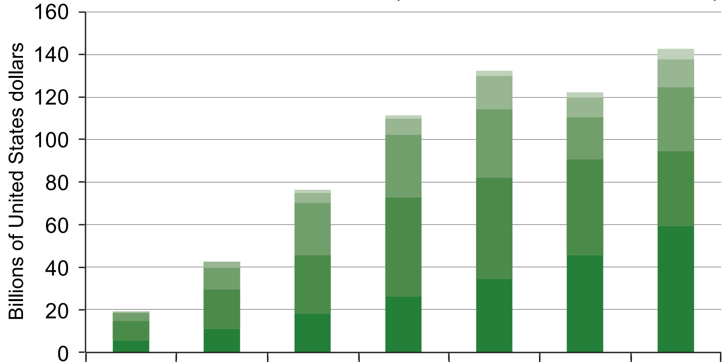
Renewable energy investments in Asia and the Pacific increased by 30 per cent in 2010, but fell by 22 per cent in Europe (figure I.23). China accounted for most of the RE investments and investment growth in the region, with a growth rate in RE investments of 28 per cent in 2010, to reach $48.9 billion.

China leads sustainable energy investments, both globally and in Asia and the Pacific

China has thus become the clear leader in RE investments, both globally and in the region, accounting for 22-34 per cent of all RE investments globally (depending on whether small distributed capacity is included) or 82 per cent of RE investments in Asia and the Pacific (figures I.24 and I.25). Other countries in Asia and the Pacific lag far behind, with India a distant second at $3.8 billion in investments in 2010, representing 2.7 per cent of global investments or 6 per cent of investments in the region.

Figure I.23. New financial investments in sustainable energy, by region, 2004-2010

(Billions of United States dollars)



	2004	2005	2006	2007	2008	2009	2010
Middle East and Africa	0.3	0.1	1.5	1.5	2.4	2.4	5.0
South America	0.5	2.8	4.7	7.7	15.7	9.4	13.1
North America	3.8	10.3	24.6	29.4	32.3	19.7	30.1
Europe	9.0	18.4	27.3	46.6	47.6	45.0	35.2
Asia and Oceania	5.6	11.0	18.3	26.2	34.4	45.7	59.3

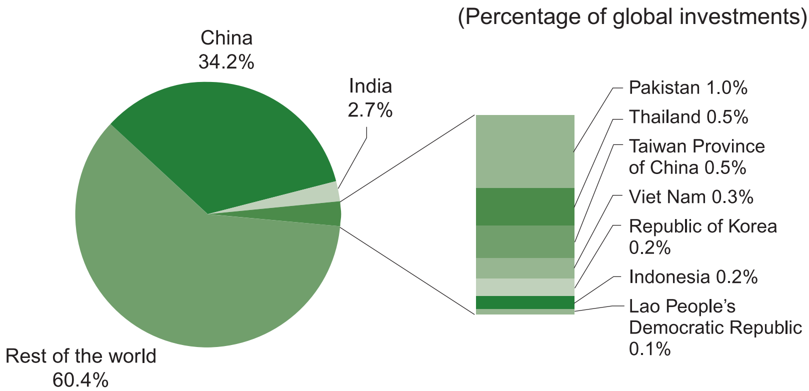
Source: UNEP/Bloomberg New Energy Finance, 2011.

Notes: Large hydro-power projects are not included. New investment volume is adjusted for reinvested equity. Total values include estimates for undisclosed deals. The numbers in this figure refer to financing of projects and equipment manufacturing, but exclude small distributed capacity (i.e. small-scale projects), and government and corporate R&D.

New financial investment in RE in Asia, excluding China and India, increased from \$3 billion to \$4 billion in 2010, largely due to strong performances by Pakistan and Thailand. Estimated investment in Pakistan tripled to \$1.5 billion, as the country financed 850 MW of new wind-energy capacity across 16 projects. In Thailand, RE investment rose more than four-fold (320 per cent) to \$700 million, as the country funded 195 MW of new capacity through nine projects. Other developing economies in Asia and the Pacific with new financial investments of more than \$100 million in RE included Taiwan Province of China (\$666 million), Viet Nam (\$380 million), Indonesia (\$250 million) and the Lao People's Democratic Republic (\$100 million) (UNEP/Bloomberg New Energy Finance, 2011). Among the developed countries, Australia and Japan each invested some \$3.3-3.5 billion, with a large part of the investments going to small distributed capacity (\$3.3 billion out of \$3.5 billon in the case of Japan, and \$0.9 billion out of \$3.3 billion in Australia).

Distribution of RE investments by technology during 2005-2010 varied considerably between countries (figure I.25). Wind energy attracted most of the RE investment (as a percentage of total investment), not only globally but in most G-20 ESCAP countries, including Australia, China, India and Turkey. Solar energy garnered the vast majority of RE investments in Japan (72 per cent) and the Republic of Korea (69 per cent). In Indonesia, almost all RE investment has been directed to geothermal energy, of which the country has an installed capacity of 1.19 GW, second among G-20 members.

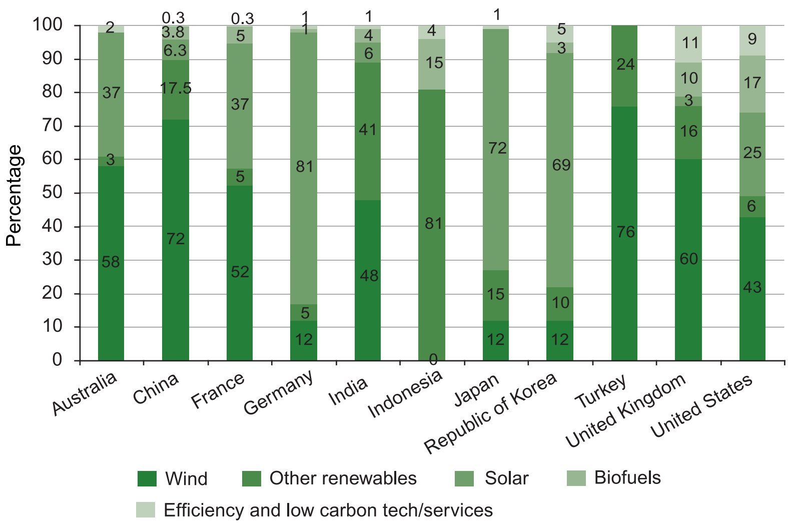
Figure I.24. New financial investment in renewable energy in developing Asia, 2010



Source: UNEP/Bloomberg New Energy Finance, 2011.

Notes: Large hydro-power projects not included. New investment volume adjusted for reinvested equity. Total values include estimates for undisclosed deals. The numbers in this figure refer to financing of projects and equipment manufacturing, but exclude small distributed capacity (i.e. small-scale projects), and technology development (R&D).

Figure I.25. Distribution of renewable energy investment, by sector, for selected G-20 countries (as a percentage of total renewable energy investment), 2005-2010



Source: The Pew Charitable Trusts, 2011.

Note: Although the Russian Federation is a G-20 member, the table does not include data for that country due to very small levels of investment.

Installed RE capacity in the Asia-Pacific region in 2010 rose to 103.4 GW in China (27 per cent of the G-20 total installed RE capacity), 26 GW in Japan, 18.7 GW in India, 4 GW in Australia, 1.42 GW in Turkey, 1.2 GW in the Republic of Korea and 1 GW in Indonesia (table I.13).

Table I.13. Installed renewable energy in selected G-20 Asia-Pacific countries, 2010

Country	Total RE capacity in 2010 (GW)	Proportion of G-20 total (per cent)	Five-year growth in RE capacity (per cent)	RE Investments in 2010[a] (billions of United States dollars)
Australia	4	0.8	18	3.3
China	103	27.0	106	54.4
India	18.7	5.0	31	4.0
Indonesia	1	0.3	7	0.25
Japan	26	7.0	45	3.5
Republic of Korea	1.2	0.3	88	0.36
Turkey	1.42	0.3	85	1.2

Source: The Pew Charitable Trusts, 2011.

Note: Despite being a G-20 member, separate data for the Russian Federation are not included due to the very small level of investment.

[a] Investment levels are higher in The Pew Charitable Trusts (2011) than in UNEP/Bloomberg New Energy Finance (2011), although the two publications use the same dataset as a base (i.e. Bloomberg New Energy Finance desktop database). The reason is that the former includes small distributed capacity (i.e. small-scale projects, mainly solar energy) while the latter does not include small-scale projects in its figures.

B. Special focus: a closer look at investment trends in selected climate-smart technologies

1. Wind energy technologies

Wind power and turbine production has experienced stupendous growth during recent years and is now one of the most widespread forms of climate-smart technologies. There are many different types and styles of wind turbines available in the market, such as: small-scale units (under 3 kW) used for direct use, pumping water or charging batteries; medium-sized units (up to 50 kW) used in grid-intertie environments[60] to generate power and to feed into the utility grid; and large-scale units (up to 6 MW) generally suited to large-scale utilities and power cooperatives and increasingly located at both on- and offshore sites.

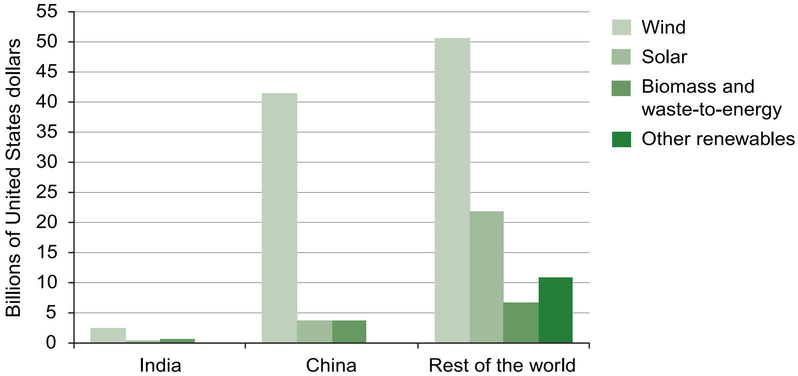
[60] Grid-intertie systems are designed for people who are “on the grid” (electricity provided from a power utility). These systems generate power and feed it directly into the power grid. Multiple options are available.

In 2010, total installed wind capacity increased by 37.6 GW to reach 197 GW at the end of the year, with a potential to generate about 2.5 per cent of global electricity demand (World Wind Energy Association, 2011). The World Wind Energy Association (2011) has estimated that global wind power capacity could reach 600 GW by 2015, and that at least 1,500 GW will have been installed globally by 2020.

In Asia and the Pacific, installed wind capacity reached 63.5 GW in 2010, accounting for 33 per cent of the global wind capacity (table I.14).[61] China was by far the largest investor in wind power, both regionally and globally in 2010, with investments totalling $41.4 billion (figure I.26), representing almost half of global wind energy investments. China's addition of 18.9 GW of new wind power capacity brought its total wind capacity to 44.7 GW, making it the global leader in total installed wind capacity (table I.14).

Figure I.26. New financial investments by China and India vis-à-vis the rest of the world, by sector, 2010

(Billions of United States dollars)



Source: UNEP/Bloomberg New Energy Finance, 2011.

Notes: Large hydro-power projects not included. New investment volume adjusted for reinvested equity. Total values include estimates for undisclosed deals. The numbers in this figure refers to financing of projects and equipment manufacturing, but excludes small distributed capacity (i.e. small-scale projects), and government and corporate R&D.

China's consistently high investments in wind energy capacity during the past few years enabled the country to overtake Germany and, more recently, the United States, to become the country with the largest wind-power capacity, globally, at 44.7 GW in December 2010 after an increase of 18.9 GW during 2010. This compares with 40.2 GW in the United States, 27.2 GW in Germany, 20.7 GW in Spain, and 13.1 GW in India (table I.14).

[61] This figure is based on country data in World Wind Energy Association, 2011.

Table I.14. Wind power capacity, selected economies, 2010

	Economy	Total wind capacity end 2010 (MW)	Share of world wind capacity (per cent)	Added capacity 2010 (MW)	Growth rate 2010 (per cent)
1	China	44 733	22.7	18 928	73
2	United States	40 180	20.4	5 600	16
3	Germany	27 215	13.8	1 551	6
4	Spain	20 676	10.5	1 527	8
5	India	13 066	6.6	1 259	11
6	Italy	5 797	2.9	950	20
7	France	5 660	2.9	1 086	24
8	United Kingdom	5 204	2.6	1 112	27
9	Canada	4 008	2.0	690	21
10	Denmark	3 734	1.9	309	9
11	Portugal	3 702	1.9	345	10
12	Japan	2 304	1.2	211	10
15	Australia	1 880	1.0	3	0
26	Taiwan Province of China	519	0.3	83	19
27	New Zealand	506	0.3	9	2
29	Republic of Korea	379	0.2	49	14
39	Iran, Islamic Republic of	100	0.1	18	22
48	Philippines	33	0.0	0	0
50	Viet Nam	31	0.0	22	253
56	Russian Federation	15	0.0	1	9
	Other Asia-Pacific	9	0.0	0	0
	Rest of the world	16 878	8.6	3 889	30
	Total	196 630		37 642	24

Source: World Wind Energy Association, 2011.

China's remarkable growth in wind power capacity is a direct result of the Government's policies aimed at developing a sustainable domestic energy supply to improve the country's energy security. This has been supported by new legislation that requires Chinese energy companies to purchase all the electricity produced by renewable sources coupled with the introduction of new feed-in-tariff legislation in 2009.

About 15 Chinese companies were manufacturing wind turbines in mid-2010 and dozens more were making components. However, these companies have thus far focused predominantly on supplying the domestic market. Developments are also underway in China to start production of the new maglev wind turbines that use magnetic levitation rather than traditional bearings in the turbine design, thus significantly increasing its efficiency in areas with low wind speeds.

The second largest Asian market for wind turbines and related parts is India, which witnessed a 7 per cent increase in installed capacity in 2010 to reach 13 GW by the end of 2010 (see table I.14), or $2.6 billion in total investments in wind energy (see figure I.26). Other Asian economies with wind energy capacity included Japan (2.3 GW), Australia (1.9 GW), Taiwan Province of China (519 MW), New Zealand (506 MW) and the Republic of Korea (379 MW). There is still major potential for other countries across the Asia-Pacific region to develop their own wind energy capabilities, particularly the Islamic Republic of Iran, Mongolia, Pakistan, the Philippines and Viet Nam.

In 2010, the top 10 wind turbine manufacturers globally produced 79.8 per cent of global wind-related manufacturing worldwide, with Chinese companies accounting for 30.5 per cent of the global total (REN21, 2011). The combined turnover of the world wind energy market reached $70 billion in 2009.

2. Solar energy technologies

Advances in solar technology have rapidly increased over the past few years and the solar photovoltaic (PV) industry continues to be one of the fastest-growing industries in the world. Currently, a wide variety of products and technologies are available to harness the power of the sun to generate RE. Companies involved in the solar power industry typically include PV equipment producers, cell manufacturers, panel manufacturers, system installers and energy service companies. During the past few years the market for solar PV technologies has witnessed growth trends in three main areas: thin-film solar PV technologies; building-integrated PV (BIPV); and utility-scale solar PV power plants (defined as larger than 200 kW). By the end of 2008 there were 1,800 utility-scale solar PV power plants throughout the world, with hundreds more under consideration or construction.

Efficiency levels for solar PV cells also continue to improve; in fact, researchers at the University of Minnesota in the United States recently discovered an alternative process to make PV cells that use tiny nano-scale crystals called quantum dots. These crystals capture more of the available energy in sunlight, thereby increasing efficiency from the present rate of about 31 per cent for conventional solar cells up to around 66 per cent. This makes solar power even more cost-competitive in relation to fossil fuels (Casey, 2010). Increased solar PV efficiency coupled with next generation flywheels that store energy mechanically as well as other energy storage devices could make solar power just as stable and reliable as oil, gas or coal. Concentrated solar power (CSP) systems have also seen tremendous growth in recent years because they are much cheaper than conventional solar PV systems. CSP systems use mirrors to focus a large area of sunlight onto a small area, similar to a magnifying glass. Sunlight is captured by PV panels or a transfer fluid, and then heated and used to generate electricity; systems such as these have great potential in developing countries.

Installed solar PV capacity reached 40 GW worldwide in 2009. With 17.3 GW of installed capacity, Germany remains the largest PV market in the world (44 per cent), largely as a consequence of their generous feed-in-tariff legislation. Germany is followed by Spain, Japan and Italy at around 3.5-3.8 GW installed capacity. Together, these four countries represent over two thirds of total worldwide solar PV installed capacity. Global installed solar heating capacity also increased by an estimated 25 GW-thermal (GWth), to reach 185 GWth in 2009. China is the largest market for solar heating, accounting for 80 per cent of added global capacity and 64 per cent of existing global installed capacity (REN21, 2011).

In Asia and the Pacific, Japan has so far been the largest investor in solar energy, adding nearly 1 GW in new installed solar energy capacity in 2010, followed by China, which added 0.6 GW (REN21, 2011). China's financial investment in solar energy (excluding small projects) reached $3.8 billion in 2010 or 15 per cent of global investments in solar energy, while India's investments were much lower at $0.5 billion or 2 per cent of global solar energy investments. The United States was the global leader in investment in solar energy in 2010, accounting for 21 per cent of global financial investments in this sector.

Both China and India have announced plans to increase their national capacity in solar power to 20 GW by 2020 (Solar Energy Industries Association, 2010), while Japan and the Republic of Korea have also begun to invest in utility-scale plants. Japan has set ambitious targets for its solar PV capacity at 28 GW by 2020 and 53 GW by 2030 (European Photovoltaic Industry Association, 2010). Much of this growth in installed capacity has been attributed to the drop in price for solar technologies. For example, solar PV modules and systems experienced a significant decrease in price in 2010 for the third year running, from $3.50-$4.00 per watt in mid-2008 to $1.30-1.80 per watt in 2010, a drop of more than 50 per cent (Solar Energy Industries Association, 2010; REN21, 2011).

Manufacturing of solar PV cells continues to be increasingly dominated by Asia. In 2010, the majority of the top 15 manufacturers were located in the region, of which seven were in China (corresponding to 29 per cent of market share), and two in Japan and Taiwan Province of China, respectively (both with a 6 per cent share). By the end of 2010, global manufacturing capacity stood at approximately 27 GW. Nearly 50 per cent of this capacity was in China, followed by Taiwan Province of China (15 per cent), the European Union (10 per cent), and Japan and the United States (both with less than 10 per cent).

3. Geothermal technologies

Geothermal resources provide energy in the form of direct heat and electricity. The energy is derived from harnessing the natural heat generated by the Earth's crust. There are three main types of geothermal power plants – dry steam, flash steam and binary cycle. Dry steam plants generate power by tapping underground sources of steam directly. Flash steam plants are the most common and utilize water spouted to the surface from underground reservoirs (geysers) where the steam is separated from the water and used to power a turbine. The condensed steam is then injected back into the reservoir, making the operation a sustainable resource. Binary cycle power plants use the heat from hot water to boil a working fluid, usually an organic compound with a low boiling point. The working fluid is then vaporized in a heat exchanger and used to power a turbine.

At the end of 2010, global geothermal capacity was 11 GW and geothermal plants worldwide generated about 67.2 TWh of electricity during the year. Geothermal power plants are in place in at least 24 countries and geothermal energy is used directly for heat in at least 78 countries (REN21, 2011). Nearly 88 per cent of this capacity is located in seven countries: the United States (3,150 MW); the Philippines (2,030 MW); Indonesia (1,200 MW); Mexico (960 MW); Italy (840 MW); New Zealand (630 MW); and Iceland (580 MW). Iceland already generates about 25 per cent of its electricity from geothermal power, while the Philippines generates about 18 per cent (REN21, 2010).

Installed geothermal capacity is expected to almost double to 18.5 GW by 2015. There is great potential for geothermal power in developing countries in Asia, where abundant high-temperature hydrothermal resources have yet to be exploited. Indonesia's National Energy Blueprint states that the country is aiming for 9,500 MW to be generated from geothermal resources by 2025, a more than 800 per cent increase from the current level (Holm and others, 2010; and REN21, 2011).

The use of geothermal energy for district heating and direct use geothermal application is increasingly being supported by government policies under broader climate initiatives (e.g. feed-in-tariffs) in many countries, consequently making their financial viability more attractive to investors.

In its Technology Roadmap for the sector, IEA estimates that geothermal electricity generation has the potential to reach 1,400 TWh per year by 2050, i.e. around 3.5 per cent of global electricity production, thus avoiding 760 mt of CO_2 emissions per year (IEA, 2011).

4. Ocean power technologies

The use of both wave and tidal forces to create RE has gained in popularity during recent years. Currently, Australia, Canada, New Zealand, the United Kingdom and the United States are the primary countries conducting research on ways to harness the power of the oceans. Generating energy from water can be achieved by tapping the energy found in waves, tides, ocean currents, varying salinity gradients and varying thermal gradients. Wave energy devices are designed to capture the energy from the surface of the seas and are usually listed under one of five main categories: buoys; surface followings; oscillating water columns; terminators; and overtoppings.

Tidal energy devices are designed to harness the energy found in tidal stream flows and usually employ three main methods: (a) cross-flow or vertical axis turbines; (b) axial or horizontal axis turbines; and (c) reciprocating hydrofoils. It has been estimated that deriving RE from the oceans has the potential to generate up to 200 GW by 2025 (Pike, 2009). However, installed capacity still lags well behind other renewable sources, with only 6 MW to date worldwide, of which 2 MW is from wave power and 4 MW from tidal stream, and is mostly in Europe (Bedard and others, 2010; and REN21, 2011). Many projects are still in the infancy stage and are solely funded by government research grants.

In the Asia-Pacific region, Australia, Japan, New Zealand and Taiwan Province of China were the major economies undertaking research and development projects in wave and tidal power. In 2011, construction of Asia's first commercial tidal current power plant could start off the coast of the Indian State of Gujarat, with an initial 50 MW capacity and a planned future total of 250 MW. Several small projects are also underway in the Republic of Korea, including the 254 MW Sihwa tidal barrage power plant, which is expected to be operational in 2011 (REN21, 2011).

5. Clean coal technologies

The most common adjective used to describe the technology that reduces the environmental impacts (including GHG emissions) from the burning of coal is “clean”. Clean coal technologies are used to reduce the environmental impacts incurred by using coal to generate electricity. The description of “clean” is slightly misleading, however. Even when applying clean coal technology, the product life cycle of coal is neither clean, nor safe. Coal mines often destroy mountain tops and pollute local aquifers, reducing scarce potable water supplies that are already being threatened by climate change. In recent years, despite improvements in safety technology and regulation, deaths from accidents in coal mines still remain high, with more than 3,000 fatalities in 2008 and hundreds of thousands suffering from pneumoconiosis in China alone (Branigan, 2009; and Zhao and Jiang, 2004).

There are a range of clean coal techniques that can be used to minimize or even eliminate pollutants and GHG emissions from being released into the atmosphere. Techniques include using chemicals to wash the impurities from the coal, gasification, treating emissions with steam to remove sulphur dioxide as well as more recent carbon capture and storage technologies that prevent the release of GHG emissions. Scrubbers attached to flumes can also reduce emissions of sulphur dioxide. The United States is leading the research into clean coal technology by developing integrated gasification combined cycle (IGCC) plants that convert the coal into a gas and separate CO_2, which can then be captured and stored underground. The Government of Germany has actively supported the research and development of a number of clean coal projects, and in 2008 opened the world’s first clean coal power plant in Spremberg, Germany.

China has emerged as the world’s leading builder of more efficient, less polluting coal power plants, retiring old plants in the process. Economies-of-scale have allowed China to also reduce costs. In 2009, about 60 per cent of new coal plants used newer, more efficient technology.[62]

6. Biofuels

Biofuels are derived from organic materials such as plant and animal matter known as biomass, commonly referred to as first generation biofuels. Fuel ethanol (or bio-ethanol) and biodiesel are used in substitution of petrol and diesel, respectively. Bio-ethanol is a form of alcohol made from fermented sugar found in plants primarily from sugar beat, corn, wheat and starch crops (e.g. potatoes or fruit waste), and more recently from trees and grasses. Biodiesel can be made from vegetable oils (e.g. sunflower seeds, palms, soy, rapeseed and

[62] *New York Times*, “China outpace US in cleaner coal-fired plants”, 10 May 2009. Available at www.nytimes.com/2009/05/11/world/asia/11coal.html

jatropha), animal fats or recycled grease. It is ordinarily used as a diesel additive, rather than a fuel in itself, to reduce levels of particulates, carbon monoxide and hydrocarbons generated by diesel-powered vehicles. Due to the controversies created by first-generation biofuels, second-generation fuels are gaining in popularity because they do not compete with existing food stocks. They are made from waste biomass, such as the stalks of wheat, corn, wood and special-energy-or-biomass crops such as miscanthus.

More recent research has focused on third-generation biofuels made from oil derived from algae known as oilgae or green crude. Using CO_2 as a catalyst to grow algae with water and sunlight offers a viable alternative to simply capturing and storing the CO_2 underground. Producing fuel from algae offers great potential as studies have shown that algae produces up to 30 times more energy per acre than current land crops used for biofuels.

Global production of fuel ethanol reached 86 billion litres annually in 2010 (REN21, 2011). The United States remains the world leader in fuel ethanol production, producing 49 billion litres in 2010. Brazil, the second-largest producer, attained a production of 28 billion litres in the same year. Major countries in Asia also involved in fuel ethanol production include China, Thailand and Indonesia, at 2.1 billion, 0.4 billion and 0.1 billion litres, respectively.

Global growth rates in biodiesel production are also reaching record levels, with an increase from 2 billion litres a year in 2004 to 19 billion litres in 2010. The European Union accounted for about half of global biodiesel production in 2010 at 10 billion litres annually, with Germany, France and Spain being the top producers. Asian countries ranked among the top producers of biodiesel include Indonesia, Thailand and China at 0.7 billion, 0.6 billion and 0.2 billion litres, respectively (REN21, 2011).

In the Asia-Pacific region, Indonesia and Malaysia are leading exporters of palm oil, which is used in the production of biodiesel, particularly in the European Union. In 2009, Malaysia produced 17,564,937 mt of palm oil. From January to April 2010, Indonesian exports of palm oil to the European Union were valued at $930 million, with a significant percentage imported for the purpose of producing biodiesel. Palm oil imports by the European Union from Indonesia totalled 135 million litres (120,000 mt) in 2010, and were expected to rise to 565 million litres (500,000 mt) in 2011 (REN21, 2011).

Biofuel blending mandates are currently in place in Thailand and China (nine provinces). India and Malaysia aimed to have it in place by 2008 (10 per cent blending of biodiesel and ethanol for India, 5 per cent biodiesel for Malaysia), while the Philippines aimed to have 10 per cent blending of both biodiesel and ethanol by 2011. The Republic of Korea recently introduced biofuel blending mandates for 2012 (2 per cent biodiesel and fuel-tax exemption incentives), and Pakistan aimed to have 5 per cent biodiesel by 2015. China has set a target of the equivalent of 13 billion litres of ethanol and 2.3 billion litres of biodiesel per year by 2020 (REN21, 2011).

C. Gauging future investment needs

As mentioned in previous chapters, in order to avoid a global temperature rise of higher than 2ºC, it has been estimated that cumulative emissions need to be limited to 450 ppm CO_2 equivalent (CO_2e). For this to happen, global emissions would need to peak (i.e. start reversing) by 2020, and decline steadily thereafter, to reach a 50 per cent reduction of global emissions by 2050 compared to the 2000 level. In view of expected population growth and economic growth, and the ensuing growth in energy demand, such a drastic reduction in emissions will require a total transformation in current production and consumption patterns. It follows that it will require huge investments in all sectors, including transport, buildings, power and industry.

1. Global investment needs

Various studies as well as modelling work have been undertaken to assess how much investment would be required in addition to current levels to stabilize emissions at a concentration of 450 ppm CO_2e. The studies often use a scenario approach based on a number of assumptions (e.g. GDP growth, oil price, growth in energy consumption, technology development and choices, and related mitigation costs etc.), and estimate the impact on emissions accordingly. Due to the large number of assumptions that have to be made to enable such calculations, these studies and models naturally arrived at different estimates of the total amount of investment needed. While none can be taken to represent the exact truth, such estimates provide very useful insights into both the scale and composition of future investment needs. Table I.15 provides an overview of some of these estimates. One important difference between the figures presented in this table is that the

Table I.15. Annual additional investment needs to limit global temperature rise to 2ºC (450 ppm CO_2e) in 2030

(Constant 2005 billions of United States dollars)

Region	IEA (a)	IEA (b)[a]	McKinsey[b]
Global	**846**	**936**	**1 217**
North America			210
Western Europe			153
Developing countries	565		676
China		311	317
India		99	92
Rest of developing Asia			105
Russian Federation		42	
Japan		46	

Sources: World Bank, 2010a; IEA, 2008 [IEA (a) in this table], referenced in World Bank, 2010a; McKinsey, 2009; IEA, 2009b [IEA (b) in this table]; and ESCAP calculations.

[a] IEA, 2009b, uses constant 2008 billions of United States dollars.

[b] McKinsey (2009) included all sectors; other models only included mitigation efforts in the energy sector. The McKinsey study was performed in euros and the results were converted to United States dollars at a rate of $1.5/€1.0.

McKinsey study includes mitigation efforts in all sectors, whereas the other models primarily study investment needs related to mitigation in the energy sector (production, distribution and consumption of energy and fuels).

One of the major studies included above was performed by McKinsey (2009). By assessing abatement options and their related costs, the study aimed to identify and measure the cost of the actions that would be most effective in delivering emission reductions targets by focusing on measures that would cost less than €60 per ton of CO_2e to implement. According to the study, an additional $476 billion per year in investments would be needed globally during 2011-2015 in order to bring emissions into line with the required emission reductions, before rising to about $1,217 billion a year in 2026-2030 (table I.16).

Table I.16. Capital investment by region, incremental to business-as-usual for the abatement potential identified

(Billions of United States dollars per year)

	2011-2015	2016-2020	2026-2030
OECD Pacific[a]	47	60	60
China	86	152	317
India	12	38	92
Rest of developing Asia[b]	29	68	105
Russian Federation and Eastern Europe[c]	30	41	53
Western Europe[d]	81	129	153
North America	104	165	210
Latin America	24	48	78
Africa	18	33	53
Middle East	24	36	51
Global air and sea transport	23	29	47
Total	**476**	**797**	**1 217**
Sum of Asia and the Pacific excluding the Russian Federation	173	317	573
Sum of Asia and the Pacific, including the Russian Federation plus non-OECD Eastern Europe	203	357	626

Source: McKinsey, 2009.

Note: United States dollar values calculated from euro values at a rate of $1.5/€1.0.

[a] OECD Pacific: Australia, Japan, New Zealand and the Republic of Korea.

[b] Includes Central Asia.

[c] Includes non-OECD Eastern Europe and the Russian Federation.

[d] European Union-27+: Andorra, Iceland, Liechtenstein, Monaco, Norway, San Marino, Switzerland.

Several studies have also been made by IEA to estimate future technology paths and related investment needs, particularly in the energy sector. According to the IEA (2009b), the required cumulative additional investments during 2021-2030 would amount to $9,361 billion, or an average of $936 billion per year during that period (table I.18). Similarly, IEA (2010b) estimated that the additional yearly investments required during 2015-2030 would amount to $450 billion per year, rising to $1,250 billion per year during 2030-2050 (table I.17). The large increase during 2030-2050 is mainly due to estimated investment needs in the transport

Table I.17. Average annual investments by sector in IEA Baseline and BLUE Map scenarios

(Billions of 2007 United States dollars)

Sector	Baseline			BLUE Map[b]		
	2010-2015	2015-2030	2030-2050	2010-2015	2015-2030	2030-2050
Power generation	210	360	430	270	470	640
Transmission and distribution	170	220	210	270	260	350
Industry[a]	130	150	290	150	170	340
Transport	3 800	4 490	7 220	4 028	4 760	8 080
Total investment (excl. buildings)	**4 310**	**5 210**	**8 150**	**4 720**	**5 660**	**9 400**
	Additional investments (BLUE Map – Baseline)			**Cumulative additional investments**		
	2010-2015	**2015-2030**	**2030-2050**	**2010-2030**	**2030-2050**	**2010-2050**
Power generation	60	110	210	1 950	4 200	6 150
Transmission and distribution	100	40	140	1 100	2 800	3 900
Industry[a]	20	20	50	400	1 000	1 400
Transport	228	270	860	5 190	17 200	22 390
Total investment by sector, excl. buildings	**410**	**450**	**1 250**	**8 800**	**25 000**	**33 800**
Buildings						**12 300**
Residential						7 900
Service sector						4 400
Total, including buildings						**46 100**

Sources: IEA, 2010b, and ESCAP calculations.

Note: The figures for total investments in the buildings sector are not available. Numbers may not add up due to rounding.

[a] Investment in industry includes only cement, aluminium, iron and steel, pulp and paper, and chemical and petrochemical sectors (i.e. the major energy consuming industries).

[b] BLUE map is an IEA scenario for reducing global energy-related CO_2 emissions to half their current levels by 2050. The BLUE scenario explores what needs to be done to meet ambitious emission reduction goals and other policy objectives. The reference scenario assumes that no new energy and climate policies are introduced during the scenario period.

sector. The above estimates include investments in power generation, transmission and distribution as well as industry and transport, but exclude investments in buildings. When investments in buildings are included, the total estimated global cumulative investment for 2010-2050 rises to $46,100 billion, implying an annual average of $1,150 billion in total required investment over that period.

In sum, most studies estimate additional global investment needs to amount to around $1 trillion per year by 2030, with higher numbers when all sectors are included. Generally, while annual investment needs before 2030 are expected to be somewhat lower, annual investment needs during 2030-2050 are expected to be higher, as the cheapest abatements options will by then have been explored.

An additional annual $1 trillion of global investments will be needed by 2030 to meet emission targets with more than half or $600 billion in Asia and the Pacific

In addition to the above estimates regarding investment needs for emission reduction (i.e. mitigation), it has also been estimated that a further $30 billion to $100 billion a year could be needed for climate change adaptation-related investments during 2010-2050, with a large majority of it for developing countries. These figures can be compared with current development assistance, which amounts to approximately $100 billion per year (World Bank, 2010a).

Most climate change-related studies highlight that any delay in mitigation investments will drastically increase the total cost of overall required investments (as the CO_2 concentrations in the atmosphere will then be higher, and more dramatic changes in the way goods are produced and consumed will then be needed to bring CO_2 concentration levels down). Therefore, it is clear that quick action is imperative; the faster action is taken, the lower the overall costs will be. Conversely, the longer action is postponed, the higher the required investments and related costs will be.

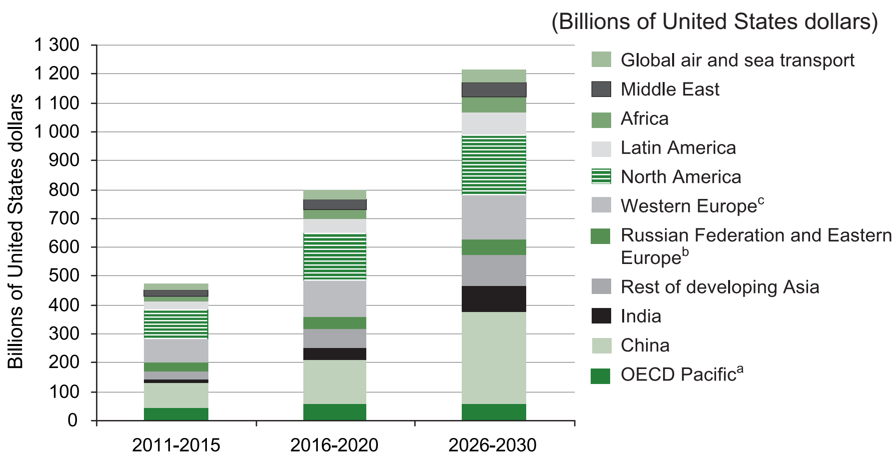
2. Investment needs in Asia and the Pacific

These large investment needs will not only be felt in developed countries, but also in major developing countries. In particular, the larger countries in the Asia-Pacific region will need to direct large investments to ensuring emission reductions.

The various IEA studies and McKinsey (2009) estimated that approximately half of the globally-required investments will be needed in the Asia-Pacific region. China is expected to require a large part of these investments, at around 26-33 per cent of global investments. For example, IEA (2009b) estimated that one third of global investments in the energy sector during 2021-2030 would be needed in China, averaging around $311 billion a year (table I.19). In addition, close to $100 billion a year will be needed in India, followed by Japan and the Russian Federation with investment needs of $46 billion and $42 billion per year, respectively. Together, IEA estimated that these four countries alone would take up almost $500 billion or 53 per cent of required global investments in the energy sector during 2021-2030.

Similarly, the McKinsey (2009) study findings indicated that 40-50 per cent of total global additional investments would be required in the Asia-Pacific region (table I.16 and figure I.27). This would amount to additional annual investments in Asia and the Pacific of approximately $180 billion during 2011-2015 (i.e. in addition to existing investment levels in 2008/09), rising to some $600 billion per year during 2026-2030.

Figure I.27. Incremental capital investment required, by region



Source: McKinsey, 2009.

Notes: Converted to United States dollars from euros at the rate $1.5/€1.0.

[a] OECD Pacific: Australia, Japan, Republic of Korea and New Zealand.

Rest of developing Asia: Central Asian republics plus rest of developing Asia.

[b] Russian Federation and Eastern Europe: non-OECD Eastern Europe plus Russian Federation.

[c] Western Europe: EU-27, Andorra, Iceland, Liechtenstein, Monaco, Norway, San Marino, Switzerland

Another recent study by the World Bank (2010b) covering six major East Asian middle income economies (China, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam) estimated the required investments in a somewhat lower range. The study estimated that the combined additional required investments for the six countries to reach a Sustainable Energy Development (SED) path[63] during 2010-2030 would average $180 billion per year, most of it in China. Compared to their Reference Scenario (which assumes all currently

[63] The Sustainable Energy Development path is a scenario for the stabilization of emissions by 2025, reaching 9.2 Gt by 2030, i.e. implying somewhat higher levels of emissions from the concerned countries than their levels in 2005. The report does not clarify whether this links to the goal of 450 ppm or not. For estimating the environmental impact, the scenarios assume a cost of carbon emissions at $20/tCO_2$. Contrary to IEA reference scenarios quoted here, the World Bank reference scenario assumes that all currently announced energy and climate change policies will be implemented.

announced policies would be implemented, i.e. it is more ambitious than the IEA reference scenario), this would imply required additional investments of $120 billion per year, of which $85 billion would be invested in energy efficiency in the power, industry and transport sectors, and another $35 billion in low-carbon technologies ($25 billion for RE and $10 billion for nuclear power). At the same time, due to energy efficiency measures, the report estimated that the SED scenario would avoid, on average, $40 billion in investments in thermal power plants, putting the required extra financing at $80 billion annually, or 0.8 per cent of GDP of the six economies included in the study. The study further estimated that such investments could halve environmental damage costs in the six countries from $127 billion (under the reference scenario) to $66 billion (under the SED scenario) as well as drastically improve energy security by reducing reliance on foreign energy imports by $1.106 trillion in 2030.

3. Investment needs per sector

In terms of sectoral distribution of investments (tables I.17 and I.18), the majority of investments are expected to be required in the transport and buildings sectors. This is particularly the case after 2030, when the transport sector is expected to account for nearly half of all investments. Investments in “green” buildings are likely to happen earlier as the technologies are already largely available. The power sector (generation, transmission and distribution) is expected to come third, followed by industry (mainly through investments in the three sectors of iron and steel, chemicals and petrochemicals, and cement).

Table I.18. Annual capital investment by sector, in addition to business-as-usual, for the abatement potential identified

(Billions of United States dollars per year)

Sector	2011-2015	2016-2020	2026-2030	Cumulative 2011-2030[a]
Power	78	144	222	3 135
Petroleum and gas	9	17	27	371
Cement	-14	-8	9	-56
Iron and steel	35	47	51	904
Chemicals	36	36	41	754
Other industry	36	54	42	900
Transport	72	189	450	5 153
Buildings	186	254	297	5 059
Waste	14	21	12	315
Forestry	23	47	65	945
Agriculture	0	0	0	0
Total	**474**	**800**	**1 215**	**17 479**

Sources: McKinsey, 2009, and ESCAP calculations.

[a] Cumulative investments have been calculated by summarizing annual investments for the above periods. For the missing period (2021-2025) it was assumed that annual investments would be an average of investments during 2016-2020 and 2026-2030.

United States dollar values were calculated from euro values at a rate of $1.5/€1.0.

(a) *Energy-related investment needs*

As shown in table I.19 and figure I.28, most investments in the reduction of energy-related emissions are expected to be in energy efficiency improvements, particularly end-use efficiency (industry, residential and transport). According to IEA (2009b), such investments are expected to constitute at least one third of total investments, or $180 billion per year globally during 2021-2030. Similarly, but at a higher percentage, the scenarios of the World Bank (2010b) report for East Asia see such investments as constituting about two thirds of total investments.[64]

Table I.19. Cumulative incremental investment for the 450 Scenario, relative to the Reference Scenario

(Billions of 2008 United States dollars)

	2010-2020 (cumulative)						
	World	**China**	**India**	**Japan**	**Russian Federation**	**Sum of these four countries**	**As a percentage of world**
Efficiency	1 999	266	74	77	51	468	23.4
End-use	*1 933*	*257*	*66*	*74*	*48*	*445*	*23.0*
Power plants	*66*	*8*	*8*	*3*	*3*	*22*	*33.3*
Renewables	527	208	48	21	7	284	53.9
Biofuels	27	1	1	1	0	3	11.1
Nuclear	125	63	0	0	0	63	50.4
CCS	56	1	1	1	3	6	10.7
Total (2010-2020)	**2 734**	**804**	**198**	**177**	**112**	**1 291**	**47.2**
	2021-2030 (cumulative)						
	World	**China**	**India**	**Japan**	**Russian Federation**	**Sum of these four countries**	**As a percentage of world**
Efficiency	5 586	1 210	301	164	153	1 828	32.7
End-use	*5 551*	*1 205*	*290*	*161*	*153*	*1 809*	*32.6*
Power plants	*35*	*5*	*11*	*3*	*0*	*19*	*54.3*
Renewables	2 260	485	312	71	89	957	42.3
Biofuels	378	28	11	7	1	47	12.4
Nuclear	491	107	59	36	0	202	41.1
CCS	646	68	11	21	25	125	19.3
Total (2021-2030)	**9 361**	**3 108**	**995**	**463**	**421**	**4 987**	**53.3**

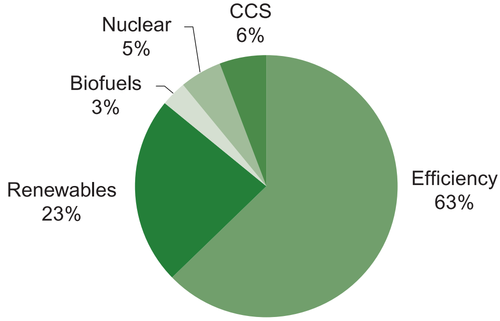
Source: IEA, 2009b.

Note: CCS – carbon capture and storage. (The data do not detail the investment levels of other Asian and Pacific countries.) See www.iea.org/country/graphs/weo_2009/fig9-2.jpg.

[64] CCS is not part of the World Bank scenario, as it is not expected to become commercially available in the region until 2025. However, it is estimated to be critically important after 2030, in particular for China.

Renewable energy is expected to constitute the second largest investment category for the energy sector, at around $96 billion per year, followed by nuclear power at $20 billion, and CCS at about $12 billion annually during 2021-2030.[65]

Figure I.28. Distribution of incremental investments, 2010-2030



Source: IEA, 2009b.

(b) *Investment needs in industry*

Most of the above investment projections focus on the energy sector due to its critical importance in GHG emission reductions. However, as energy efficiency in the end-use sectors will be a key component of reducing emissions, a closer look at the investment needs of those sectors is also important.

As noted in the introduction to this chapter, if CO_2 emissions from heat and electricity generation are allocated to consuming (rather than producing) sectors, industrial activities (manufacturing and construction) account for nearly one third of global energy demand and 37 per cent of global energy-related CO_2 emissions, followed by transport (23 per cent), and residential (18 per cent) (IEA, 2010a).

Among developing countries, particularly large exporters, industry's share of emissions is even larger. For example, in the case of China, GHG emissions from industry account for more than 60 per cent of the country's total GHG emissions.[66] Likewise, a few other major manufacturing countries in the region are at above-average levels, with 50 per cent of emissions deriving from industrial activities in Viet Nam, and around 45 per cent in India, Indonesia and Thailand (IEA, 2010a).

[65] In view of the recent events in Japan following the 11 March 2011 earthquake and tsunami, it is likely that many countries around the world will review their nuclear plans. What the impact of this will be on investments remains to be seen.

[66] The figure is approximately 60 per cent according to IEA (2010b). ESCAP calculations based on IEA (2010a), estimates that emissions from manufacturing industry and construction account for 63 per cent of total emissions for China and Hong Kong, China combined.

Most industry-related emissions derive from only a few sectors, particularly large primary materials industries, i.e. those that are large energy consumers. In fact, nearly three quarters of all direct CO_2 emissions from industry are accounted for by only three sectors: iron and steel (30 per cent); cement (26 per cent); and chemical and petrochemical industries (17 per cent). These are followed by the pulp and paper sector and the aluminium sector, at 2 per cent each. In line with this, most investments to reduce emissions from industry are expected to be needed in these sectors.

China is currently the world's largest producer of cement (49 per cent) and one of the six largest producers of iron and steel. High growth is also expected in its chemicals and petrochemicals sector (IEA, 2010b). Thus, investments in the industrial sector totalling between $290 billion and $460 billion are expected to be needed in the country during 2010-2050 (table I.20).

Unlike China, India currently accounts for much smaller shares of both sectors. However, its shares are expected to advance during the next few decades at a high rate, reaching similar levels to those of China. To mitigate the effect of this growth on emissions, India is also expected to require high levels of investment, in the order of $160 billion-$300 billion during that period.

Table I.20. Cumulative investment needs in industry, during 2010-2050, according to the IEA Baseline and BLUE Scenarios

(Billions of United States dollars)

	Investment needs 2010-2050						
	Total		Additional[a]				
	Baseline	**BLUE**	**Total additional[a]**	Of which: China	India	OECD Europe	United States
Iron and steel	2 000-2 300	2 300-2 700	300-400	130-160	90-115	20-25	10-15
Cement	760-970	1 200-1 640	350-840	50-130	50-150	35-100	30-80
Chemicals and petrochemicals	4 100-4 700	4 500-5 200	400-500	60-100	15-25	50-70	60-80
Pulp and paper	1 220-1 350	1 360-1 510	140-160	30-40	5-10	25-35	40-50
Aluminium	660-910	720-1 000	60-95	20-30	3-6	7-10	5-6
Total industry			**2 000-2 500**				

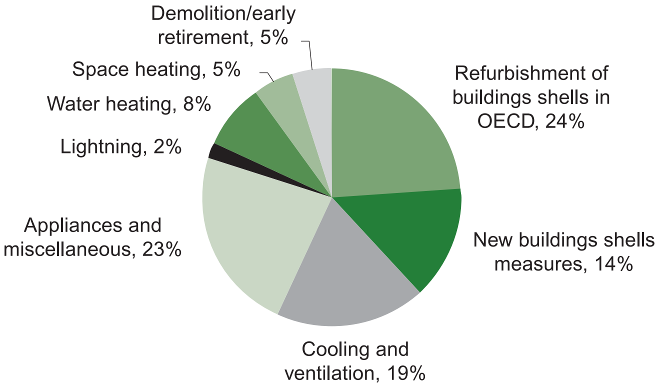
Source: IEA, 2010b.

[a] Additional investment needs imply BLUE Scenario as compared with Baseline Scenario.

(c) Investment needs in buildings

As noted above, estimates of required additional investments in the buildings sector range from $5,059 billion during 2011-2030 (McKinsey, 2009; see table I.18) to $12,300 billion during 2010-2050 (IEA, 2010b; see table I.17). IEA estimates that of those amounts, $7,900 billion will be needed in the residential sector and $4,400 billion in the services sector. Improvements in shells of buildings are expected to account for a large part of investment needs, particularly in OECD countries (figure I.29). In the services sector, one third of investments is expected to be needed for improvement of building shells, while more efficient heating, cooling and ventilation systems as well as more efficient lighting and other end-uses of electricity will be required. Taken together, investments in the buildings sector are expected to bring significant savings on fuel costs, with net savings totalling $5,000 billion-$18,600 billion during 2010-2050 depending on whether a 10 per cent or a 3 per cent discount rate is applied (IEA, 2010b).

Figure I.29. Incremental investment needs in the buildings sector, 2010-2050 (percentage of global investments of $12,300 billion) in the sector



Source: IEA, 2010b.

Note: Miscellaneous includes appliances, information technology (IT) and office equipment, pumps and other small plug loads in the residential and service sectors. It also includes cooking in the residential and service sectors.

(d) Investment needs in transport

As noted above, transport accounted for about 23 per cent of global energy-related CO_2 emissions in 2008. With economic growth and resulting increases in demand for transport in developing countries, transport is likely to account for a substantially higher share in the future unless strong action is taken. IEA, in its report on “Transport, energy and CO_2: moving towards sustainability” (referenced in IEA, 2009b), concluded that reducing the global use of fossil fuels in transport would be very challenging. It also noted that in spite of expected strong growth in vehicle numbers, total emissions from the sector would need to be less in 2050 than current levels if a halving of global energy-related CO_2 emissions was to be achieved by 2050 (IEA, 2010b).

Technical options for reducing CO_2 emissions from motor vehicles can be broadly categorized in five areas: (a) improving conventional engine efficiency; (b) use of alternative low-CO_2 fuels; (c) use of alternative drive trains (e.g. hybrid or electric cars); (d) improving aerodynamics and reducing vehicle weight; and (e) others.

It has been estimated that car manufacturers could reduce fuel consumption of conventional engines by 20-25 per cent across all vehicle classes in the near future. However, internal combustion engines do not represent an efficient technology, as only around 20 per cent of the energy derived from gasoline or diesel is used to move the vehicle, while the remaining energy is wasted in heat. In contrast, vehicles powered by electric motors can convert roughly 65 per cent of the energy into vehicle movement (Earth Policy Institute, 2008).

Thus, to achieve the required levels of emission reductions, a large part of the emission reduction needs to occur through a drastic increase in the use of hybrid, electric and plug-in hybrid electric vehicles (EVs/PHEVs), and, to some extent, fuel-cell vehicles at the expense of conventional internal combustion engine technology. Such vehicles are therefore expected to play a very important role in achieving a low-CO_2 transport system in the IEA BLUE Map scenario, particularly in the case of light-duty vehicles.

The IEA technology roadmap for EV/PHEV vehicles envisions that by 2050 EVs/PHEVs will reach combined sales of about 100 million vehicles per year worldwide, accounting for more than half of all new light-duty vehicle sales. India and China alone are expected to make up more than 40 per cent of these sales, with numbers approaching half of the world sales, when OECD Pacific is included (Australia, Japan, New Zealand and the Republic of Korea). According to IEA, a number of manufacturers have already announced plans to mass-produce one or more EV/PHEV models, and many countries have announced targets for sales by or before 2020 (IEA, 2010b).

Required additional investments in the transport sector globally are projected to amount to some $260 billion annually during 2011-2030, rising to $860 billion annually or $17,200 billion in total during 2030-2050 (tables I.17 and I.18). This corresponds to about half of all required additional investments during 2010-2050, with the bulk of it expected during 2030-2050 (table I.17).

D. Quick action makes economic sense

As noted above, most climate change-related studies highlight that any delay in investments in mitigation efforts will drastically increase the total cost of overall required investments. Thus, quick action is imperative; the quicker that action is taken, the lower the costs will be over time.

Savings in fuel and electricity costs will more than make up for additional investments in mitigation of climate change

While the required amounts of investment may seem staggering, on the upside energy efficiency improvements and increased use of RE will simultaneously reduce the demand for electricity in general and fossil fuels in particular. This is expected to lead to substantial savings, which in the longer term will more than compensate for the upfront cost of investment. For example, the World Bank scenario for East Asia estimates that the savings on fuel costs will allow recovery of additional investment costs within just three years. Similarly, IEA (2010b) has estimated that reduction in fuel costs will lead to large savings in the order of many trillions of United States dollars during 2010-2050.[67] For example, in the buildings sector, IEA calculates that the required $12.3 trillion in investment will yield undiscounted net savings of $39 trillion during 2010-2050, or $18.6 trillion if discounted at a 3 per cent rate. Of course, the sooner energy efficiency improvements are implemented, the higher will be the cumulative long-term savings in fuel costs and, thus, the payback on the investments.

At the same time, the costs of energy efficiency technologies are expected to decrease with increased economies-of-scale. Moreover, subsidies for the consumption of fossil fuels have been estimated to total $312 billion in 2009 (IEA, 2010c). In addition, subsidies to fossil fuel producers are estimated to amount to some $100 billion per year (Global Subsidies Initiative, 2009). Removing such subsidies would not only make RE sources more competitive, but would also liberate substantial funds for potential investment in more sustainable energy sources (see chapter 8).

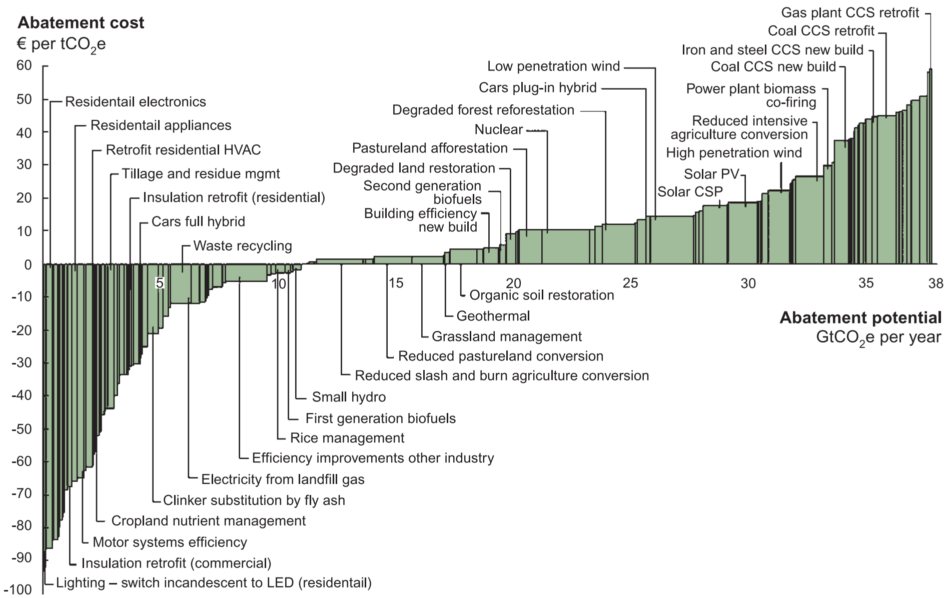
The McKinsey (2009) study identified a number of technologies that were already sufficiently cost-effective to offer emission reduction potential at zero or negative costs. Such technologies include light-emitting diode (LED) illumination, residential electronics and appliances, insulation retro-fitting of commercial and residential buildings, retro-fitting of residential heat, ventilation and air-conditioning systems, cropland nutrient management and tillage as well as residue management in the agricultural sector, full hybrid cars, clinker substitution by fly ash in the cement sector, waste recycling, electricity from landfill gas, and efficiency improvements in other industries. Together, these measures are estimated to have an abatement potential of 10 $GtCo_2e$ per year (figure I.30).

Abatement options that would come at only slightly negative or positive cost, but with large abatement potential, include many options available in the agricultural sector; most of these options are related to land use and land-use change (e.g. reduced slash and burn, pasture land conversion, grassland management and rice management). Other abatement options at below zero cost include small hydro-power projects and first-generation biofuels, while geothermal, organic soil restoration, new building efficiency and second-generation biofuels would come at a slightly positive cost. The abatement potential of all these measures combined is also estimated to be close to 10 $GtCO_2e$ per year.

At abatement costs above €10 per mt of CO_2e there are a host of other RETs, including nuclear and plug-in hybrid cars, while the high end of the cost scale is dominated by various CCS technologies.

[67] A total of $66 trillion in undiscounted savings, corresponding to $32 trillion if discounted at 3 per cent, or $8 trillion if discounted at 10 per cent.

Figure I.30. Global GHG abatement cost curve and abatement potential in 2030, by technology/modality



Source: McKinsey, 2009.

Rapid action to mitigate GHG emissions in the power and industry sectors is particularly important to avoid long-term lock-in in high GHG emitting infrastructure

According to McKinsey (2009), about three quarters of today's emissions are infrastructure related, including much of the emissions from buildings, transportation, power and industrial sectors. Infrastructure normally has a long life once built, and therefore has an impact on overall emissions for many years. Retro-fitting existing capacity is generally far more costly than building new infrastructure with more energy-efficient technologies.

Table I.21 shows the impact of a delay in investments in seven sectors. While different assumptions can be made about lifespans,[68] the table provides a clear argument for why rapid action in the power and industrial sectors is critical to achieving overall GHG emission reductions.

[68] For example, residential building shells would likely have substantially longer time spans than 15 years, while appliances and heating/cooling systems in such buildings would likely have a time-span of around 15 years.

Table I.21. Global GHG abatement cost curve and abatement potential in 2030, by sector

Sector	Annual abatement opportunity 2010-2015 ($GtCO_2e$/year)	Life-span of infrastructure built[a] (years)	Cumulative emissions caused by each year of inaction ($GtCO_2e$)
Power	0.3	38	12.3
Industry	0.3	24	8.2
Buildings	0.1	15	2.0
Transport	0.1	15	1.3
Waste	0.1	1	0.1
Forestry	0.6	1	0.6
Agriculture	0.3	1	0.3
Total/average	1.8	14	25.0

Source: McKinsey, 2009.

[a] Weighted average of lifespan of carbon intensive assets or infrastructure in the respective sectors.

Given that fuel cost savings are, in many cases, expected to make up for investment costs, why is investment in climate-smart technologies lagging? The key reason is that many climate-smart technologies have higher up-front investment costs than conventional technologies. This requires increased access to financing, which is a constraint in many developing countries. Moreover, investment costs are fully known and appear in the short term, while fuel savings are less well known (price fluctuations in fuel costs, less than full knowledge of the energy saving potential of respective technologies etc.) and appear in the longer term. The impact is a bias towards energy choices with lower up-front capital costs resulting in under-investment in lower emission infrastructure, even when such choices eventually result in higher overall costs. This is why government policies and financial mechanisms that reduce short-term costs and/or increase the expected longer term payback are imperative to stimulate the required change, including ensuring rapid action.

E. Opportunities and challenges for business

To summarize the above, reducing emissions will require additional investments averaging $1 trillion per year during 2010-2050. A large part of such investments will be needed for energy efficiency-related technologies, both in industry and in residential buildings and appliances. Substantial investments will also be needed in RE as well as in new types of transport vehicles. Within the industrial sector, key industrial sectors requiring investment are iron and steel, cement, and chemicals and petrochemicals. About half of the investments are expected to be needed in Asia and the Pacific, particularly in China and India.

To ensure that this investment happens, governments will need to adopt policy packages that stimulate demand and market growth for CSGTs, including policies in the area of energy efficiency as well as policies that promote investments in technology and infrastructure related to more renewable sources of fuel. As discussed in part II of this study, such policies will need to address the incentive system of each market and bridge the gap between short-term costs and long-term savings. To ensure maximum efficiency, such policies should aim at internalizing the cost of emissions in one or several ways (primarily through carbon price or taxes, or the mandating of various performance standards). These policies are further discussed in part II of this study.

A comprehensive policy framework will be needed to decrease business risk and increase business opportunities in CSGTs and climate-smart services

Assuming that governments are serious about taking such action, a few generalizations can be made regarding emerging business opportunities in CSGTs and climate-smart services in particular and climate change mitigation in general.

First of all, a switch from fossil fuels to more renewable sources of energy will be imperative. Such a switch will lead to dramatically increased growth in RE, including wind, solar, geothermal, biomass and waste-to-energy systems. This switch is already taking place in a number of countries but much more can be done. Capacity in the wind and hydro-power sectors alone is expected to continue increasing dramatically, contributing to a large part of the required increase in electricity generation from RE (IEA, 2010c). This will be complemented by drastically increased capacity in solar PV, off-shore wind, CSP, geothermal, biomass, carbon capture and storage, and nuclear (IEA, 2010b).

Second, as energy efficiency is one of the areas where a host of technologies are already commercially viable, once conducive government policies are in place the market for energy-efficient technologies and services is expected to experience dramatic increases. Considering the generally long lifespan of investments in industry and the sector's contribution to global GHG emissions, increased implementation of energy efficiency measures in industry will be a priority for many countries. As a result, investment in process improvements and energy efficiency technologies in the iron and steel, cement, and chemicals and petrochemicals sectors should be experiencing a strong increase. In addition, implementation of carbon capture and storage in these sectors is also expected to increase in the next decade.

Third, reducing energy consumption in buildings is another area where many technologies are already commercially viable. In the buildings sector, about one third of energy consumption is derived from heating and cooling needs. With the right policies in place to ensure improved energy performance of building envelopes (e.g. through building codes), there should be strong increases in the market for building insulation and retro-fitting, particularly in OECD countries. Moreover, as developing countries grow, the demand for cooling is expected to increase. Thus, to reduce overall emissions, building shells will need to be much improved in these countries as well. In contrast to OECD, however, a large part of the improvement in developing countries is expected to come with the construction of new buildings rather than through retrofitting existing ones.

Likewise, strong investment growth should be expected in technologies that improve the efficiency of heating, ventilation and air-conditioning systems for buildings, including through the increased use of solar water heating and heat pumps for both space and water heating. In fact, solar water heating is already competitive in many developing countries. In China and India, for example, the cost of such systems starts at $200, ensuring that CO_2 abatement costs are often modest or even negative. Moreover, China is already the world's largest producer and consumer of solar water heating, accounting for 65 per cent of all installations worldwide (IEA, 2010b). Investments in highly efficient appliances and lightning should also experience growth, assuming a rapid shift to least lifecycle cost standards. Finally, in developing countries, the use of more efficient biomass cooking stoves and switching to commercial fuels will simultaneously reduce energy consumption and deforestation, and improve indoor air quality.

Fourth, in the transport sector, business opportunities arise from both the expected dramatic increases in transport volumes and car sales, and the required transformation to lower emitting and fuel-efficient vehicles. As noted above, the latter will require rapid adoption of new technologies, including PHEVs and full EVs after 2015, and fuel-cell vehicles (FCVs) after 2025 (see box 1.9). It will also require production of around a quarter of transport fuel requirements from sustainable biofuels by 2050. In addition, it will necessitate planning and construction of sustainable transport systems, including those in urban areas, and the stimulation of much wider use of the most efficient travel modes, such as rail, air, shipping, bus and non-motorised travel (IEA, 2010b). All these areas will require major investments in new vehicle technologies, biofuel production and public transport systems.

Finally, in the services sector, the market for energy efficiency services should be experiencing drastic increases, especially energy efficiency consulting services, in all the above sectors.

Box I.9. Is the "Big Bang" in the automotive industry coming?

Competition for the development of environmentally-friendly and fuel-efficient vehicles could lead to significant structural changes in the automotive industry. In particular, FCVs could change the horizon of the industry in the coming decades.

Major automobile assemblers have competed in the development of FCVs, which consume hydrogen instead of fossil fuels and emit the least hazardous materials among technologically feasible power trains. The assemblers aimed to market FCVs by the end of the 2010s, which would lead to a "Big Bang" in the automotive industry (Schlapbach, 2009). Winners of the development of FCVs are expected to dominate the global automobile markets in the future.

Due to the costs and technological sophistication, however, only cash-rich assemblers are expected to succeed with development, by mobilizing technical support from various supporting industries (Abe and Ohn, 2004). In order to effectively commercialize FCVs, adequate hydrogen supplies and distribution infrastructure will be needed, with the hydrogen produced through CO_2-free processes. Financial incentives to offset the expected high costs of FCVs (at least in their introduction phase) will also be needed.

Source: Abe, 2010.

At the same time, the required transformation into more energy-efficient products will, of course, present a major challenge for companies that, today, are producing or operating on the basis of conventional technologies; most affected will be small companies that do not have the capacity or financial means to be at the forefront of developing or applying new technologies. Eventually, however, assuming policies are adopted that integrate the cost of emissions into product costs, a structural change will occur whereby companies producing lower CO_2/GHG emitting products and services will gain market share at the expense of those that produce higher emitting ones. Early mover advantages should be exploited and governments should give the right signals in this regard.

Several countries in Asia and the Pacific are already well positioned to benefit from this expected transformation. With extensive manufacturing capabilities, China in particular has established itself as a leader in the manufacturing of a number of low-carbon energy technologies. As noted above, in 2009 China produced 40 per cent of the world's solar PV supply, 30 per cent of the world's wind turbines (up from 10 per cent in 2007), and 77 per cent of the world's solar water collectors (REN21, 2010) China is also becoming a world leader in developing bus rapid transit systems, using advanced technologies such as real-time bus schedule information and smart card ticketing systems (IEA, 2010b). As also noted above, of the 10 major wind turbine manufacturers globally four are Chinese, accounting for 30 per cent of global production. Similarly, among solar PV manufacturers, 4 of the top 10 or 7 of the top 15 are Chinese.

With high capacity in automotive manufacturing and R&D, both Japan and the Republic of Korea should be able to benefit from the expected dramatic increases in demand for electric, hybrid and plug-in hybrid vehicles. Likewise, with large domestic markets and production capacity for vehicles, China and India should also be able to benefit. Some less developed countries, such as Thailand, are currently working to attract low-carbon vehicle production and should stand to benefit from the change towards "green" automobiles.

F. Conclusion

Bringing down GHG emissions will require fundamental changes in the way energy is produced and consumed, both by industry and at the household level. This, in turn, will necessitate huge investments, including investments in new plants for RE generation and CSTs, in order to increase energy efficiency and allow cost-effective use of RE in industry and households, and investments in improved public transportation systems, alternative fuels and improved fuel efficiency of cars etc.

The additional global investments (i.e. above and beyond the level of investment that is currently taking place) that are required to achieve a sustainable level of GHG emissions have been estimated to be around $1 trillion per year during the next decade. More than half that amount, around $600 billion per year, is expected to be required in the Asia-Pacific region.

While the up-front costs of these investments may seem staggering, the savings generated in terms of reduced fuel and electricity consumption are expected to more than compensate in most cases. Thus, with the right policy framework, ensuring that more investments are channelled into production and design of goods and technologies, the use of which will lead to lower GHG emissions, should be feasible even for developing countries with limited public budgets.

The scale of the required investments presents huge business opportunities. To mitigate climate change, governments throughout the world will sooner or later move towards improving energy efficiency standards and strive towards integrating the costs of emissions into products through the imposition of taxes or offering of incentives. This will increase demand for more energy-efficient and less GHG-emitting or resource-intense products, processes and services. Early movers will clearly benefit. The size and composition of these business opportunities will be highly dependent on the policy choices that governments make as well as the boldness of their efforts. The policy framework for promoting climate-smart trade and investment is discussed further in part II of this study.

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PART II

COHESIVE AND COHERENT CLIMATE-SMART TRADE AND INVESTMENT POLICIES

CHAPTER 5

SETTING THE SCENE: GENERAL POLICY FRAMEWORK FOR PROMOTING CLIMATE-SMART TRADE AND INVESTMENT

Introduction

As explained in part I of this study, climate change poses a serious and urgent threat to inclusive development and environmental sustainability. Surmounting this threat will necessitate a paradigm shift towards low-carbon or climate-smart development. Promoting increased trade and investment in CSGTs can work towards such an end. Experience has demonstrated, however, that the market alone has been unable to mobilize enough trade and investment in CSGTs or develop and commercialize climate-smart technologies to the extent necessary to limit the average global temperature rise to 2ºC (the 450 Scenario). Realizing climate-smart development will thus necessitate the engineering of a policy architecture that promotes energy efficiency and the deployment of CSTs over fossil fuel-based technologies.

As individual country circumstances differ, and because not all policymakers are equally equipped with options for intervention, there will be no single panacea that is appropriate for fostering such a change. It is thus essential for countries to develop nationally appropriate, comprehensive policy mixes that consist of mutually reinforcing and non-counterproductive policies and programmes for achieving the 3W outcome. Climate-smart trade and investment policies assume a central position in this mix, while other policies will have a strong link with or at least affect to some extent climate-smart trade and investment.[69] This chapter and subsequent chapters will review some of these policies in more detail.

The mitigation of climate change requires a comprehensive approach combining various policies that promote trade and investment in CSGTs. These policies need to be consistent and carefully coordinated at the national and regional levels

Many policies for mitigating and adapting to climate change can be identified, most of which will have a direct or indirect impact on or implications for trade and investment in CSGTs. At the same time, it would be difficult to label many such policies as either trade or

[69] It could be argued that a comprehensive integrated sustainable development strategy would contribute to the 3W outcome rather than climate-smart policies alone. This is certainly true and many of the policies presented in part II would apply to promotion of sustainable trade and investment in general rather than merely “climate-smart” trade and investment. However, the focus of this study remains on climate-smart trade and investment policies with the understanding that the role of trade and investment in the mitigation of climate change is part and parcel of a wider framework to achieve “green” growth and sustainable development.

investment policies. Rather, many could be labelled as energy, financial, industrial or enterprise development policies aimed at supporting enterprises that develop, produce and trade in CSGTs. Since there are many interlinkages and relationships among these policies it is therefore difficult to provide a clear distinction among them. The situation gets even more complicated when sectoral policies are taken into account. For example, specific policies would be required for mitigation of GHG emissions in specific economic sectors (i.e. mining, industry and agriculture) or industrial sectors (pulp and paper, automobiles, iron and steel etc.). It is beyond the scope of this study to discuss sectoral policies in any detail. Section A discusses some of the general climate-change mitigation policies that affect trade and investment in general, and which have a positive impact on trade and investment in climate-smart trade and investment. However, as these policies are not, strictly speaking, trade and investment policies they will not be elaborated on in subsequent chapters. In contrast, the policy areas presented in sections B to G are directly linked to climate-smart trade and investment and will be discussed in more detail in subsequent chapters.

A. General climate change mitigation policies affecting trade and investment

1. Nationally Appropriate Mitigation Actions

Nationally Appropriate Mitigation Actions (NAMAs)[70] are voluntary emission reduction measures undertaken by developing countries that are reported by national governments to UNFCCC, and can cover any policy that works towards reducing GHG emissions. In principle, this means that NAMAs also cover carbon-friendly trade and investment policies. Apart from the policies discussed in this study, NAMAs cover a wide range of policy areas, including sectoral policies. NAMAs involve improvements of land, soil and water management (United Nations, 2009). The idea is that some policies that are effective in some countries may not be effective in others, so the countries themselves should be able to design their own mitigation strategies. Whatever strategy a country chooses, it must conform to international trade rules if they affect trade. NAMAs ensure that mitigation actions undertaken at the national level are recognized internationally and that they will bolster the demand for CSGTs, particularly in renewables. However, it is important to have a proper monitoring, evaluation and verification process in place with clear objective indicators and measurements to ensure that NAMAs are actually implemented.[71] Table II.1 shows the committed mitigation targets of various Asia-Pacific economies as reported to UNFCCC and according to public statements.

[70] NAMAs were first used in the Bali Action Plan as part of the Bali Road Map agreed on at the United Nations Climate Change Conference in Bali in December 2007, and also formed part of the Copenhagen Accord issued following the United Nations Climate Change Conference in Copenhagen (COP15) in December 2009.

[71] Lucas (2009) referred to the following sets of indicators: (a) inputs (the financial, human, technical or organizational resources used); (b) outputs (objectively verifiable indicators that demonstrate the progress made in implementing the measures, e.g. the creation of a minimum energy performance standard); (c) outcomes (immediate effects on the regulated subject, e.g. the offer of new products and retooling of production lines); and (d) impacts (direct measurements of the improvements that the programme is designed to bring about, e.g. more efficient products and lower energy use).

Table II.1. Renewable energy targets and GHG emission reduction commitments in selected Asia-Pacific economies

Economy	Commitments to reduce GHG emissions
Bangladesh	Renewable energy to meet 5 per cent of total power demand by 2015 and 10 per cent by 2020.
Bhutan	Remain carbon neutral.
China	Reduction of carbon emission intensity by 40-45 per cent from 2005 levels by 2020; Renewable energy to meet about 15 per cent of total energy consumption by 2020. On 27 February 2011, China expressed intention to cut CO_2 emissions per unit of economic growth by 16-17 per cent by the end of 2015.
India	Reduction of emission intensity by 20-25 per cent from 2005 levels by 2020. Renewable energy to make up 20 per cent of the total additional energy planned by 2012.
Indonesia	Reduce carbon emissions by 26 per cent by 2020 from business-as-usual levels and by as much as 41 per cent with international support. Renewable energy to meet 17 per cent of all its energy needs by 2025.
Kazakhstan	Reduce GHG emissions by 15 per cent from 1992 levels by 2020.
Malaysia	Reduce carbon emission intensity by up to 40 per cent by 2020. Renewable energy to meet 5.5 per cent of electricity supply by 2015, 9 per cent by 2020 and 24 per cent by 2050.
Maldives	Carbon neutral by 2020.
Marshall Islands	Reduce CO_2 emissions by 40 per cent from the 2009 level by 2020.
Pakistan	Wind and solar energy to meet at least 5 per cent of the total installed electricity capacity by 2030.
Papua New Guinea	Reduce GHG emissions by at least 50 per cent before 2030 and become carbon neutral before 2050.
Philippines	Double the installed capacity for power generation from RE sources between 2008 and 2030.
Republic of Korea	Reduce emissions to 30 per cent below projected levels by 2010, which equates with a target of approximately 4 per cent below 2005 levels.
Singapore	Reduce carbon emissions by 16 per cent from the reference scenario level by 2020. Improve on carbon intensity by 25 per cent from 1990 level, by 2012.
Sri Lanka	Renewable energy to meet a minimum level of 10 per cent of electricity generation by 2015.
Thailand	Aims to generate 20.4 per cent of primary commercial energy from RE sources by 2022. By the end of 2011, at least 20 per cent of vehicle fuel consumption should come from biofuels.

2. National Adaptation Programmes of Action

National Adaptation Programmes of Action (NAPAs)[72] are action plans to increase the capacity of least developed countries to adapt to the impacts of climate change. NAPAs provide a process for least developed countries to identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change. Prominence is given to community-level input as an important source of information, recognizing that grassroots communities are the main stakeholders.[73] NAPAs can take many forms, including awareness creating campaigns, the construction of flood shelters and flood protection systems (dams, dykes etc.), research and development of drought and saline tolerant crops, evacuation of coastal areas and retraining facilities. Many such actions require substantive amounts of investment and thus offer investment opportunities. As of 1 July 2011, UNFCCC had received 45 NAPAs, including from 12 Asia-Pacific least developed countries (table II.2).

Table II.2. NAPAs received from Asia-Pacific least developed countries

Country	NAPA posting date
Afghanistan	September 2009
Bangladesh	November 2005
Bhutan	May 2006
Cambodia	March 2007
Kiribati	January 2007
Lao People’s Democratic Republic	May 2009
Maldives	March 2008
Nepal	November 2010
Samoa	December 2005
Solomon Islands	December 2008
Tuvalu	May 2007
Vanuatu	December 2007

Source: UNFCCC website at http://unfccc.int/cooperation_support/least_ developed_ countries_ portal/submitted_napas/items/4585.php.

[72] The Seventh Conference of the Parties (COP) of UNFCCC, held in Marrakech in 2001, acknowledged the specific situations of least developed countries (LDCs) in that they do not have the means to deal with problems associated with adaptation to climate change, and established an LDC work programme including NAPAs as well as other supporting activities. Decision 28/CP.7 set the guidelines for NAPAs while Decision 29/CP.7 set up an LDC Expert Group (LEG) to provide guidance and advice on the preparation and implementation strategy for NAPAs.

[73] See website at http://unfccc.int/cooperation_support/least_developed_countries_portal/ldc_work_ programme_and_ napa/items/4722.php.

3. Legal framework and compliance mechanisms for climate change mitigation and adaptation

This is required for the effective implementation of all NAMAs and NAPAs and any other policy outlined below. A comprehensive “green growth” legislative framework would also ensure the coordination, consistency and coherence among all policies and ensure environmentally sustainable and climate-smart economic growth. The Republic of Korea adopted the Framework Act on Low Carbon Green Growth in early 2010 as part of its National Strategy for Green Growth. This legislation is intended to support the Five-Year Plan for Green Growth of the Republic of Korea. China adopted the Clean Production Promotion Law, Energy Conservation Law and Renewable Energy Law. India has an Electricity (Amendment Act) 2007, Energy Conservation Act 2001 and Forest Conservation Act (amended in 1988). The Philippines adopted a Renewable Energy Act in 2008 and a Biofuels Act in 2006. Thailand and Viet Nam have also adopted biofuels legislation. Energy efficiency laws are obviously an important part of such a framework as well as laws in other related areas (see below). In addition, national and regional compliance mechanisms need to be developed to monitor the actual implementation of NAMAs (OECD, 2009).

4. Cap-and-trade systems, also known as Emission Trading Schemes or Systems

Emission Trading Schemes or Systems (ETS) at the national, regional or multilateral level, i.e. CDM under the Kyoto Protocol, set an aggregate limit on the amount of GHGs that may be emitted annually by certain capped sources. Subject to the overall limit, capped sources may buy and sell permits for the right to emit GHGs. Japan and New Zealand have implemented local and national cap-and-trade systems already while China, India and the Republic of Korea are planning them. A cap-and-trade market is expected to be ready in China by 2014. India approved in principle new trading plans on energy efficiency, opening up a potential market worth more than $15 billion by 2015. The Republic of Korea passed a national law to implement a cap-and-trade programme with CO_2 emission trading to start by 1 January 2015. In August 2011, Australia’s parliament endorsed the world’s first national scheme to regulate the creation and trade of carbon credits from farming and forestry.

Such systems encourage investment in clean production and have little chance of running afoul of international trade rules as the “trade” involved is in permits, rather than in concrete goods and services. However, eventually their widespread adoption could also contribute to trade in CSGTs. Recent thefts of carbon credits under the European cap-and-trading scheme have undermined their credibility and acceptance (see box II.14, chapter 12). As their effectiveness depends on a critical minimum mass of participating partners, such schemes make more sense at the international or regional levels. However, the feasibility of such schemes for Asia and the Pacific is an issue for debate and is further discussed in chapter 12.

5. Sectoral policies, including reducing emissions from deforestation and forest degradation

Closely related to cap-and-trade systems is the reducing emissions from deforestation and forest degradation (REDD) mechanism, which uses market/financial incentives to reduce GHG emissions from deforestation and forest degradation. Such actions offset carbon emissions and contribute to carbon credits. Actions involve reforestation and afforestation.[74] REDD "+" adds to these actions in order to include the possibility of offsetting emissions through sustainable forest management, conservation and increasing forest carbon stocks. REDD and REDD+ are important for business as such actions contribute to sustainable business practices, ensuring sustained long-term supplies of forest-based raw materials for a variety of industries (e.g. furniture, and pulp and paper), and the preservation of forests with added benefits such as conservation of bio-diversity.[75] Actions involving REDD are important NAMAs and are potentially an important carbon offset credit under cap-and-trading schemes. Forest-rich countries stand to potentially benefit from REDD projects. For example, the World Bank (2010) estimates that if the world put a monetary value on the carbon stored in trees, Indonesia could earn between $500 million and $2 billion a year by selling carbon credits.

Apart from REDD, specific sectoral policies can be designed to mitigate GHG emissions. In various energy-intensive sectors, binding emission reduction targets need to be imposed in combination with emission crediting schemes. In the agricultural sector, land, livestock and waste management needs to be improved while increased attention should be paid to the development of drought or flood-resistant crops (OECD, 2009). Given the importance of the agricultural sector, box II.1 explores some climate change mitigation and adaptation policies affecting trade and investment in agricultural products in the Republic of Korea.

Box II.1. Climate change mitigation and adaptation policies in support of investment in the agricultural sector: the case of the Republic of Korea

Climate-smart agriculture is agriculture that sustainably increases productivity and resilience to environmental pressures, while at the same time reduces GHG emissions or removes them from the atmosphere. Mitigation measures for the agricultural sector include: the improvement of cultivation methods through better irrigation and fertilization control for the arable sector in order to suppress major greenhouse gases such as methane (CH_4) and nitrous oxide (N_2O); improvement of animal excretion treatment technologies in the livestock sector; and carbon fixing for farmland soil. A mix of policies discussed in this report would also be applicable to the agricultural sector. However, in the longer term, adaptation policies are more important than mitigation policies.

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[74] Reforestation refers to the re-establishment of forest cover either naturally (by natural seeding, coppice or root suckers) or artificially (by direct seeding or planting), usually maintaining a same or similar forest type, and is done promptly after the previous stand or forest has been removed. Afforestation is the establishment of a forest or stand of trees in an area where the preceding vegetation or land use was not forest.

[75] While it is acknowledged that REDD/REDD+ have added benefits, there are concerns that actions under such schemes will give more control over forests to governments, TNCs, lawyers etc., and thereby undermine the rights and livelihoods of indigenous peoples living in those forests. Care should therefore be taken that these schemes are not abused, leading to less forest cover rather than more.

Box II.1. *(continued)*

In particular, there are a number of areas where changes in the food production sector are required. Farming must become more resilient to disruptive events such as flooding and drought through investment in agricultural water and soil management improvement. The vulnerability of farming communities to climate-related disasters must be reduced, and better warning and insurance systems to help them cope with climate-related problems need to be established. A recent FAO (2010) report also emphasized that greater coherence among agriculture, food security and climate change policymaking was urgently needed. In addition, adequate investment in national climate-smart agricultural formulation, research and extension, including capacity-building, is important to supporting action by farmers.

The Republic of Korea, as part of its “green growth” strategy developed a road map for climate change adaptation in the agricultural sector, which may serve as a role model for other countries to follow. The road map is presented in annex A of part II.

A few considerations are necessary in implementing the road map. First, in order to achieve green growth in the agricultural sector, environmentally-friendly agriculture should be built based on a solid resource-cycling system linked with related industries that are environmentally-friendly. An industry of environmentally-friendly machinery will need to be fostered in order to build sound, environmentally-friendly agriculture. Organic fertilizer and by-product fertilizer will need to be combined to improve the fertilizer processing standards, and an industry base should be established for the strict management of inferior organic fertilizer and post-management of agricultural machinery through mandatory listings.

Second, green growth pursues a harmonization between agricultural activity and the environment through a paradigm shift towards a low-carbon agricultural system that mitigates or absorbs greenhouse gases. To maximize the efficiency in using agricultural resources, while minimizing environmental pollution, an environmental evaluation test should be conducted on all agricultural policy programmes so that they can be combined or made consistent with the low-carbon policy.

Third, improvements need to be sought in the development and dissemination of “green” technology (see chapter 10). Fourth, there is a need for proper carbon information through carbon labelling (chapter 9). Last, provisions for “green” finance should be made (chapter 8).

Source: Kim, Chang-Gil and others, 2007.

6. Sustainable public procurement

Sustainable public procurement is a tool that allows governments to leverage public spending (which, in the ESCAP region, averaged around 18-20 per cent of GDP during 2005-2007) (ESCAP, 2010b) in order to promote the country’s social, environmental and economic policies.[76] It provides governments with a powerful tool to influence the way in which businesses operate through purchasing decisions. Government procurement often involves large sums, with regard to investment projects and in the procurement of goods and

[76] United Nations Environment Programme, Department of Technology, Industry and Economics website on sustainable public procurement at www.unep.fr/scp/procurement/?utm_source=newsletter &utm_ medium=email&utm_term=spp&utm_campaign=issue02.

services for consumption. More importantly, it includes the procurement of key infrastructure, such as power- and transport-related infrastructure as well as public buildings, i.e. the type of investments that will have an impact on GHG emission levels for many years to come.

By applying clear sustainability criteria in purchasing and investment decisions, governments can provide a major driving force for lowering emissions. First, this will help to ensure that public investments are low-emitting and use low GHG-emitting input materials. Second, in so doing, this will stimulate the market for environmental goods and services, thus stimulating innovation and increasing the competitiveness of such goods and services, both locally and globally. By actually encouraging green procurement practices in government activities, new markets for indigenous green products and services can be developed. Japan's Green Public Procurement Law (enacted in May 2000), the Philippines Green Procurement Programme, and Thailand's Green Purchasing Policy are examples of the progressive initiatives being undertaken by ESCAP members. China adopted a Government Procurement Law in 2003.

In the Republic of Korea, a Promotion of the Purchase of Environment-Friendly Products Act was passed in 2005. This Act requires public agencies (at both the national and the local level) to publish green procurement policies and implementation plans, and report the results (United Nations, 2008). Other GPP forms introduced include: (a) public procurement for energy efficient labelled products; (b) high-efficiency appliances; and (c) e-standby certified products, among others.

Government procurement programmes have been cited as important drivers in stimulating the greening of business and markets. Public procurement practices may potentially distort trade and investment, but are currently only governed internationally by the WTO Agreement on Government Procurement (AGP), which has provisions on transparency and non-discrimination. However, the Agreement is plurilateral, i.e. not all WTO members are a party to this Agreement.[77]

B. Trade policies

Trade policies are a central topic of discussion in this study and will be further discussed in chapter 6 below. For the purpose of this study, trade policies can be distinguished as those that (a) restrict or ban the import or export of carbon-intensive products, and (b) promote export and import of CSGTs.

1. Trade policies that restrict or ban the import or export of carbon-intensive products

Typical trade policy tools consist of tariffs and non-tariff measures (NTMs). While countries have leeway to increase their tariffs on selected products within the limits of their ceiling bindings, as committed in their schedules under WTO, such actions may be further

[77] From the Asia-Pacific region, only Japan, the Republic of Korea, Singapore, Hong Kong, China and Taiwan Province of China are members of the WTO Agreement on Government Procurement.

limited as a result of commitments under various regional or bilateral trade agreements to which they are a party. Countries do have recourse to a variety of NTMs such as standards and border tax adjustments. Standards are not, by definition, a trade policy tool; however, they are a powerful tool for mitigating and adapting to climate change and may, in the process, restrict trade. They are therefore further discussed in chapter 9 (see also energy policies below). An instrument being reviewed by many countries as a possible trade policy tool is the border tax adjustment or border carbon adjustment (BCA). This is a direct tax on imports of products considered carbon-intensive, with the purpose of levelling the playing field with domestic producers of similar products. Therefore, BCAs are essentially also a competition policy instrument. Import and export restrictions are, by definition, trade-distorting and should be discouraged. Therefore, they are also not advocated in this report. However, given the potential importance of, and current attention to BCAs as a potentially important tool for discouraging trade in carbon-intensive products, they are further discussed in chapter 6.

2. Trade policies that promote export and import of CSGTs

These policies aim at dismantling or reducing tariffs and NTMs on trade in CSGTs and climate-smart services. Three modalities for doing so can be identified: (a) unilaterally; (b) multilaterally (through the multilateral trading system); and (c) regionally/bilaterally through regional and bilateral trade agreements. These modalities are further discussed in chapter 6.

C. Investment policies

Investment policies comprise policies that promote domestic and foreign investment, particularly FDI, in the development and production of CSGTs. As domestic enterprises often lack the capacity to perform this role, many developing countries rely on FDI for the necessary capital, technology and expertise to develop, produce or even export CSGTs. While portfolio investment and investment from venture capital funds are very important, the issue of promotion and attraction of FDI in CSGTs requires special attention, as such investment yields additional benefits beyond pure finance capital. This important policy area is therefore further discussed in chapter 7.

D. Financial policies in support of climate-smart trade and investment

1. Financial policies which offer financial rewards or incentives to processes, products and services that are considered climate-smart

These policies involve subsidies, tax breaks and soft loans to “green” industries. Feed-in-tariffs (see below) can also be considered a subsidy and are routinely included in the measurement of “green” subsidies. Green and climate bonds are alternative financial instruments for raising funds for green projects. Given the importance of financial policies in the context of trade and investment, they are discussed in more detail in chapter 8.

2. Financial policies which impose financial penalties on processes, products and services that are considered carbon-intensive

The most cost-effective approach to tackling climate change is to put a price on GHG emissions, i.e. to make polluters pay across all sectors, emission sources and countries. In the absence of a global carbon price, carbon pricing can be adopted at the national or regional level, and can be multilateralized at a later stage (OECD, 2009). The most typical instruments used are the carbon tax and energy tax. Other policies involve the withdrawal or reduction of existing financial privileges and incentives for carbon-intensive producers and consumers, such as the elimination of fossil-based subsidies and tax breaks, and replaced with financial incentives for low-carbon production and consumption instead.

E. Renewable energy, renewable energy technology and related industrial policies

Renewable energy policies are policies that promote the use and development of RE sources. They could also be interpreted as including policies that discourage the use of fossil fuels. They are mentioned here, as RE is at the core of mitigating and adapting to climate change. However, in essence, many of the policies that could be termed RE policies are often trade, investment, financial or technology policies. Lucas (2009) concluded that a significant part of energy policy had no strong and consistent relationship with climate change. The key policies to consider are price reform, energy efficiency and the promotion of low-carbon fuels. For the purpose of this study, the following RE policies can be considered in addition to some of the policies identified in other policy areas. These policies basically aim to set standards and regulations for energy use. Standards and labels in the context of climate change mitigation are further discussed in chapter 9.

1. Mandatory RE targets and energy efficiency policies/law

While mandatory RE targets are an important part of NAMAs, and an energy efficiency law is part of the legal framework discussed above, they are such an important part of a RE policy that they deserve separate mention. Lucas (2009) argued that an energy efficiency law was necessary for mandatory functions such as audits, designation of energy managers, reporting, labelling, standards (for equipment and buildings), tradable certificates and the creation of an energy efficiency agency. As is the case with many other laws, effective enforcement remains a challenge in many countries. Lucas (2009) further argued that the energy efficiency agency should be separate from government in order to avoid the most restrictive constraints on recruitment and financial control; however, he acknowledged that this was often difficult to achieve in developing countries. Renewable energy and energy efficiency targets can be achieved through policies such as renewable portfolio standards and feed-in-tariffs, which are mentioned separately below. Box II.2 reviews the recent policies introduced by China and India to reduce energy consumption and increase energy efficiency.

Box II.2. Energy-saving policies in China and India

As part of its efforts to reduce energy consumption per unit of GDP by 20 per cent between 2005 and 2010, the Government of China initiated the “Top 1,000 Enterprises Energy Consuming Programme” in April 2006. Under this programme, the Government negotiated energy savings targets with the top 1,008 energy-consuming enterprises, and required them to conduct energy audits and establish energy savings plans to reach their targets. Already, these enterprises have reportedly invested around $13.2 billion in energy efficiency and have already met their collective target under the eleventh Five Year Plan (2005-2010) of reducing energy consumption by 100 million mt of coal equivalent. In the meantime, China is replacing outdated and inefficient power and industrial plants. According to the latest reports, China phased out 55.5 gigawatts of old thermal power plants during 2006-2009 as well as 61 million mt of outdated iron-making capacity and similarly large quantities for steel and cement.

India launched a National Action Plan on Climate Change (NAPCC) in 2008. The Plan identifies eight core “national missions” running through 2017, including a National Solar Mission and a National Mission for Enhanced Energy Efficiency (NMEEE). Current initiatives under NMEEE are expected to yield savings of 10 GW by 2012 and 19 GW by 2014, and save 98 million mt of CO_2 emissions per year. NMEE builds on the provisions of the Energy Conservation Act 2001. Under the Act, large energy-consuming industries are required to undertake energy audits. The “Perform Achieve and Trade” (PAT) scheme is a market-based mechanism under NMEEE that is crucial for achieving these targets. It aims to fix specific energy consumption targets for large energy-consuming installations across India in nine sectors: power stations; cement; steel; fertilizers; aluminium; chlor-alkali; paper; textiles and railways. A total of 714 energy-intensive installations across these sectors have been identified as the initial targets for the PAT scheme. The scheme is limited to energy efficiency targets and does not cover other sources of carbon emissions. Under the PAT scheme, starting in April 2011, the Bureau of Energy Efficiency (which is the implementation agency of NMEEE) is issuing Energy Savings Certificates for the targets that the bureau will identify for them. These certificates can then be traded.

Sources: Natural Resources Defense Council staff blog available at http://switchboard.nrdc.org/blogs/bfinamore/china_records_its_climate_acti.html (posted 1 February 2010); and India Climate Watch – April 2010 (issue 13) available at www.climatechallengeindia.org/india-climate-watch-april-2010.

2. Renewable portfolio standards

The renewable portfolio standards (RPS) are regulations set by government that direct utility companies to purchase or produce a set percentage of their energy from renewable sources. The benefits of RPS are greater competition between suppliers, increased innovation and improved efficiency. RPS facilitates energy generated from renewable sources to be delivered at the lowest possible cost, enabling it to better compete with fossil fuels and spur the demand in climate-smart technologies. A number of countries in Asia and the Pacific are pursuing RPS, including China (20 per cent by 2020); Indonesia (15 per cent by 2025), Japan (5,000 MW from wind and 28,000 MW from solar by 2020), and the Republic of Korea (4 per cent by 2015 and 10 per cent by 2022). India also has an RPS policy. Under the Electricity Act 2003 and the National Tariff Policy 2006, all state electricity boards will have to acquire 10 per cent of their power supply from RE sources by the end of 2010 and then increase the share of power produced by clean energy sources by 1 per cent every year until 2020.

Renewable portfolio standards are generally imposed at the national level and have no impact on international trade, but do promote investment in RE sources. However, under bilateral or regional schemes, such standards could promote imports of RE from other countries.

3. Feed-in-tariffs

Feed-in laws, advanced renewable tariffs and RE payments are different terms used to describe a feed-in-tariff (FiT) policy. Related to RPS, FiTs provide incentives for RE production by requiring utilities to purchase and feed into the grid any surplus electricity generated by individuals, companies or organizations from renewable sources. FiT legislation around the world has provided impetus for successfully increasing global investment in, and deployment of RE technologies. When designing FiT legislation, law makers need to pay attention to the possible demand that could be created. For example, concerns arose in Spain as too many people started installing RE, which almost bankrupted the fund set up to promote FiTs.

In 2009, China introduced FiTs for offshore wind, setting the buying price at a premium compared to electricity generation from coal. Depending on the region, the generator will get 0.51, 0.54, 0.58 or 0.61 yuan per kWh of clean energy generated. Within the Asia-Pacific region, numerous countries have implemented or are planning to adopt FiTs in order to provide incentive for deploying CSTs, including Australia, China, India, Japan, Malaysia, New Zealand, the Philippines, Thailand and Turkey.

4. Promoting energy efficiency through standards and labelling

Energy efficiency labels are informative labels attached to manufactured products to describe the product's energy performance (usually in the form of energy use, efficiency or energy cost). These labels give consumers the data necessary to make informed purchases, and to promote the trade and purchase of CSGTs and other green products. Carbon standards are an important tool for informing consumers of the carbon footprint of a particular product as well as for indirectly encouraging domestic demand for, and production of products on the basis of RE. As mentioned above, the issue of standards and labelling is further discussed in chapter 9.

5. Renewable energy technology policies

These are policies that promote the development, transfer and use of RETs, or CSTs in general. Issues related to transfer and development of RETs and CSTs are discussed in more detail in chapter 10.

F. Enterprise development policies

Enterprise development policies are policies that strengthen the supply-side capacity of enterprises, particularly SMEs, to produce CSGTs and climate-smart services. Like other policy areas outlined above, these policies overlap with policies distinguished in those other areas, but they deserve special mention because of the importance of SMEs, both in the production and trade of CSGTs as well as in the practice of corporate social responsibility (CSR)[78] in the context of promoting climate-smart behaviour and responsibilities of both government and business. The following policies have been identified for the purpose of this study, and are discussed further in chapter 11.

1. Strengthening supply-side capacities of small and medium-sized enterprises to produce and use CSGTs

Many policies distinguished under other policy areas also qualify under this heading. Specific policies in this context include those that provide technological, financial and information support to SMEs to use RE sources and CSTs in their production process, and to produce CSGTs. They also include policies that help those SMEs integrate into regional and global value chains that are considered climate-smart. Therefore, there is a strong link with the promotion of climate-smart investment. The role of SMEs in mitigating climate change is further discussed in chapter 11.

2. Strengthening public-private partnerships and promoting adoption and implementation of the principles of corporate social responsibility

Mitigation of, and adaptation to climate change cannot be done without the support of business. Public-private partnerships need to be developed to ensure that mitigation of climate change is effective and efficient. At the same time, being climate-smart is essentially a responsibility of enterprises, regardless of policy support. Sustainable business practices are a core principle of the United Nations Global Compact. Governments, however, can support the adoption and implementation of CSR through policy advocacy and public-private sector dialogue on how to engage the private sector more pro-actively in promoting inclusive and sustainable development.

G. Regional cooperation

As climate change on the one hand, and trade and investment on the other hand are cross-border phenomena, regional cooperation is essential to promoting climate-smart trade and investment in support of national, regional and global inclusive and sustainable development. With regard to mitigating climate change, such mechanisms can be developed

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[78] There is no official United Nations' definition of CSR. However, based on international applications, CSR is "a form of corporate self-regulation integrated into a business model, and its policy functions as a built-in, self-regulating mechanism whereby business monitors and ensures its active compliance with the spirit of the law, ethical standards, and international norms" (Wikipedia). The goal of CSR is to embrace responsibility for the company's actions and encourage a positive impact through its activities on the environment, consumers, employees, communities, stakeholders and all other members of the public sphere.

in virtually all the policy areas outlined above, though not all currently have political support. Nevertheless, the wider acceptance and implementation of these policies will ensure a greater impact and result. Regional cooperation is further discussed in chapter 12.

H. Conclusion

Much more can be said about any of the above-mentioned policies. The costs and benefits of each policy will have to be evaluated. In particular, an evaluation should take place based on three criteria: cost effectiveness (static efficiency); contribution to innovation (dynamic innovation); and adequately addressing climate and economic uncertainties (OECD, 2009).

A proper mix of the above-mentioned policies and policy instruments is required to effectively achieve climate-smart trade and investment, which, in turn, would contribute to mitigation of climate change. However, care should be taken to avoid undesirable overlaps. As a general rule, different instruments should address different market imperfections and/or cover different emission sources (OECD, 2009). Proper coordination among the various policies is essential; thus, mechanisms for the effective coordination and cooperation among concerned agencies at the (sub)regional, national and subnational levels should be in place.

Finally, whether a particular policy tool can be described as a trade policy has little meaning. In the end, what really matters is whether a particular policy tool affects trade. If it does, it would be classified as an NTM and probably be subject to international trade rules. Annex B of part II categorizes the most important WTO rules that could have an impact on a variety of policies.

The following chapters will further explore the role of trade, investment and enterprise development policy in promoting investment and trade in, and the production and use of CSGTs. Figure II.1 on chapter 6 presents an example of an integrated trade, investment and related climate change mitigation policy mix for that purpose.

CHAPTER 6

PROMOTING CLIMATE-SMART TRADE

Introduction

As already indicated, trade policies in relation to climate change consist of policies that ban or restrict imports or exports of climate-unfriendly goods and services, and promote imports and exports of CSGTs and climate-smart services. Such policies are subject to international trade rules under the multilateral trading system (MTS).[79] Annex B of part II categorizes the most important WTO rules that could have an impact on various climate-smart policies, not just climate-smart trade policies. With regard to restrictive import practices, countries can resort to tariffs and NTMs. Tariffs are generally already very low although, in some cases, countries have the flexibility to raise tariffs up to a certain ceiling that they have committed to under their WTO schedules. A popular trade policy tool is the border tax adjustment, but this tool also has its limitations. This concept is further discussed below.

Trade in carbon-intensive goods and services should be discouraged through environmental laws and regulations implemented on a non-discriminatory basis, rather than through trade-distorting measures that should be avoided

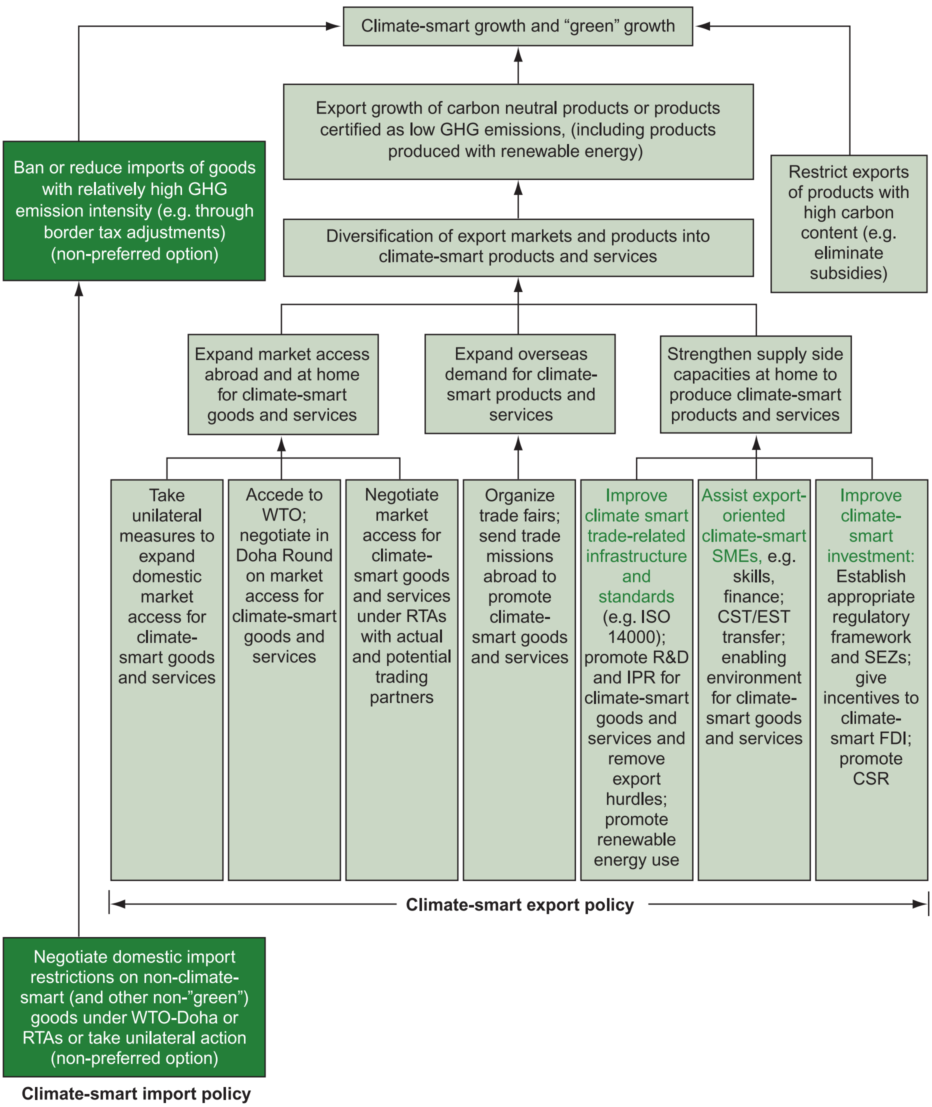
In addition, countries have to take their commitments under various bilateral and regional trade agreements into account, which often results in zero or very low tariffs as well. For that reason, countries increasingly deploy a wide array of NTMs in order to prevent or discourage imports of particular goods and services ostensibly on the basis of social and environmental concerns, but more often than not as a tool of "murky protectionism" (Baldwin and Evenett, 2009). As any restriction or ban of either imports or exports may distort trade and violate WTO rules as well as commitments under regional and bilateral trade agreements, these policies are not recommended in this report. Rather than resorting to such restrictive measures, the use of proper environmental regulations may be applied on a non-discriminatory basis to discourage the production and use of climate-unfriendly goods.

Suggestions have been made for reviewing the WTO rules with regard to climate change. For example, Hufbauer, Charnovitz and Kim (2009) recommended changes in existing WTO rules that would simultaneously create policy space for countries to limit GHG emissions without sacrificing the competitive advantage of their own industries, while also preserving an open trading system relatively free of discrimination and opportunistic protectionist measures. They also recommended that WTO members should negotiate a Code of Good WTO Practice on Greenhouse Gas Emissions Controls that would delineate a large "green space" for measures designed to limit GHG emissions, both nationally and

[79] Multilateral Environmental Agreements related to climate change (basically, the Kyoto Protocol) do not have specific trade rules. Therefore, the only international trade rules are found in e WTO agreements and regional/bilateral trade agreements.

globally. Such a "green space" would allow climate measures that are imposed in a manner broadly consistent with core WTO principles, even if a technical violation of WTO law could occur. As a result, such measures would not be subject to challenge in WTO dispute settlement by governments subscribing to the Code. Measures covered in the Code include border carbon taxes, non-discriminatory performance requirements on imports, cap-and-trade systems, comparability assessments of foreign climate regulations, non-compliance measures for climate commitments, preferences for least developed countries as well as climate and climate-unfriendly subsidies.

Figure II.1. An example of a mix of climate-smart trade, investment and enterprise development policy



However, the promotion of trade in CSGTs and climate-smart services is certainly possible, legal and therefore the recommended option for achieving the 3W outcome (World Bank, 2008). Section C explores the various modalities for liberalizing trade in CSGTs. As with all other policies, trade policies need to be consistent and coherent with other climate-smart policies. Figure II.1 shows an example of an integrated climate-smart trade, investment and enterprise development policy.

A. Border carbon adjustments

Among all measures for restricting imports of climate-unfriendly or carbon-intensive products, the border carbon adjustment (BCA) has emerged as a potentially powerful instrument. In countries that impose a national carbon tax, there are concerns that such a tax would affect competitiveness of domestic companies and may result in carbon leakage. As a result, some countries (mostly developed countries) are considering levying a border tax adjustment or BCA on imported goods that are not subject to such taxes in their home countries. In the United States, for example, the American Clean Energy and Security Act of 2009 (based on the "Waxman-Markey Bill") includes BCAs for addressing competitiveness concerns.

Other developed countries have not yet resorted to this unilateral instrument, but they may follow suit. BCAs in particular are considered to be important national instruments, as discussions on international (sectoral) agreements on global carbon costs are still ongoing. Despite the potential usefulness of BCAs as instruments for pushing companies towards clean production, there are concerns regarding their effectiveness as well as legal and economic concerns (Pauwelyn, 2007). In particular, there is concern that such taxes would unfavourably affect those developing countries that are not in a position to easily switch to clean energy and use of clean technologies. In fact, developing countries see such measures as protectionist and a violation of the principle of "common but differentiated responsibilities". As a result, BCAs may be challenged under the WTO Dispute Settlement Mechanism.

The application of BCAs should not be a preferred climate-smart trade policy tool as they may constitute disguised restrictions on international trade and disproportionally affect exports from developing countries

Pauwelyn (2007), in evaluating the use of BCAs in the United States, argued that "border tax adjustments" were explicitly permitted under WTO rules for product-related or indirect taxes (such as VAT or sales taxes). The carbon tax is, then, simply the extension to imported products of the tax or cost of holding emission allowances imposed on domestic producers. However, to limit the impact on trade, only a limited list of imports of energy-intensive raw materials should be covered. The carbon tax on imports must be "equivalent" to the internal cost imposed by domestic climate legislation on domestic products. Importers are required to submit information on the amount of carbon emitted in the production of the product abroad; such information is to be certified by the foreign manufacturer.

Various studies have revealed that the increases in production costs as a result of BCAs are only marginal, and are often compensated and therefore do not significantly affect competitiveness and trade (e.g. World Bank, 2008; and Whalley and Lockwood, 2008).[80] However, if larger GHG emission cuts are needed than currently committed (and it is clear that they are), then higher BCAs may be the result in the future. The problem is that BCAs are very difficult to calculate to enable adjustments for direct and indirect cost differentials associated with climate change policies. BCAs would have to be levied on “like” products to satisfy the national treatment principle, which includes the way they are produced. Determining “likeness” is a complicated matter. While GATT law allows border adjustments for indirect taxes, it is not clear whether inputs that are not incorporated in the final product can be subject to BCAs. Most importantly, World Bank studies have indicated a potential export loss for developing countries as well, particularly if BCAs are based on the carbon content of imports rather than on carbon content of domestic production. For example, China’s manufacturing exports would decline by 20 per cent and those of all low- and middle-income countries by 8 per cent; the corresponding declines in income would be 3.7 per cent and 2.4 per cent, respectively.

BCAs may lead to a reduction in world market prices for products subject to BCAs, leading to reduced export revenue (Mattoo and others, 2009). Another analysis found that tax rates of $50 per mt of virtual carbon could lead to very substantial effective tariff rates on the exports of the most carbon-intensive developing nations (Atkinson and others, 2010). Countries relying, to a high degree, on energy-intensive manufacturing are likely to be particularly vulnerable to unilateral trade measures. A way out would be to seek a waiver under WTO on the MFN principle for imports from developing, and in particular for least developed countries. Another way out is to justify BCAs on the basis of GATT XX, which lists general exceptions to GATT obligations (Pauwelyn, 2007), although it is not clear whether this justification is legally acceptable. In any case, since most demand for carbon-intensive products comes from developing countries, the effectiveness of BCAs imposed by developed countries in disciplining developing countries may be limited.

Border tax adjustments based on carbon content in domestic production rather than on the carbon content of imports would address the competitiveness concerns of domestic producers in developed countries, and would less seriously damage exports from developing countries (Mattoo and others, 2009). In any case, as the compatibility of BCAs with WTO law is uncertain, Asia-Pacific countries could, in the meantime, consider establishing a regional mechanism and disciplines for BCAs on a non-binding basis (e.g. within the context of APEC, APTA or ASEAN + arrangements). Such arrangements could, in due course, be multilateralized at the global level.

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[80] The World Bank (2008) found that only in the case of the cement industry did the imposition of a carbon tax by the exporting OECD country have an adverse effect on trade. In the case of the paper industry, trade actually increased as a result of a carbon tax.

B. Liberalizing trade in climate-smart goods and technologies

Chapter 3 shows that there are indeed many opportunities for trade in CSGTs in the region. The promotion of imports of CSGTs can take place on the basis of dismantling barriers, consisting of tariffs and non-tariff barriers (NTBs), to such imports. In many cases, it appears that tariffs on imports of goods in general, and CSGTs in particular, are already quite low. The incidence of NTBs, such as licence requirements or standards is of much greater concern, although some instruments that could be interpreted as NTBs may actually play a useful role in strengthening domestic competitiveness in CSGTs. In any case, the promotion of exports of CSGTs is undertaken in many countries through the provision of active support for domestic "green" enterprises, either financially (e.g. through subsidies or tax incentives, as discussed above) or in kind (e.g. technology support, government procurement etc.). However, such exports may encounter import barriers in destination countries. Again, these barriers tend to be NTBs rather than tariffs. This section explores the modalities to reduce or eliminate barriers to international trade in CSGTs.

In essence, three modalities can be distinguished to liberalize trade in CSGTs and climate-smart services:

(a) Multilaterally, through the Doha negotiations;

(b) Bilaterally or regionally through bilateral and regional (free) trade agreements;

(c) Unilaterally or autonomously where no reciprocity is demanded or expected.

The liberalization of trade in CSGTs and climate-smart services, both globally and regionally, and including the reduction or removal of both tariffs and NTBs is a principal policy tool to achieve the 3W outcome

Of these three modalities, the third option remains the prerogative of a national government without interference from other countries. The only obstacle may be posed by domestic stakeholders (particularly domestic businesses developing competitiveness in CSGTs and therefore may object to import liberalization of potentially competing products). From a national efficiency point of view, governments may wish to pursue unilateral import liberalization anyway in order to force domestic businesses to compete and upgrade their own performance. However, where national stakeholders are powerful, or domestic businesses are not competent enough to face international competition, governments may not be able to pursue this policy. In any case, the decision is a national matter.

In most cases, unilateral trade liberalization targets inputs to domestic climate-smart industries or climate-smart consumer goods not readily made in the home market. They tend to be tariff cuts rather than reductions in NTBs. Bangladesh, for example, recently cut import duties on hybrid cars from 195 per cent to 56 per cent. China has also cut import duties on selected products and reduced excise tax for energy-saving small cars. India introduced preferential import duties on imports of RE equipment and reduced customs duties on bio-diesel to 2.5 per cent. Indonesia and Pakistan impose zero duty on products and equipment used in RE development and energy-saving activities. Similarly, the Philippines imposes zero customs duty on imported materials for power plant construction. Malaysia introduced an exemption of 100 per cent import duty and 50 per cent excise duty on new hybrid vehicles of less than 2,000 cc as announced in its 2009 National Budget. The Republic of Korea cut import duties by 50 per cent on hybrid cars and recycling facilities as well as components used in RE generation, e.g. geothermal, hydrogen fuel cells, solar energy and wind power. Thailand introduced cuts of up to 90 per cent on tariffs for imported parts and materials for fuel efficient and eco-friendly vehicles. There is also an exemption from import duties for selected RE-related machinery and equipment.

Despite these initiatives, countries tend to pursue trade liberalization through multilateral, regional and bilateral modalities. These modalities are no longer the prerogative of individual countries, but depend on often arduous negotiations and the need to accommodate the concerns of other countries as reciprocity is expected. While there is no evidence to suggest that these modalities are more efficient or lead to more trade than unilateral trade liberalization efforts. In fact, evidence may be found that unilateral liberalization has, on the whole, been the most successful approach in generating trade and welfare in many cases (see, for example, IMF, 2001), although the evidence is not conclusive (for another view, see Winters, 2000). The multilateral and regional/bilateral tracks have become politically more acceptable as countries are reluctant to open their borders without a clear quid pro quo. These two modalities are explored further below.

1. Doha negotiations[81]

Within the current global trade regime, a World Bank (2008) study found that removing tariff and non-tariff barriers for four basic clean energy technologies (wind, solar, clean coal and efficient lighting) in 18 high-emitting developing countries would result in trade gains of up to 13 per cent.[82] The negotiations further on liberalization of clean energy technologies take place in the context of liberalization of trade in environmental goods, as mandated by the Doha Declaration of 2001, which launched the current Doha Round.

Multilateral trade negotiations take place in the WTO Committee on Trade and Environment (CTE) special sessions. Negotiations have focused on definitions of EGs as well as modalities for their liberalization. The principal submissions by WTO members involved a list approach (listing of EGs including CSGTs advocated by developed countries) or project approach (targeting only goods involved in temporary environmental projects, including those aimed at GHG emission reduction as advocated by some developing countries, notably India) or a combination of both. The issues involved in defining an EG are complex. To date, no consensus has been reached. A deal in this area is contingent on a total deal under the Doha Round as part of the single undertaking and is not expected any time soon. A way out may well be a plurilateral agreement such as the WTO Information Technology Agreement or the Agreement on Government Procurement (World Bank, 2008). In the meantime, WTO has been used for litigation purposes (see box II.3).

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[81] See also annex 1 of chapter 3.

[82] Also reported in a brief by WTO on the Multilateral Trading System and Climate Change, www.wto.org/english/tratop_e/envir_e/climate_change_e.pdf.

Box II.3. Use of the World Trade Organization as a litigation platform to challenge policy measures for promoting trade in CSGTs

In efforts to stimulate the production of CSGTs, various countries have resorted to a variety of measures to support enterprises for that purpose. Sometimes these measures may violate, or are perceived to violate, WTO rules and are challenged by other countries. For example, in early September 2010 Japan filed a complaint at WTO against Canadian subsidies for solar power generation. Japan alleged that above-market rates were paid to producers of electricity from renewable sources under Ontario's feed-in-tariff programme, created by that Canadian province's Green Energy Act. The Act aims to help Ontario meet its goal to eliminate 6.4 gigawatts of coal-fired energy by 2014. A provision of the programme requires projects to use Ontario goods and labour for between 25 per cent and 40 per cent of supply costs, depending on the type of renewable-energy source. The requirements were set to rise in 2011. This Act was seen as treating local firms more favourably (i.e. breaching the core WTO principle of national treatment) through subsidizing the cost of solar and wind power generation and thus contravened WTO rules that ban unfair treatment of import products, except for tariffs.

China has been similarly accused by the United States of providing subsidies to its producers of wind and solar equipment, which are not in synch with the multilateral trading rules, putting the Government of the United States under pressure to launch an investigation that could lead to cases similar to this being filed with WTO against China. Moreover, foreign producers of wind energy generation equipment have complained that they have no access to power projects financed by China's central Government. More frequent use of government purchases during 2009 and 2010 as part of crisis-managing strategies, combined with the use of public procurement, in area of "greening the growth" has increased the pressure on China to join the WTO Government Procurement Agreement (which is still a voluntary agreement). In response, China (supported by a number of developing economies) has pointed to the contradictory position it (and other developing countries) in which it has been placed by having to shoulder the responsibility of energy saving and cutting emissions but then criticized for taking active energy and mitigation policies.

Protectionist actions and threats, and resulting litigation processes, underscore the importance of forging a global climate change agreement that has specific provisions for trade that are both fair and which respect the principles of responsibility and capacity. In the absence of such an agreement, the multilateral trade negotiations on liberalization of trade in EGs assume special importance. The negotiations resumed in earnest in January and February 2011. Various lists were circulated that covered 400 EGs (including RE, environmental technologies and CCS), which included to a large extent the ESCAP list of 64 CSTs presented in chapter 3. However, definitional issues remain a sticking point and members have been requested to reduce the lists as well as provide more focus in them. Negotiations are also continuing on the modalities of liberalization and are focusing on tariffs that are often already small. Members have re-emphasized the importance of special and differential treatment, technical assistance, capacity-building and the transfer of technology.[83]

The Committee on Trade and Environment, Special Session, addresses the liberalization of environmental services, which include climate-smart services. However, to

[83] See website at www.wto.org/english/news_e/news11_e/envir_10jan11_e.htm.

date, no proposals have been submitted. Members agree that this issue is also very important and could also be discussed in the Services Council in Special Session.[84]

2. Regional and bilateral trade agreements

In the absence of multilateral commitments on reduction of tariffs and NTBs to trade in CSGTs, regional and bilateral trade agreements have emerged as the second-best option to address this issue. While various RTAs have chapters on environment, the articles contained in those chapters tend to focus on cooperation rather than reduction commitments on specific goods and services classified as "climate-smart". As Kim (2009) observed in a recent UNEP report, "it still remains to be seen whether environmental cooperation provisions reflected in a number of RTAs have been successfully implemented, and, moreover, whether RTAs' potential contribution to tackling climate change will be realized". Kim (2009) also observed that countries address environmental concerns in RTAs by using environmental impact assessments and the setting of environmental standards and enforcement of environmental laws.

RTAs can contribute to the liberalization of trade in CSGTs, depending on the coverage of CSGTs in the schedules of commitments by parties to individual RTAs

However, the real value-added of RTAs is in the coverage of CSGTs and climate-smart services in the total goods and services that are covered in the positive or negative lists in the schedules of commitment. It would therefore be opportune to examine the schedules of commitments by member States of individual RTAs on the extent and depth of commitments on reductions of tariffs and NTBs on trade in CSGTs as well as related rules of origin. This, however, is not always an easy task in the absence of universally agreed definitions and lists of such goods. Often, those schedules are not in the public domain. Such an analysis may reveal that quite a substantial number of RTAs have commitments on goods and services that could be considered environmentally- and climate-friendly (although restrictive rules of origin may militate against effective market opening). This is particularly so for those RTAs that "substantially cover all the trade". Table II.3 shows that, based on the ESCAP list, the coverage of CSGTs is 100 per cent in the case of AFTA and SAFTA; in the case of APTA, it will be close to 90 per cent when the Fourth Round is finished, although the level of commitment is perhaps not always as substantive. In most cases, the commitments are limited to tariffs rather than NTBs. In the case of ASEAN, tariffs range from zero to 5 per cent while in the case of SAFTA they are in principle zero per cent (by 2012), if implemented. In the case of APTA, after the Third Round of tariff concessions, the average margin of preference was 27 per cent while the Fourth Round is meant to result in an average margin of preference (MOP) of 40 per cent on all agreed products including CSGTs.[85] In many RTAs, relatively restrictive rules of origin may undermine the effective utilization of concessions.

[84] Ibid.

[85] Under the Third Round preferences, 30 tariff lines were included from the ESCAP CSGT list with an average MOP of 27.8 per cent.

Table II.3. Coverage of climate-smart goods in selected RTAs in the Asia-Pacific region

		No. of covered items	Coverage ratio (out of 64 items) (%)
APTA	(3rd Round)	30	47
	(4th Round)	57 [a]	89 [a]
AFTA (ASEAN)		64	100
SAFTA		64	100
PICTA		64	100
SPARTECA		0	0

Source: ESCAP.

Notes: PICTA – Pacific Island Countries Trade Agreement; SPARTECA – South Pacific Regional Trade and Economic Co-operation.

[a] Under negotiation (China's concession list excluded).

However, climate-unfriendly products will also be covered under RTAs which "substantially cover all the trade". Commitments made under a specific RTA on reduction of tariffs and NTBs on those products may undermine the capability of parties to the RTA to formulate trade policy with the purpose of restricting market access in such products, at least through tariffs, unless the parties can resort to provisions on general exceptions, similar to GATT Article XX. Legally speaking, the success of recourse to such provisions for environmental purposes is not guaranteed and, so far, there has been no legal precedent with regard to climate change. Another alternative is to renegotiate the RTA to make it more environmentally-friendly, which is also not easy. An additional problem is that RTAs as a principal modality for liberalization of CSGTs risk defining such goods in accordance with the self-interest of member countries of the RTAs, i.e. covering goods on which tariffs are already low or zero ("greenwash").

C. Policy recommendations

In general terms, the following trade policies are recommended for mitigating GHG emissions:

(a) Negotiate for "policy space" in WTO rules in order to allow climate-smart policies that may currently potentially violate existing WTO rules;

(b) Speed up liberalization and facilitation of trade in CSGTs with focus on unilateral action and multilateral negotiations (Doha Round) and on RTAs as a second-best option;

(c) In particular, notwithstanding the level of progress or commitments as a result of multilateral or regional/bilateral trade negotiations and agreements, pursue comprehensive unilateral liberalization. This is particularly important in the case of imports of parts, components and technologies necessary for domestic production of CSGTs and related technologies, in order to develop and strengthen national competitiveness in CSGTs, and to strengthen global and regional "green" value chains;

(d) When negotiating trade agreements, ensure broad coverage of CSGTs and climate-smart services as well as deep commitments (ideally zero tariffs with generous rules of origin and verifiable NTBs such as standards);[86]

(e) Avoid NTBs such as local content requirements, which also discourage investment and may violate the WTO Trade-Related Investment Measures (TRIMS) Agreement, and ensure that others (such as standards, taxes and subsidies) are applied in a non-discriminatory manner (national treatment). See also chapter 7 on climate-smart investment;

(f) In addition to general exception clauses in RTAs, ensure inclusion of comprehensive and clear environmental clauses in RTAs that would enable parties to facilitate the control, regulation and import of climate-unfriendly goods and services;

(g) Keep RTAs open to new members in order to avoid trade diversion. Liberalization of CSGTs has more impact with wider membership;

(h) Promote exports of CSGTs through environmental regulations and incentives while avoiding restrictive trade practices, including BCAs, which may violate WTO rules or otherwise constitute distortions of international trade;

(i) Promote paperless trade in all goods, and facilitate trade and transport of all goods and services through easy procedures and single windows;

(j) Organize trade fairs at home and abroad to promote trade in CSGTs and climate-smart services.

[86] This may be difficult to do in the absence of a clear definition of a climate-smart good or service. The ESCAP list is only indicative but may serve as a guide. However, nothing prevents countries from drawing up their own lists and pursuing liberalization of all goods identified on national lists.

CHAPTER 7

PROMOTING CLIMATE-SMART FOREIGN DIRECT INVESTMENT

A. Importance and determinants of climate-smart foreign direct investment

Trade in CSGTs and climate-smart services cannot take place without prior investment. Both domestic investment and FDI are important in this regard. Investment is required to set up production capacity of CSGTs and to develop tools, machinery and technologies that are climate-smart. As domestic companies in developing countries often lack the capacity to invest in CSGTs due to a lack of capital or access to required technologies, FDI plays a fundamental role in bridging the gap. While foreign portfolio investment and venture capital are important sources of finance, FDI is advocated as it provides capital, expertise and technology in a convenient package. Modalities for facilitating the transfer of CSTs are discussed further below. This section focuses on policies and measures that countries can adopt to promote and facilitate the inflow of climate-smart FDI.[87]

Among all types of investment, climate-smart FDI should be pursued on a priority basis as it has high potential to transfer capital, technology and expertise for climate-smart growth and development

UNCTAD (2010), in its World Investment Report, covered issues related to FDI in CSGTs quite comprehensively. It noted the role of TNCs in causing GHG emissions as well as in mitigating such emissions. TNCs are actually taking the lead in developing and producing CSGTs. Many TNCs are adopting “green” practices to boost their international competitiveness (box II.4). As TNCs are often leading complex global supply chains, their standards and processes help or force the whole supply chain to adopt “green” practices and produce “green” products. TNCs are leading producers of “green” products such as electronic vehicles, RE equipment and energy-saving light bulbs. TNCs are also more likely to adopt environmentally-friendly standards, including energy efficiency and carbon standards, to boost their competitiveness, and they play an important role in CDM projects under the Kyoto Protocol.[88] TNCs are often accused of avoiding the stringent environmental

[87] Climate-smart FDI can be defined simply as FDI in CSGTs and climate-smart services but can also be defined in a wider dimension as covering any type of FDI which results in the use, production and distribution of CSGTs or delivery of climate-smart services, or even more broadly as any type of FDI which results in mitigation of or adaptation to climate change. For the purpose of this chapter, the precise definition of climate-smart FDI is of minor consideration as policy issues and considerations are basically the same regardless of definition.

[88] UNEP Risoe (2010). CDM/JI Pipeline Analysis and Database, 1 March, as quoted in UNCTAD (2010).

Box II.4. Going green: TNCs in the driver's seat

Various global TNCs have taken initiatives to go green or produce green products. In the automobile sector, the production of hybrids is taking off, following the example of Toyota's Prius model that, so far, sources its components mainly from Japanese companies.

Coca Cola has taken the lead in eliminating HFC refrigerants, starting with its own supply chain of 10 million refrigeration units. It took the company eight years to replace its first 8,000 units and it now has 200,000 HFC-free units globally. The company hopes to be entirely HFC-free by 2015.

HFC is a GHG that is a thousand times more potent than CO_2. In 2005, Coca-Cola shared a United States Environmental Protection Agency Climate Protection Award for efforts to promote eco-friendly refrigeration together with Unilever, whose brands include Lipton and McDonald's (which opened its first HFC-free restaurant in 2003). The three companies, together with Carlsberg Group, Ikea and Pepsico participate in the Refrigerant Naturally coalition, which is supported by UNEP and Greenpeace.

Pepsi Cola is undertaking a similar initiative. Following Coca Cola, the Consumer Goods Forum, a consortium of 400 global consumer goods manufacturers with combined revenues of nearly $3 trillion, pledged to phase out HFC refrigerants beginning in 2015 and replace them with natural refrigerants in late November 2010, on the first day of the COP16 negotiations in Mexico.

Another example is Nike's decision to allow other apparel makers to use its $6 million software tool for designing sustainable products. Nike is also spearheading the Green Xchange, a breakthrough concept that allows companies working on sustainability innovations to share their research and ideas.

Source: www.greenbiz.com/blog/2010/12/07/un-expert-urges-firms-tackle-climate-issues-supply-chains.

regulations in their home countries by investing in developing countries where those regulations are less stringent. However, as discussed above, this phenomenon – known as "carbon leakage" – is actually quite rare. It seems that TNCs, on the whole, adopt environmentally-friendlier practices than many domestic companies in developing countries.

However, the attraction of FDI is not without problems, and the impact of FDI on local economies, societies and environments is not necessary positive. TNCs may crowd out domestic companies and enforce stringent intellectual property rights on their CSTs, preventing effective transfer and leading to dependence of host countries on foreign technologies. Technology transfer as a result of FDI is therefore not guaranteed. Furthermore, the attraction of FDI is not an easy matter and requires a holistic approach involving investment policies as well as concrete targeted investment promotion policies and facilitation measures, including after-care in combination with many other development policies. In fact, the required policies for FDI attraction in general do not differ much from policies to attract climate-smart FDI; it is only the focus that differs.

However, there are a number of barriers that are specific to clean energy investment. These include: a lack of clear guidance on future energy policy (lack of signals); monopoly structures for existing producers with a lack of purchase agreements or feed-in tariffs for independent producers; a lack of fiscal incentives for clean energy production; weak environmental regulation and enforcement; subsidies for conventional energy sources; a domestic financial sector that has little experience with new technologies etc. (ICSTD, 2008b). A recent study found that technical/infrastructure barriers (including grid-related barriers) rank highest among obstacles to investment in renewables identified in ASEAN countries, followed by administrative and market-related hurdles (IEA, 2010c).

The host country determinants for climate-smart FDI and related critical host country policies for attracting climate-smart FDI are listed in table II.4. The table uses the well-known categorization of FDI into: market-seeking; natural resource-seeking; efficiency-seeking; and strategic asset-seeking.

In addition to FDI policies and related measures, the role of IIAs, which is similar to that of RTAs, is also discussed in section C.

Table II.4. Host-country determinants and associated policies for climate-smart FDI

General policy framework	
General policies	**Climate change-specific policies**
• Economic, political and social stability • Good governance • Policies on functioning and structure of markets (especially competition, M&A and simple, transparent reporting standards, in line with common international practice) • Protection of property rights (including intellectual property) • Industrial and regional policies; development of competitive clusters • Trade policy (tariffs and non-tariff barriers) and stable exchange rates • International investment agreements	• Nationally Appropriate Mitigation Actions • National Adaptation Programmes of Action • Environmental policy (environmental standards, carbon taxes, cap-and-trade schemes for greenhouse gas reductions) • Industrial policy (including energy efficiency standards) • Public procurement of energy efficient products • Energy policy (e.g. requirements of renewable/low-carbon energy shares in energy mix of utilities, feed-in tariffs, subsidies and incentives for low-carbon investments) • International/domestic financial mechanisms (carbon markets and public/private finance mechanisms) • National Joint Implementation or CDM policy framework • Technology policy (related to generation, dissemination and diffusion of low-carbon know-how) • Trade policy adjustments for low-carbon activities (e.g. tariff reductions for capital goods/inputs for low-carbon activities, tariff policy of the home country with regard to potential host countries – for export activities of TNCs)

Table II.4. *(continued)*

Economic determinants			
	General	Climate change-specific	
TNC motive	Economic determinants	Specific economic determinants	Relevant TNCs
Market seeking	• Per capita income • Market size • Market growth • Access to regional/ global market	New or expanding, often policy-created (see above), markets for: • Low-carbon products (in general) • Low-carbon energy • Energy efficiency/ carbon market services	• Power utilities • Energy efficiency or process improvement technology services • Producers of low-carbon goods (e.g. carmakers, appliance manufacturers)
Natural resource-seeking	• Access to raw materials	• Access to sun, wind, water, natural gas or nuclear fuel/precious metals • Access to precious metals, e.g. for solar batteries	• Utilities and independent power producers • Energy services companies
Efficiency-seeking	• Different comparative advantages of countries • Better deployment of global resources	• Technology upgrades of existing foreign affiliates to gain advantage/or remain in local market	• Manufacturers • Power utilities
Strategic asset-seeking	• Access to new competitive advantages • Availability of and access to skilled labour • Strategic infrastructure (e.g. oil pipelines, power grids)	• Access to low-carbon know-how/project pipelines • Leveraging of existing industrial know-how for low-carbon goods • Local R&D into low-carbon technologies • Participation in low-carbon “clusters” (agglomeration effects facilitating rapid learning and uptake of new technologies)	• TNCs seeking to fill knowledge and skills gaps in their product/ service lines specific to low-carbon technologies • TNCs seeking to enter new markets beyond their traditional activities • TNCs desiring to “follow” developments in a key market • Manufacturers of low-carbon goods to gain access to local knowledge

Table II.4. *(continued)*

Business facilitation	
General measures	**Climate change-specific measures**
• Investment promotion • Investment incentives • Reduction of hassle costs • Availability of one-stop shop services • Provision of social amenities • Provision of after-investment services	• Incentives for manufacturers of low-carbon goods and/or providers of energy efficiency or process improvement services (e.g. tax benefits, subsidies, concessionary loans and export guarantee insurance) • Support for joint implementation, CDM or other carbon market operations

Source: UNCTAD, 2010.

B. Policies and strategies to attract climate-smart foreign direct investment

This report does not review the general economic policies necessary to attract quality FDI as these policies are well known. FDI is attracted to high-growth economies with a minimum level of economic and political stability, a well-educated workforce and relatively well-developed infrastructure. Countries that (a) maintain open markets and enforce their laws and regulations (b) have a good reputation in investor after-care with a minimum of corruption (c) are WTO members and employ investment-conducive trade and industrial policies (d) enforce intellectual property rights and international labour standards and (e) have a good track record in settling investment-related disputes, are obviously favoured by investors including those who can be characterized as climate-smart investors.

As table II.4 shows, climate-smart foreign investors will favour investing in countries that, in addition to the above, show a clear commitment to “going green” and the adoption of a mix of policies outlined in section A above, including:

(a) Clear and comprehensive NAMAs and GHG emission reduction targets;

(b) Clear, transparent and enforced environmental regulations;

(c) Effective carbon taxes and energy efficiency standards;

(d) Public procurement schemes favouring “green” products and services;

(e) Incentives and privileges for climate-smart investors (subsidies, tax rebates, feed-in-tariffs etc.);

(f) Active participation in CDMs as a Kyoto Protocol member.

Such government assistance does not have to be necessarily at the country level, but could be provided at the provincial or municipal level. For example, in the Republic of Korea, Seoul has been particularly pro-active in this regard (box II.5).

Box II.5. Cities in action: Seoul's initiatives in promoting and investing in climate-smart technologies

Although cities have been blamed to account for 75 per cent of global GHG emissions the true rate is about 40 per cent, which is still quite high (Satterthwaite, 2008). Various cities around the world, including in Asia, are taking "greening" initiatives. One such city is Seoul, the capital of the Republic of Korea. The city's Eco-Friendly Declaration in 2007 set out goals to reduce energy use by 15 per cent, reduce GHG emissions by 25 per cent and increase new energy or RE use by 10 per cent by 2020. In March 2010, Seoul revealed its Master Plan for Low Carbon and Green Growth. Under the plan, Seoul plans to invest $45 billion, including private investment, by 2030 to reduce GHG emissions by 40 per cent compared with the level of 1990, reduce energy consumption by 20 per cent, raise new/renewable energy use by 20 per cent, create 1 million green jobs and develop the city to adapt to climate change. To achieve those goals, the city plans to enhance the energy efficiency of all buildings that measure a minimum 2,000 m^2 by improving illumination, heating and cooling facilities. The target is to make 10,000 "green" buildings by 2030 and establish a "green" market worth $170 billion. The city also plans to replace all existing buses and taxis with vehicles powered by batteries and electricity by 2020, and to increase the use of public transportation to 70 per cent from the current 62.5 per cent

The city intends to develop 10 major green technologies suitable for Seoul: hydrogen fuel cells; solar cells; IT electricity; green buildings; LED lighting; green IT; green cars; urban environment recovery; recycling waste into resources; and climate change adaptation technology. Seoul is planning to invest around $2 million (an average of $100 million annually, $20,000 per technology) in R&D by 2030. The city intends to subsidize and protect green technology-related SMEs and venture start-ups. For those SMEs and venture start-ups that have the best green technologies, Seoul will support overseas marketing, and facilitate the acquisition of patents and other intellectual property rights. The city will also protect and actively support stabilization of the business through capital loans and trust guarantees.

Source: www.c40cities.org/docs/ccap-seoul-131109.pdf.

While developing countries generally face constraints in developing a climate-smart investment environment, early movers have a clear advantage in strengthening competitive advantages in this area. As discussed in part I, China in particular, while known for its environmental problems associated with its rapid growth, has evolved as the world's leading producer of wind turbines and solar panels, which are critical CSTs.

The following concrete strategies, policies and measures to promote climate-smart investment can be identified (based on UNCTAD, 2010):

(a) Mainstream FDI into climate-smart development strategies (as discussed above). Promoting FDI in CSGTs is not a panacea for climate change mitigation and adaptation by itself, but should be considered as part of a holistic approach to mitigating and adapting to climate change;

(b) Create an enabling regulatory framework. Specific regulations need to be adopted and enforced to facilitate the entry, treatment and protection of climate-smart FDI, including in the normally heavily regulated energy sector. Sufficient investment protection may be accorded under national laws, IIAs and investment contracts (see section C);

(c) Pursue regional market integration in support of regional climate-smart value chains. Domestic markets are often too small for any investor, including climate-smart investors, seeking efficiencies through expanding and strengthening regional and global value chains. The formation of these value chains can be supported through market integration, e.g. through RTAs or economic partnership agreements with wide and deep commitments to reduce tariffs and NTBs and to facilitate trade. In short, a favourable trade policy is essential for supporting climate-smart FDI;

(d) Liberalize and deregulate energy markets (particularly the power sector). In many countries, entry restrictions for foreign investors are still high in many energy sectors. Liberalizing entry will be a larger incentive than financial incentives, and is part and parcel of establishing an enabling environment. In particular, the complete unbundling of generation, transmission and distribution functions to different commercial entities while promoting competition in all sectors can provide greater incentives for power suppliers to use clean energy technologies (ICSTD, 2008b);

(e) Provide specific incentives and privileges for climate-smart investment. A mix of appropriate fiscal and regulatory measures can be applied both to promote both climate-smart domestic investment and to attract climate-smart FDI. While tax incentives are normally not known to be a principal determinant for most types of quality FDI, it may help smooth the investment decision-making process as "icing on the cake". Tax rebates can be offered, although subsidies may perhaps be too much of a drain on the national budget and may violate WTO rules if they are linked to export performance. Instead, privileges can be offered both at the pre-establishment and the post-establishment phases in the form of preferential treatment for foreign investors in getting licences as well as access to land, labour, capital and other resources. Other measures include the accelerated depreciation of assets put in place to increase energy efficiency, and the lowering of withholding taxes on payments abroad for intellectual property licences.

At the same time, incentives for climate-unfriendly FDI may be downsized or eliminated (disincentives, e.g. in the form of higher taxes etc. may be considered instead). Various countries have given incentives and other privileges to promote climate-smart FDI, especially in the RE sector. Some of the financial incentives offered to domestic enterprises are also available to foreign investors. However, incentives and privileges do not have to be financial in nature; they could include better infrastructural facilities for foreign investors (e.g. special economic zones [SEZs] or export processing zones, see below), or preferential access to land, labour and domestic finance as well as preferential import duties and relaxed ownership. For example, India allows 100 per cent FDI in the RE sector while Thailand allows land ownership by climate-smart foreign investors;

(f) Avoid performance requirements. Some countries (e.g. China) have successfully imposed performance requirements such as local content requirements. However, many developing countries do not have a sufficiently developed domestic sector to warrant such requirements, which may affect the location choice of foreign investors who should be free to decide on their suppliers within the context of their global strategic management decisions. Such requirements may also violate TRIMS;

(g) Provide necessary infrastructure and institutional framework for climate-smart FDI. Depending on whether climate-smart FDI is efficiency-seeking, resource-seeking or market-seeking, transportation, communication and (clean) energy infrastructure is always required, but so are institutions that support climate-smart business and development, including universities and R&D institutions. In particular, climate-smart TNCs can be a catalyst in boosting domestic R&D and may be attracted by the availability of R&D capacity as well as qualified personnel in the host country. With regard to physical infrastructure, the establishment of climate-smart SEZs may be considered. Core elements of such SEZs include GHG mitigation targets, sustainable infrastructure, a smart incentives/policy regulatory framework and carbon finance (UNCTAD, 2010). China, India and the Republic of Korea are currently exploring the possibility of establishing "green" SEZs;

(h) Promote and target specific climate-smart investment. Down from the policy level, the actual function of an investment promotion agency (IPA) or equivalent is to promote and target specific types of FDI. A special department or unit may be established in an IPA for the purpose of attracting climate-smart FDI. Such a department needs to be well-informed about investor needs and be client-oriented. IPAs may: (i) establish databases of global and regional TNCs producing CSGTs and climate-smart services or having a track record of being "green" and practicing the principles of CSR;[89] (ii) conduct a SWOT analysis of specific locations and sites in the host country suitable for climate-smart FDI (i.e. SEZs or locations close to industry clusters or infrastructure hubs); (iii) prepare detailed sector and investor opportunity profiles; (iv) develop an image-building campaign, including a unique selling slogan; (v) prepare detailed and to-the-point presentations for investor visits; (vi) organize climate-smart investment forums and road shows; and (vii) use a variety of media and tools for advertising and awareness-creation, including industry magazines and newsletters as well as clear and focused websites. However, it must be emphasized that such promotion and targeting strategies are complementary to general investment and development policies, not a replacement. In the absence of catering to the core determinants and requirements of a specific type of FDI, investment promotion and targeting will be fruitless.

A good example is the Republic of Korea, which is targeting FDI in R&D in key sectors such as smart grids and LED panels, and grant incentives, such

[89] Being a signatory of the United Nations Global Compact may be indicative of such practices but not a guarantee. It is important that the targeted TNC has a verifiable track record in CSR.

as cash grants and corporate tax breaks for companies that develop cutting edge green technologies (UNCTAD, 2010);

(i) Leverage the power of institutional investors. Institutional investors such as pension funds, insurance companies and SWFs have large funds under their management. Through their investment decisions, they can provide a strong impetus for company-level change through the investment decisions they make, either by ensuring they invest in companies that show responsible business behaviour or by demanding a seat on the board to induce positive change in companies that still have some way to go.

In addition to this voluntary/CSR/risk reduction approach for institutional investors, governments can also take an active decision to ensure that the funds under their own management (e.g. SWFs) are directed towards investments that directly or indirectly contribute to emissions reduction. For example, in January 2010 the Government of Indonesia created a $1 billion Green Investment Fund to spur economic growth and reduce GHG emissions. Indonesia's SWF, the Government Investment Unit, was to contribute $100 million to the fund while another $900 million was to come from international investors. The reason why institutional investors are already proceeding along this path voluntarily are partly due to risk reduction concerns, i.e. that well governed and more ethically managed companies will present a lower risk in the longer term;

(j) Facilitate climate-smart investment and pay due attention to investor after-care. Finally, as with all types of FDI, it is important that the IPA facilitates FDI both at the pre- and post-establishment phases. The IPA will be the interface and bridge between investors and a host of central and local government authorities and ministries. The IPA will assist in obtaining the investment licence, prepare a site visit by investors and help coordinate with local and central government officials in the implementation of a climate-smart investment project;

(k) Conclude IIAs conducive to climate-smart FDI. This issue is taken up in detail in section C;

(l) Formulate and implement supporting policies related to enhancing fair trade (competition), IPR protection and human resources development. These policies play a vital role in making trade and investment policy work. Without a proper competition policy and laws that ensure fair trade and business transactions as well as prevent abuse of dominant positions, there is a risk that TNCs could crowd out domestic companies. Further, since TNCs are usually the owners of advanced CSTs, they may be discouraged from investing in a host country with lax IPR laws and lax enforcement of such laws. In addition, the chances that effective technology transfer will take place without an effective IPR regime are subject to debate (see chapter 10). Finally, there is a need to provide comprehensive skills development and re-training where necessary to ensure that climate-smart TNCs have access to a well-trained labour force;

(m) Fill investment gaps through public investment or public-private partnerships. Public investment has an important role to play in the absence of sufficient private investment (Cosbey and others, 2008). Such investment may create the initial momentum for eventual private investment. Public-private partnerships in large-scale investments can also be considered. In particular, governments can help guarantee risks associated with private investments in CSTs. (See chapter 6);

While there is no one-size-fits-all scenario, a proper mix of the above policies will go a long way in ascertaining the interest of climate-smart foreign investors. The most important signal that governments can give to investors is that they are committed to climate-smart development, as demonstrated in word and action. Investors are willing to overlook certain deficiencies as long as their core requirements are met. One such requirement may be the existence of a bilateral investment treaty (BIT) or other form of legal document ensuring the protection of the investment. This issue is briefly discussed below.

C. Role of international investment agreements in climate-smart foreign direct investment attraction

Apart from RTAs, there is a web of IIAs, primarily composed of BITs, double-taxation treaties (DTTs) and investment provisions in RTAs. At the multilateral level there is TRIMS, which prevents discrimination between domestic and foreign investors and prohibits certain performance requirements such as local content. BITs and investment provisions in RTAs are much broader in scope. In general, their key objectives are to: (a) ensure fair and equitable treatment of foreign investors; (b) ensure non-discrimination between foreign investors from different countries, and between foreign and national investors: (c) protect foreign investors from direct and indirect expropriation without proper procedures and compensation; and (d) guarantee profit-repatriation and transfer of other assets. A BIT normally allows for a dispute resolution mechanism, whereby an investor, whose rights under the BIT have been violated, has recourse to international arbitration (investor-state dispute). It has been estimated that, at the end of 2010, there were more than 2,800 BITs worldwide (UNCTAD, 2011), of which some 50 per cent involved countries in Asia and the Pacific. In addition, of more than 170 regional trade agreements involving an ESCAP member State, more than 60 had investment provisions.[90]

International investment agreements could restrict policy space for governments to pursue climate-smart investment. They could also be adjusted to become an important tool for promoting such investment

Most agreements only cover post-establishment, i.e. protecting the rights of the investor after the investment has been made. Only a few IIAs include obligations related to pre-establishment, i.e. governing the right to invest in a country. This means that most

[90] According to ESCAP's Asia-Pacific Trade and Investment Agreements Database (APTIAD), available at www.unescap.org/tid/aptiad/agg_db.aspx.

governments have retained the right to decide which kind of investments will be allowed to enter the country, and are, for example, at liberty to refuse permission for investments in certain high-emission industries or production processes (Cosbey and others, 2008). Like RTAs, increasingly environmental clauses are inserted in BITs (see box II.6).

Box II.6. Examples of environmental provisions in recent IIAs

Various regional and bilateral investment agreements have inserted language with specific reference to the environment. For example, Article 17 (General Exceptions) of the ASEAN Comprehensive Investment Agreement (ACIA) of 2009 is formulated as follows:

> "Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between Member states or their investors where like conditions prevail, or a disguised restriction on investors of any other Member State and their investments, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any Member State of measures:
>
> "(b) …necessary to protect human, animal or plant life or health;" and "(f) …relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restriction son domestic production and in the host country consumption."

Japan's BITs usually have specific provisions related to the protection of environment. For example, Article 23 of the Japan-Uzbekistan BIT states:

> "The Contracting Parties recognize that it is inappropriate to encourage investment by investors of the other Contracting Party and of a non-Contracting Party by relaxing its health, safety or environmental measures, or by lowering its labour standards. To this effect, each Contracting Party should not waive or otherwise derogate from such measures and standards as an encouragement for the establishment, acquisition or expansion in its area of investments by investors of the other Contracting Party and of a non-Contracting Party."

While BITs contain provisions to ensure that foreign direct investors are not treated discriminatorily compared to their national counterparts, there is nothing to prevent foreign investors from being treated more favourably than their national counterparts. In short, official promotion of "clean" or low-emission FDI would be unaffected under most IIAs, as most IIAs only cover post-establishment. Thus, as long as such promotional efforts treat foreign and domestic investors alike, there should not be any legal concerns with regard to FDI incentives (Cosbey and others, 2008).

However, when it comes to the policy space for introducing new environmental legislation, including legislation related to GHG emissions, the picture is slightly more complicated. While, in principle, any policy that has the same effect on national and foreign-owned enterprises, and which is implemented in a transparent and non-discriminatory way, would be unproblematic, a few exceptions to this rule exist. These exceptions are related to the commitments in most IIAs regarding expropriation, and fair and equitable treatment. As to expropriation, if a new policy has significant economic impacts on an investment, there is a possibility that a foreign investor would be able to argue that that his or her investment was being "indirectly expropriated" and claim damages, although case law on this is contradictory (Cosbey and others, 2008). As to the obligation to ensure fair and equitable treatment, in some cases this obligation has been interpreted to mean no costly regulatory surprises. Thus, while most regulations would be safe as long as they are undertaken in a transparent and non-discriminatory way, in cases where there is a "stabilization clause/ agreement" in place that guarantees the investor unchanged regulatory treatment for a number of years, additional regulatory measures, (e.g. to restrict investment in carbon-intensive goods) could, in principle, be brought to arbitration (Cosbey and others, 2008). Such clauses are common in investment contracts that should be distinguished from BITs (box II.7).

Box II.7. Investment contracts

An investment contract is an agreement concluded between an investor and the host government (or a state-owned enterprise) for the purposes of regulating a specific investment project. Outside of extractive industries, contracts may also be concluded with a private entity based in the host country, including companies or other structures controlled by local communities. Contracts should not be confused with investment treaties, which are concluded between two or more States to regulate establishment and treatment of all investments by nationals of one State in the territory of the other State(s). Investment contracts may take many different forms, including concessions or "production sharing agreements" for the exploitation of mineral and petroleum resources, and "host government agreements for the construction and operation of pipelines and land concessions or leases for agricultural investments."

Investment contracts are crucial to the definition of the terms of an investment project, and thus the extent to which it advances – or undermines – sustainable development goals. Badly drafted or executed contracts may impose unfavourable terms on the host country for long periods, sow the seeds of disputes or undermine the pursuit of policy goals such as poverty reduction and environmental sustainability. Getting the contract right is therefore key to minimizing the risks and seizing the opportunities created by natural resource investment, thus avoiding the "resource curse".

Stabilization clauses are a legal device to manage non-commercial (that is, fiscal or regulatory) risk. The host government makes a contractual commitment to only alter the tax and regulatory framework governing an investment project, or specific aspects of it, in specified circumstances – such as investor consent, restoration of the economic equilibrium of the contract and/ or payment of compensation.

Source: Cotula, 2010.

However, since very few agreements cover pre-establishment, in most cases governments would have the full right to promote and limit whatever type of investments they choose. Thus, unless they have concluded agreements that include pre-establishment rights, they would have full liberty to provide positive discrimination to more environmentally/ emissions-friendly foreign investments, and to decline more "polluting" ones. However, all BITs would require that host countries do not provide more favourable treatment to domestic enterprises than to foreign-owned ones. In addition, the TRIMS agreement would prevent governments that are WTO members from putting in place local content requirements, unless they negotiated an exception to that clause at the time of accession to WTO.

In any case, the existence of IIAs is not normally a key determinant for FDI, except perhaps for the resource-seeking type, which is more prone to nationalization (and tends to be relatively more polluting). However, IIAs can contribute to the stabilization and/or liberalization of national legal regimes, such as those in the area of energy (UNCTAD, 2010). The conclusion of such agreements also allows governments to ensure the necessary policy space to promote climate-smart FDI. In this regard, the following recommendations can be proposed to governments when they are negotiating or re-negotiating IIAs:

(a) Insert language in the preamble, or in a separate article on objectives, that FDI should contribute to climate-smart growth and development (or, in a wider context, inclusive and sustainable development);

(b) Add clauses stipulating that future policies on limiting GHG emissions and/or ensure environmental protection, if applied equally among all investors, cannot be challenged under the expropriation articles, whether or not some sectors have very few or no national enterprises. Lately, some investment agreements have started including general exceptions clauses regarding measures "necessary to protect human, animal or plant life or health" as well as, in some cases, "relating to the conservation of exhaustible natural resources…"[91] As in trade agreements, it remains to be resolved whether, or to what extent, GHG emissions reduction initiatives would fall under those exceptions;

(c) Avoid stabilization clauses in investment contracts, or avoid similar clauses in investment agreements, or insert language in investment agreements to ensure that as long as new regulations are implemented in a transparent and fair manner, and applied to domestic and foreign investors alike, they cannot be challenged;

(d) Ensure that all new policies related to reducing GHG emissions are implemented through a fair and transparent process, in order to avoid such policies being challenged under the "fair and equitable treatment" clause. In some cases, precise language and definitions may be included in articles dealing with "fair and equitable treatment" to avoid confusion over the meaning of those terms;

(e) Ensure that environmental impact assessments, including assessments of impacts and implications of GHG emissions associated with a particular investment, are required and properly conducted, and screened for all investment proposals (or at least all those that involve some kind of manufacturing or resource extraction). In doing so, it should be kept in mind that due to the national treatment clause, the same requirement needs to apply

[91] See, for example, the ASEAN Comprehensive Investment Agreement, signed on 26 February 2009, between all ASEAN member States.

to both national and foreign investors. Such an assessment may be extended to the whole supply chain of which the particular investment is a part. IIAs could include language for this purpose to prevent that such actions are challenged;

(f) Avoid the inclusion of performance requirements in IIAs. In most cases, such requirements, covering obligations for foreign investors to transfer technology, enter into joint ventures or adhere to minimum employment requirements, will do little to attract the right type of FDI. In fact, many such requirements may violate international trade law (i.e. in the case of local content of import requirements);

(g) Provide clear provisions and procedures for international arbitration of investment-related disputes. This is a key requirement for investors in IIAs, but it also helps host governments by providing guidance in choosing the right legal recourse in case of a dispute.

CHAPTER 8

FINANCIAL POLICIES IN SUPPORT OF CLIMATE-SMART TRADE AND INVESTMENT

A. Carbon taxes

Financial policy tools in support of climate-smart trade and investment comprise (a) financial charges on carbon-intensive production processes, products or use of carbon-intensive products, and (b) subsidies or other forms of financial incentives to promote climate-smart production processes, products or use of those products. With regard to the former instrument, carbon taxes are the most common, as they constitute the easiest way to put a price on carbon. It is recognized that such a carbon price is necessary to change consumer behaviour. Carbon prices are also essential for inducing R&D and the diffusion of technologies that are less carbon-intensive (UNCTAD, 2009). Together with cap-and-trade systems, they are a market-based mechanism for putting a price on carbon. Simply put, a carbon tax is a fee on the production, distribution or use of fossil fuels, based on how much carbon their combustion emits.

Carbon taxes address the negative externalities associated with production. Such externalities are costs to society that nobody bears in the absence of the tax. Unlike the price of carbon under cap-and-trade schemes, carbon taxes will make energy prices predictable and stable, are easier to implement and much less complex than cap-and-trade schemes.[92] Carbon taxes can be levied both on producers and on consumers, but are most commonly levied on consumers of fossil fuels (WTO-UNEP, 2009). A carbon tax introduced concurrently with a gradual reduction in fossil fuels subsidies can help level the playing field for the uptake and trade in renewables (Milne, 2008).

Carbon taxes are a convenient, if not perfect, market-based instrument that put a price on carbon and help to change the behaviour of producers and consumers with regard to the use of renewable energy and adoption of energy efficiency

Carbon taxes are essentially aimed at changing consumer behaviour rather than raising revenue. For that reason, a carbon tax should ideally be revenue-neutral to limit the impact on consumers. Revenue-neutral means that the revenue of the tax is returned to RE-producing businesses, and consumers using RE, rather than fossil fuel, in the form of tax breaks or subsidies of "green" projects. As such, local businesses will not lose international competitiveness as a result of the tax. As a carbon tax is potentially regressive, the revenue can also be used to compensate the poor and low-income users. For example,

[92] See website at www.carbontax.org/introduction/.

governments can "tax-shift" carbon tax revenues by reducing other regressive taxes such as sales tax and payroll tax.[93]

As explained by WTO-UNEP (2009), carbon taxes are based on carbon content and, in this regard, differ from energy taxes that are based on energy content. However, to the extent that energy content refers to fossil fuels, energy taxes are inherent carbon taxes. Energy taxes affect the use of oil and gas more than the use of coal, as oil and gas have higher energy content, while carbon taxes affect the use of coal more because of the larger carbon content of coal. Taxes on other GHGs have been implemented and proposed, although taxes on CO_2 emissions are the most common. In principle, a carbon tax at-the-source reflects the price on the release of CO_2 gases into the atmosphere. The tax base of such a carbon tax is the combustion-related CO_2 emissions of fossil fuels. Taxes related to CO_2 emissions are easier because CO_2 emissions are easier to measure than the total carbon footprint of a particular product. Nevertheless, the method of calculating the tax rate per mt of CO_2 emissions remains a particular challenge. Hence, it is more difficult to levy carbon taxes on products manufactured on the basis of fossil fuels than on direct consumers of fossil fuels such as petrol for vehicles. Therefore, in practice, carbon taxes are often set so as to simply influence taxpayers' behaviour to in order to achieve a specific emission reduction target (Wermelinger and Barnes, 2010).

Carbon taxes are not widely used in the Asia-Pacific region. China intends to impose a carbon-cum-environment related tax from 2012-2013 to curb emissions. Taxes will start at Y20/mt of CO_2 and rise to Y50/mt by 2020. The Government of China's basic approach is to tax emissions of carbon dioxide, sulphur dioxide, nitrogen oxide and industrial wastewater, while levying a pro rata-based tax on coal and petrochemical products such as petrol, aircraft fuel and natural gas. Japan has a tax on fossil fuel, electricity and vehicles that effectively functions as carbon energy tax. India also recently imposed a carbon tax on coal, both domestically mined and imported, of Rs.50 per mt, which it hopes will generate $650 million annually for the clean energy fund. Singapore is also considering a carbon tax to meet its GHG emission reduction targets. Australia is planning to impose a carbon tax but the Government's proposal is facing heavy opposition (box II.8).

Box II.8. Australia's carbon tax

Although Australia only accounts for 1.5 per cent of global GHG emissions, its per capita emissions are the largest of any rich country, mainly because it has a relatively small population and generates about 80 per cent of its electricity from coal. As a follow-up to an earlier unpopular government plan to impose a carbon tax, the current Government's plan envisages a tax of about A$23 ($24) per mt for the 500 biggest polluters on their own carbon emissions as of mid-2012. The tax would rise by 2.5 per cent per year before being replaced by a market-based emissions trading scheme in 2015. Half the revenue from the carbon tax would be used to compensate households for higher electricity and other living costs that polluters pass on. Another 40 per cent of revenue will help businesses and industry to adjust, and to switch to cleaner forms of energy.

[93] See website at www.carbontax.org/myths/.

Box II.8. *(continued)*

In the first four years of the plan, compensation, measures and income tax cuts will lead to a deficit; however, in the longer term, the budget would return to a surplus according to the Government. The plan aims to cut 120 million mt in Australia's carbon emissions by 2020. During the scheme's first four years, the Government's projected spending on compensation measures and income tax cuts will be A$4.3 billion more than the tax raises. Nonetheless, it claims its promise to return the budget to surplus by 2013 will not suffer. Although previously there was some support from Australia's big mining companies for a price on carbon, support is waning, particularly among the public.

Australia plans to cut its carbon emissions by 80 per cent from their 2000 levels by 2050. About A$10 billion will be invested over five years on RE sources such as wind and solar power, and on energy efficiency technologies.

Source: *The Economist*, "Australia's carbon tax: Breaching the brick wall"; accessed at www.economist.com/blogs/banyan/2011/07/australias-carbon-tax.

Carbon taxes are not a trade policy tool, but they play a potentially important role to promote trade and investment in CSGTs. Furthermore, according to multilateral trade rules, carbon taxes need to adhere to the principles of non-discrimination, and particularly national treatment. In contrast, BCAs are a trade policy tool for ensuring that imported products that are considered relatively more carbon-intensive than domestic products do not gain unfair competitive advantages in the domestic market as a result of a domestic carbon tax (see chapter 6).

B. Subsidies

1. Subsidies for promoting CSGTs

Subsidies can be defined as financial or in-kind assistance by governments to producers or consumers of particular commodities, manufactured products or services. They may also include FiTs. Subsidies for RE and the use of associated technologies are justified on the basis that international markets fail to put a proper price on climate change (Lucas, 2009). While classified here as a financial policy in order to emphasize its usage for a wide variety of purposes, it is often used as a trade policy with the particular purpose of stimulating the export of a particular product or service through some form of financial assistance.[94] The WTO Agreement on Subsidies and Countervailing Measures prohibits specific subsidies "contingent on export performance". However, general subsidies for the support of an industry, including CSGTs, not contingent on export performance are allowed (e.g. subsidies for R&D). Direct RE subsidies would be considered "specific", which warrants their prohibition (Bigdeli, 2009).

[94] The WTO Agreement on Subsidies and Countervailing Measures defines subsidies as financial contributions by a government of public body, direct transfer of funds or potential transfer of funds (e.g. grants, loans and equity infusions), government revenue foregone or not collected, government provision of goods and services other than general infrastructure, payments to a funding mechanism or a private body to perform these functions, income or price support. Agricultural subsidies are covered by the WTO Agreement on Agriculture.

With regard to biofuels, the WTO Agreement on Agriculture allows domestic and export subsidies on the products covered under the Agreement, provided WTO members have scheduled their subsidies that are subject to reductions.[95] If members have not scheduled their subsidies, they are not allowed to introduce them. Under current proposals in the Doha Round, members have committed to phase out all agricultural export subsidies by 2013. However, some countries using subsidies as a major policy tool to promote the development and export of CSGTs are being challenged in WTO (see box II.3 in chapter 6). In order to prevent such challenges in the future, some have proposed that Article 8.3 of the WTO Agreement on Subsidies and Countervailing Measures on non-actionable subsidies be revived, which would allow RE subsidies, subject to a necessity test (Bigdeli, 2009).

Subsidies to promote the development and use of CSGTs and withdrawal of fossil fuel subsidies are important instruments for mitigating and adapting to climate change. Their use should be in line with international trade rules while any withdrawal should take the potential impact on the poor into account

Various countries have used either direct subsidies or tax exemptions to promote CSGTs, particularly RETs. In Bangladesh, all RE equipment and related RE raw materials are exempt from the 15 per cent value-added tax while loan schemes are available for RE projects. China provides financial subsidies for energy-efficient products and vehicles, among other items, and adopted a “Green Investment Plan” in 2010 to provide subsidies totalling $1.5 billion for three years for the development of alternative-energy vehicles. India has a variety of financial incentives, including interest and capital subsidies, soft loans, fiscal incentives (e.g. direct taxes, exemption/reduction in excise duty and generation-based incentives for solar and wind power projects. In the wind power sector, India grants a 10-year income tax exemption, 80 per cent accelerated depreciation, and sales tax and excise duty exemption. It provides grant subsidies for R&D up to 100 per cent of project cost to government R&D institutions and 50 per cent in the case of private institutions (WSP Group plc, 2010). Malaysia provides tax exemption on companies’ income earned via trading of carbon emission reduction credits, an Accelerated Capital Allowance to support and improve power quality of renewable projects, and tax exemptions for various industries with Pioneer Status. In Pakistan, enterprises operating RE projects are exempted from income tax, turnover rate tax and withholding tax on imports. In the Philippines, various tax incentive schemes exist for various RE industries, including biofuels. Renewable energy power plants enjoy seven-year income tax holidays and pay an annual tax rate of 10 per cent thereafter.

Under its 2009 Green Growth Plan, the Republic of Korea intends to boost energy R&D spending significantly during the next five years ($1.3 billion per year) for clean energy R&D in order to advance 27 core green technologies, including LED technology, solar power and hybrid vehicles. Preferential financing to small clean businesses will amount to approximately $900 million by 2013, and the Korean Development Bank will establish a $237 million fund to support R&D activities of private sector green industries. The Green Growth Plan also rolled out “green stimulus funding” whereby the Government would

[95] Not all biofuels are covered by the WTO Agreement on Agriculture. For example, for the purpose of the Agreement, ethanol is considered to be an agricultural good while biodiesel is not considered to be such a good.

distribute a total investment amount of US$83.6 billion between 2009 and 2013, US$22.3 billion of which would be directed to advancing green industries. In Singapore, buyers of "green" cars will get tax breaks.

In Thailand, the Board of Investment provides investment incentives to RE projects, including an eight-year corporate income tax exemption for producing solar cells, the generation of alternative source energy, the production of energy-saving machinery or RE equipment and machinery, and energy service consulting firms that provide services on the use and installation of energy-saving machinery and equipment.

2. Removing fossil-fuel subsidies

In conjunction with subsidies for the promotion of CSGTs, subsidies for the production or consumption of fossil-based energy sources, or goods produced on the basis of intensive use of such energy or which would require the extensive use of such energy when consumed, would need to be reduced or eliminated, to encourage producers to switch to (a) clean production processes, (b) produce clean products and (c) encourage consumers to demand clean products. Recent research has indicated that the removal of such subsidies would contribute greatly to global reduction of CO_2 emissions, particularly when combined with emission caps in developed countries (OECD, 2009; and IEA, 2010a).

UNEP (2008b) concluded that energy subsidies often led to increased levels of consumption and waste, exacerbating the harmful effects of energy use on the environment. In addition, such subsidies do not always end up helping the people who need them most. The Research and Information System for Developing Countries (2010), based on a review of fossil fuel subsidies in India, also observed that such subsidies led to wastage, leakage, adulteration and inefficiency when the subsidy was available to all consumers regardless of economic status. UNEP (2008b) also gave an example of how subsidization could stand in the way of rural electrification in India. According to official 2008 data, less than half of the rural Indian population has access to electricity. Electricity tariffs recover only 85 per cent of the full costs of supplying customers on average throughout the country. In addition, those subsidies do not always reach the poor, particularly the rural poor who continue to depend on logging or biomass for their fuel.

Fossil fuel subsidies work against other GHG emissions reduction policies in several ways. Through subsidizing fossil fuels, governments in fact add a "negative" cost to the use of fossil fuels. This has the detrimental effect of (a) stimulating their use and (b) reducing the competitiveness of alternative forms of energy, thus reducing investments in energy efficient technologies and non-fossil fuel energy supply. As a corollary, the removal of fossil fuel subsidies will generally (a) increase the profitability of alternative energy forms, thus increasing their use and stimulating more investments in non-fossil fuel energy supply, and (b) stimulate energy efficiency measures and related investments, thus further encouraging the development of more energy efficient technologies. Both channels will lead to reduced GHG emissions. In addition, the removal of such subsides will reduce the strain on government finances and improve the balance of payments. Box II.9 discusses the incidence of fossil-based energy subsidies in the Asia-Pacific region in more detail.

Box II.9. Phasing out fossil-based energy subsidies in the Asia-Pacific region

According to IEA (2010a), global fossil fuel consumption subsidies amounted to $557 billion in 2008, up from $342 billion in 2007, but then fell to $312 billion in 2009 due to a decline in world energy prices, domestic pricing policy and demand. Only a small portion of these subsidies reach the poor. The 2008 amount was 12 times the amount of subsidies given to the RE sector. Governments gave $57 billion of support to RE through tax credits, guaranteed electricity prices, known as feed-in tariffs, and alternative energy credits in 2009. The Islamic Republic of Iran was identified as having the highest fossil fuel subsidies at about $101 billion, or approximately a third of the country's annual budget. ESCAP members included in the overview of fossil fuel subsides in 2008 are Azerbaijan, Bangladesh, China, India, Indonesia, the Islamic Republic of Iran, Kazakhstan, Malaysia, Pakistan, the Philippines, the Russian Federation, Sri Lanka, Thailand, Uzbekistan and Viet Nam. While the subsidy levels in most countries are estimated to be relatively low, both in absolute terms and in terms of GDP (purchasing power parity or PPP), the subsidy equivalent in China, India, the Islamic Republic of Iran and the Russian Federation are estimated to range between $40 billion and $100 billion annually.

Moreover, in the case of the Islamic Republic of Iran, Turkmenistan and Uzbekistan, the subsidy levels present a large share of GDP, varying between 15 per cent and 20 per cent of GDP (PPP). The types of fuels that were subsidized in the case of the Islamic Republic of Iran mainly included oil and gas, while in the Russian Federation it was mainly gas, and in China, India and Indonesia mainly oil (although coal still presents a substantial part of Chinese subsidies). However, as noted by IEA, since 2008 a number of countries (including China, India, Indonesia and the Russian Federation) have implemented reforms to bring their domestic energy prices into line with world prices.

Various Asian countries have taken measures to reduce their fossil fuel subsidies. In China, oil product prices were indexed to a weighted basket of international crude prices in 2008. Natural gas prices increased by 25 per cent in May 2010. China has already removed preferential power tariffs for energy-intensive industries. India abolished petrol price regulation in June 2010 and plans to do the same for diesel. The price of natural gas paid to producers under the regulated price regime was increased by 230 per cent in May 2010. State-owned Coal India Ltd. announced that it would benchmark its premium grade coal to world prices. In December 2010, Indonesia approved stopping the use of subsidized fuel for private cars from March 2011 onwards. The country plans to reduce spending on energy subsidies by 40 per cent by 2013 and fully eliminate fuel subsidies by 2014. Electricity tariffs were raised by 10 per cent in July 2010. Indonesia also has an ongoing programme to phase out the use of kerosene in favour of LPG.

The Islamic Republic of Iran sharply reduced energy subsidies in December 2010 as the first step in a five-year programme to bring the prices of oil products, natural gas and electricity into line with international market levels. Cash payments are being provided to low-income groups to help them cope with the increases in energy prices. Malaysia, in July 2010, started reducing and eliminating subsidies for petrol, diesel and LPG as the first step in a gradual reform programme in July 2010. Pakistan has plans to phase out electricity subsidies and has implemented a tariff increase of around 20 per cent.

In the meantime, Asian countries are increasing their subsidies for RE. China, the leader in this area, offered direct subsidies worth $2 billion alongside low-interest loans from state banks to the sector as early as 1999. These subsidies have not always remained unchallenged under WTO rules (see box II.3).

Source: IEA, 2010a.

The removal of subsidies on fossil fuels will thus be an important, although politically challenging, step to reduce emissions. In fact, recent estimates by the IEA suggests that a phase-out of fossil fuel subsidies between 2011 and 2020 would reduce primary global energy demand by 5 per cent, global oil demand by 6.5 million barrels per day in 2020, and reduce global CO_2 emissions by 5.8 per cent (2 gigatons of CO_2) by 2020 (IEA, 2010a). Other OECD estimates have indicated that the phasing out of fossil fuel subsidies would reduce global CO_2 emissions by 10 per cent or more by 2050. OECD has also estimated that fossil fuel subsidy removal could lower GHG emissions by more than 10 per cent in China, 25 per cent in India and nearly 35 per cent in the Russian Federation. At the same time, it would increase household real income by 2.5 per cent in India and 0.7 per cent in China.[96]

While a clear case can be made for subsidy removal of fossil-based energy, the impact of such removal on different income groups needs to be considered. Depending on the carbon intensity of their consumption, and whether they are employed in sectors that may shrink as a result of the policy, the poor may be relatively more affected by the removal of the subsidy (World Bank, 2010). Lucas (2009) argued that subsidies given on the basis of protecting the poor were often specious. Withdrawal of the subsidies would generate revenue that could be channelled to pro-poor programmes. On the one hand, fossil fuel-related products may present a proportionally larger share of the budget of a poor household. On the other hand, the major consumers of fossil fuels are generally not found in this income group, but rather in the higher income groups. Thus, the subsidy would, in fact, benefit those groups more. Complementing the removal of such subsidies with the introduction of targeted transfers or tax relief for low-income households is one way to ensure that subsidy removal would achieve GHG reductions while at the same time being pro-poor.

The liberated funds from fossil fuel subsidies have many potential uses. They can be converted to subsidies for R&D in low-carbon technologies, for investments in renewable energies or other emission-friendly technological solutions, targeted as assistance to poor-income households (to ensure that subsidy cuts would not affect the poor disproportionately) or exchanged for tax reductions in other more employment stimulating areas such as employment taxes or VAT.

In the absence of a price on carbon, and considering the currently higher cost of producing RE, various kinds of support schemes for the production of such energy would be temporarily needed to ensure that this inherent market failure is addressed. A related argument is the need to enable or speed up the creation of economies-of-scale in the production of such goods. For new technologies (such as solar panels) to become affordable, they generally need to reach a certain level of consumption, and thus production. If designed appropriately, government support can lower prices of such products and thus increase demand, which in the long term will lower production costs.

Once in place, however, subsidies have a tendency to be difficult to remove. Thus, when introducing subsidies, policymakers need to ensure that they are designed in a transparent way and with a phase-out (sunset clause), or else the required increase in productivity and resulting change in prices is less likely to occur.

[96] "Tackling climate change and growing the economy: Key messages and recommendations from recent OECD work"; available at www.oecd.org/dataoecd/28/18/44287948.pdf.

C. Other financial instruments

Apart from subsidies there are other financial instruments for supporting the production and development of CSGTs. Many of those instruments have close links to subsidies or are themselves subsidies in disguise. In particular, development banks can provide soft loans for such purposes, refinanced by governments. Such loans offer flexible or lenient terms for repayment, usually at lower than market interest rates. In particular, such loans could be channelled to SMEs to raise their capacity to adopt green practices (e.g. acquire or develop CSTs). For example, the India Renewable Energy Development Agency provides loans for clean energy projects while government low-interest loans have assisted in the development of the PV industry in the Republic of Korea.

Apart from taxes and subsidies, there are many other financial instruments that governments can deploy to support climate-smart development, such as low-cost loans by development banks, green bonds, and risk insurance and guarantees. Some of these instruments require public-private partnerships

Green bonds are tax-exempt bonds that are issued by qualified central or local government agencies for the development of environmentally-friendly projects. A related concept is climate bonds, which are bonds issued by a government or corporate entity in order to raise finance for climate change mitigation or adaptation-related programmes or projects. All funds raised from such bonds will only go to climate-related programmes or assets, such as RE plants or climate mitigation focused funding programmes. Mackenzie and Ascui (2009) differentiated a climate bond from a green bond. According to them, green bond issues by a government or corporate entity were aimed at raising the finance for an environmental project. Issues of climate bonds by governments (or others) were intended to raise finance for investments in emission reduction or climate change adaptation. Such bonds operate like normal bonds, are subject to credit ratings and are normally tradable in secondary markets.

Various provisions in the tax code could be made to allow suitable tax breaks for enterprises or adopt relaxed tax calculation methods based on the equipment and technologies (and their depreciation) used by enterprises. Tax breaks could be given to enterprises that undertake R&D in CSTs or development of CSGTs, and/or enterprises that are actually already producing such goods and climate-smart services. Such measures are normally associated with the promotion of investment (see chapter 7). In the absence of an internationally-defined list of CSGTs and climate-smart services, countries could adopt their own lists for tax purposes.

Another end-user type of innovative financing mechanism is dealer-credit financing where the RE provider obtains a loan from a financial institution, either national or international, which is then converted into a loan to consumers so that they can purchase the appropriate RET. Bangladesh offers a good example of this practice whereby Grameen Shakti, a non-profit rural power company, obtained World Bank funding and then extended credit to consumers (Shrestha, 2007). Additional financial instruments include risk-sharing instruments such as catastrophe bonds, weather derivatives, mutual funds and micro-insurance index-based schemes through partnerships involving the private sector (ADB, 2009b).

The choice of financial instrument also often depends on a particular sector. Table II.5 shows the various economic and financial measures that governments can take to improve fuel efficiency in motor vehicles.

Table II.5. Economic and financial strategies to lower CO_2 emissions from the automotive sector

Acquisition tax	Lower tax for smaller engine capacity (China). Tax cut for compact and hybrid cars, and subsidy for natural gas vehicles (Republic of Korea). Auctioned vehicle permits (Singapore). Tax and fee reductions or exemptions for new clean, fuel-efficient cars (Japan).
Excise tax	Lower tax for compact cars and eco-cars, including hybrid, electric, fuel cell and alternative-fuel vehicles (Thailand).
Annual circulation tax	Annual vehicle attribute taxes and fees (European Union). Annual fees for CO_2 and smog externalities (European Union). Differentiated tax by vintage (Singapore, India and European Union). Emissions-tax deductions on cleaner cars, e.g. battery operated or alternative-fuel vehicles (Republic of Korea, European Union and Japan). Special tax for diesel-driven vehicles (Singapore).
Fuel tax	Petroleum/diesel tax (Singapore). CO_2 tax (Sweden). CO_2 tax according to engine size. 50 per cent or higher of crude oil base price (European Union and Japan). Tax incentives to promote use of natural gas (Australia, Canada, European Union, Pakistan and the Russian Federation). Urban petroleum tax (Canada). Cross-subsidization of cleaner fuels, e.g. ethanol blending by petroleum tax through imposition of lower surcharge or excise duty exemption (India). Fuel refund and subsidy for compact cars, trucks and taxis (Republic of Korea). Lower biofuel tax (Thailand).
New vehicle incentives	Clean car rebates (Japan and the United States). Petrol guzzler tax (United States). Variable purchase tax with fuel consumption (Austria). Incentives to promote natural gas vehicles (Malaysia, Pakistan, India, Islamic Republic of Iran, United Kingdom, United States and Australia). Tax relief based on engine size, efficiency and CO_2 emission (European Union and Japan). Early scrapping (China). Rebate for new and green cars (Singapore). Clean energy vehicles (Thailand).

Table II.5. *(continued)*

Road fees	Road pricing/high occupancy toll lanes (United States). Congestion pricing (United Kingdom). Electronic road pricing (Singapore). Road and bridge fee (Viet Nam). Low parking fees and toll cuts for compact cars (Republic of Korea).
Vehicle insurance	Fines for lack of mandatory insurance (United Kingdom and the United States). Insurance-specific auto tax (France). Pay-as-you-drive and pay-as-you pump insurance (United Kingdom and the United States).
Fleet vehicle incentives	Cost-effective, clean and fuel-efficient public fleets (Canada). Incentives for clean, fuel-efficient company cars (United Kingdom). Incentives for public transport companies (Malaysia).
Incentives for the development of clean car technologies and alternative fuels	Subsidies and grants for introducing clean and environmentally efficient technologies (China and Japan). Incentives for particular technologies and alternative fuels (European Union, Japan and Thailand). Exemption from corporate income tax and import duties throughout the national value chains of eco-cars and renewable and alternative fuels (Thailand).
Congestion pricing	Area licensing scheme, vehicle registration fees and annual circulation tax (Chile, Singapore, Norway and Belgium). Toll pricing based on congestion charging (United Kingdom and the Republic of Korea).

Sources: Amin, 2009; Hirota, 2010; IPCC, 2007; Sauer, 2005; and World Economic Forum, 2009.

D. Policy recommendations

Based on the above discussion, the following recommendations can be briefly summarized as:

(a) Provide financial support for the production, development and use of CSGTs and climate-smart services. Such support can take the form of soft loans, green and climate bonds, tax breaks or subsidies;

(b) Financial incentives should be temporary, performance-based and easy to implement (World Bank, 2008);

(c) Care should be taken that any form of financial support conforms to WTO rules and does not unduly or intentionally distort trade;

(d) In particular, any form of subsidy or financial assistance should be transparent and fair, and should not accord more favourable treatment to domestic producers, products and services over foreign producers, products and services;

(e) In order to discourage the use of fossil fuels and forge a change in consumer behaviour towards the use of RE, countries should put a price on the use of carbon in order to send clear signals to business and consumers alike. A market-based mechanism such as the carbon tax is the most favoured method in this regard. The revenue generated from such a tax should be used to subsidize consumption and/or production of CSGTs;

(f) In addition, countries should phase out tax breaks and subsidies on fossil fuels and use the savings to encourage production and use of RE, or provide other forms of tax breaks or financial assistance to the poorer segments of society. Such a phase-out should take place gradually in line with the increasing availability of RE at affordable prices.

CHAPTER 9

DEVELOPING AND ALIGNING NATIONAL AND INTERNATIONAL CLIMATE-SMART STANDARDS AND LABELLING

A. National climate-smart standards and labels: an overview

1. Rationale and overview

Climate-smart standards refer to technical standards which help to certify that the use or production of a specific product or application of a specific process has a minimum or no impact on GHG emissions. Such standards and regulations can be mandatory or voluntary, and public or private in nature. They can be further related to products or processes/production methods. Finally, they can be based on design/descriptive characteristics (e.g. the quality and specifications for biofuels), or dictate performance requirements (e.g. emissions per amount of energy used). Performance-based requirements are often established to stimulate the development of more efficient products while, at the same time, encouraging the removal of environmentally less cost-effective products from the market. The level of performance may be calculated based, for example, on the most efficient product in its category, or on the average energy consumption of emissions of all products in a particular category (WTO-UNEP, 2009). More generally, standards cover the following aspects of attempts to mitigate climate change:

(a) Monitoring and measurement of GHG emissions;

(b) Measuring the carbon footprint of networks and products;

(c) Designing and building energy efficient homes and workplaces;

(d) Benchmarking good practices including environmental and energy efficiency labelling;

(e) Promoting good practices for environmental management and design, and for energy management;

(f) Disseminating innovative technologies that promise to help reduce the effects of climate change;

(g) Fostering the introduction of new energy-efficient technologies and services.

Mandatory and voluntary private technical climate-smart standards and labels are a powerful tool to influence consumer behaviour and upgrade climate-smart competitiveness of enterprises along whole value chains. However, they should conform to international trade rules and not be abused as disguised forms of protectionism

Consumers need to be informed that the product conforms to international and national standards. For that reason, labelling schemes are used. By providing consumers with comparable information on which to base their purchase decisions, labelling schemes allow consumers to have an important impact on reducing emissions. Recently, environment-related labels targeting Asia-Pacific domestic consumers, including those in developing countries/economies, have been steadily growing in number (e.g. Japan's Eco Mark, the Republic of Korea's Eco-labelling Programme, Singapore's Green Label, Thailand's Green Label and Green Mark of Taiwan Province of China).

Since the 1980s, eco-standards and labels have been adopted by most developed countries as well as a growing number of developing countries, particularly in the field of energy efficiency. It has been estimated that the resulting energy efficiency improvements have resulted in savings of more than 50 per cent in energy consumption over the past 30 years (IEA, 2008). In 2000, it was estimated that comprehensive use of standards and labels for appliances and other equipment already had the potential to reduce electricity consumption and resultant GHG emissions in developing countries by 10-20 per cent during the next 20 years.[97]

Standards and labels are primarily developed to influence consumer purchasing decisions and thus are an information tool for consumers. They also play an important role in forcing enterprises to upgrade their production processes as well as stimulate them to develop CSGTs and use clean technologies. However, since they can also be used as a trade policy tool to protect domestic industries, they may therefore be unnecessarily stringent. A recent World Bank (2008) study found that efficiency standards were more likely to adversely affect industrial competitiveness than carbon taxes, particularly in sectors such as metal products and transport equipment. Interestingly, for those industries, the analysis also suggested that it did not matter whether such standard requirements were imposed by the exporting country, the importing country or both.

For that reason, the WTO Agreement on Technical Barriers to Trade (TBT): (a) sets out specific rules and guidelines for the development and use of national standards; and (b) promotes the harmonization of national standards and use of, or conformity to international standards. The Agreement applies to mandatory standards set by government bodies and non-governmental organizations (NGOs). There is no consensus on whether standards or technical regulations on non-product-related production and process methods, and private voluntary standard and labelling schemes fall within the purview of the

[97] See United Nations Department of Economic and Social Affairs website at http://esa.un.org/techcoop/flagship.asp?Code=GLO99095.

Agreement. However, the Agreement sets out a Code of Good Practice for the Preparation, Adoption and Application of Standards (Annex 3 of the TBT Agreement) for governments as well as non-governmental or industry bodies to prepare, adopt and apply voluntary standards. More than 200 standards-setting bodies apply the Code.[98] The three leading international standardization organizations are the International Electrotechnical Commission, the International Organization for Standardization (ISO) and the International Telecommunication Union. These three bodies are coordinating their work to ensure that government, business and society are provided with the necessary tools to help combat global climate change and to support the reduction of GHG emissions by increasing energy efficiency.

2. Categorization of national climate-smart standards and labels

The categories of national climate-smart standards and labels are detailed below.

(a) Energy efficiency standards and labels

Energy efficiency standards are aimed at enhancing energy efficiency and conservation that can result in increased economic productivity, financial savings and international competitiveness for companies using or producing CSGTs. These standards are the most widely accepted climate-smart standards, as there is more international consensus on the need for energy efficiency than on the need to reduce GHG emissions. These standards are also important modalities for promoting environmental sustainability in general.

Numerous countries in the region have already set national level targets. India, for example, aims to save about 10,000 MW by 2012 as indicated in its National Mission for Enhanced Energy Efficiency (NMEEE), which contains energy efficiency standards for household appliances. India also introduced mandatory labels in January 2010 for products such as refrigerators, transformers, air conditioners and tube lights. China’s energy conservation labelling programme was launched in 1998 for pilot products such as refrigerators, and expanded to more than 50 product categories. China’s goal was to reduce its energy intensity by 20 per cent from 2005 levels by 2010. The Republic of Korea established a strategy to support higher energy efficiency products and eco-friendly industries through the High-efficiency Appliances Certification Programme and e-Standby Programme for energy efficiency labelling.

(b) Fuel efficiency standards

Adopting robust fuel efficiency standards for automobiles has the potential to spur demand in energy-efficient technologies used in the automobile industry as well as mitigate GHG emissions from the transport sector. Many developing countries have recently announced plans to increase their fuel efficiency standards. China, for example, is planning to raise its fleet-wide fuel economy average standard to 42.2 miles per gallon by 2015. According to its National Strategy on Climate Change, Thailand is also planning to improve

[98] See WTO website at www.wto.org/english/thewto_e/whatis_e/tif_e/agrm4_e.htm#TRS.

Box II.10. Vehicle fuel-efficiency standards

Energy efficiency standards take on special importance in the context of carbon emissions from vehicles, as they are a major contributor worldwide to GHG emissions. As a result, fuel efficiency and CO_2 emission standards, including CO_2 emission labelling schemes have emerged as particularly powerful tools for promoting the reduction of CO_2 emissions from automobile use. American, European and Japanese automobile manufacturers, among others, have steadily increased the average fuel efficiency of new cars in compliance with relevant fuel-efficiency standards. Other countries/ economies in the region that have implemented fuel-efficiency standards are China, the Republic of Korea, Taiwan Province of China and Thailand. As yet, no country in the region has adopted a CO_2 emission standard scheme.

The criteria applied to fuel efficiency standards vary depending on the country or region of implementation. First, the standards typically target one of three related but different objectives, i.e. fuel economy, fuel efficiency and CO_2 (and other greenhouse gas) emissions. Second, the standards use different test methods, such as test driving cycles. Third, they are implemented on either a mandatory or voluntary basis, although the global trend is shifting towards mandatory regulatory standards (e.g. the European Union's new mandatory regulation of 2008 and Canada's new vehicle emissions standards for 2011).

Different requirements of the various fuel efficiency standards among vehicle segments and/or weight-classes have become a critical issue for the effectiveness of the standards. Three types of requirements are widely used (European Federation for Transport and Environment, 2008). First, weight-based standards encourage the development of technologies for greater fuel efficiency while promoting product diversification. It may punish car-makers that produce lighter vehicles, one of the most important options for reducing CO_2 emissions and fuel consumption. Instead, such standards could lead to an increase in vehicle weight, and achieving the intended level of fuel efficiency could be more difficult to achieve.

Second, footprint-based standards are based on track width multiplied by wheel base. Footprint-based standards leave more technological options open to car-makers for reducing CO_2 emissions and may not penalize weight reduction too much as a compliance option. However, their effectiveness may be smaller if car-makers move to high-profit, large-size vehicle segments, which carry heavier weights, thus less fuel economy.

Third, flat standards, not differentiated for vehicle weight or footprint, offer direct guarantees for achieving CO_2 emission targets, and encourage greater fuel efficiency overall, regardless of vehicle weight and size. In any case, the achievement of CO_2 reduction targets must be guaranteed by correcting for unforeseen increases in average vehicle weight or footprint. However, such targets pose far greater compliance challenges for large car manufacturers than for small-sized car manufacturers.

Two problems arise with regard to these standards. First, the standards currently in place cover a relatively short period, none extending beyond 2020, which creates regulatory uncertainty for car-makers working with long development and investment cycles. Second, different safety regulations and compliance methods are enforced around the world. As a result, it is difficult to compare existing standards with total accuracy. As many different fuel efficiency standards exist worldwide, the automotive sector has proposed the development of universal standards for the global market.

its fuel economy standards for new vehicles. India, under its twelfth five-year plan, intends to make fuel efficiency standards mandatory for all vehicles by December 2011. New Zealand has also implemented legislation for energy-efficiency labels known as the Vehicle Fuel Economy Labelling Regulations of 2007. It stipulates that every passenger car at the point of sale requires fuel economy information labels to be displayed. See box II.10 for more details about these types of standards.

(c) Minimum energy performance standards

Minimum energy performance standards (MEPS) refer to energy performance criteria for devices that use electricity such as air conditioners, refrigerators or lights, which must be legally adhered to in order to enter the market. These standards also apply to imports and can thus be viewed as a market barrier to less energy-efficient products that do not comply. As such, adopting MEPS promotes trade and investment in CSGTs, especially energy-efficient ones. MEPS throughout Asia and the Pacific have been growing, both in terms of their application by developed and developing countries/economies and in terms of the level of performance required. Australia and New Zealand have closely aligned their MEPS and energy performance labels – which cover electric motors, lamps, air conditioners, televisions and distribution transformers, among others – so as to ease regulatory compliance for producers and importers who operate in both markets. The Republic of Korea adopted its Energy Efficiency Label and Standard Programme as early as 1992. Under the Programme, the country has required imported and domestically manufactured products to indicate their energy performance ranging from 1 to 5 on a label, with 1 being the highest level of performance.

Products that do not meet the necessary minimum performance standard are banned. China and Thailand recently passed legislation for establishing MEPS for appliances and equipment. The Government of Indonesia has also promoted energy efficiency standards for lighting products and many appliances. Even though a complementary labelling programme has supported these standards in Indonesia, they have been viewed as ineffective and have yet to gain traction owing to insufficient public awareness (ESCAP, 2010a). Turkey has mandated energy labels for many household appliances since 2002. Energy labelling in India became mandatory as of 2007 for various electrical appliances.

(d) Greener building codes

Numerous countries and economies in Asia and the Pacific are developing their own institutions and standards for assessing the energy, water and waste-efficiency performance of buildings. Examples include: Australia’s Green Star, China’s Green Building Assessment Method and Green Building Network; Hong Kong, China’s Building Environmental Assessment Method; India’s Indian Green Building Council; Malaysia’s Green Building Index; New Zealand’s Green Star; and Singapore’s Green Mark. The Republic of Korea adopted mandatory building energy standards in 2004. These codes were not as descriptive or as detailed as in Germany and the United States and more closely resembled those in Japan and the United Kingdom.

In the Republic of Korea, the new action plan for emission reductions seeks to further improve the country's building energy performance. The plan requires building owners to significantly reduce energy consumption and encourage the replacement of conventional structures with "zero energy" buildings that produce their own energy from renewable sources such as wind, solar and geothermal power as of 2025 (J-H. Lee, 2009). In India, the States of Delhi, Haryana, Uttarakhand and Gujarat are among the first moving towards mandating building codes that encourage energy conservation and efficiency (Gombar, 2009). Japan recently indicated that it will finally be moving away from voluntary targets to mandatory energy-saving standards for new buildings, which will apply to windows, thermal insulation and outer walls (Kyodo News, 2010).

(e) Carbon emission standards and labels

While energy-efficiency labelling schemes are the most common, labels may also be used, for example, to communicate other information regarding: how a product has been produced in terms of life-cycle impact, environmental friendliness (e.g. eco-labels); fair payment for growers (fair trade labels); and how the emissions are generated during the transport of a product ("food miles"). These standards are more controversial and can be rather trade-restrictive.

The impact of transportation in the trade of goods has resulted in the introduction of so-called "food miles" which informs consumers about the actual distance various items have to be transported to reach the retail store. The idea is that the greater the distance, the higher will be the GHG emissions related to transportation. However, critics of the concept have pointed out that transportation is only one aspect of the carbon footprint of a particular product and when emissions over the whole life cycle of the product are taken into account, the total carbon footprint of a product may be actually lower when produced at greater distance from the retail store. For example, Appleton (2009) found that based on the life cycle analysis, cut roses grown in Kenya for the British market were 5.8 times more carbon-efficient than Dutch greenhouse flowers, even after accounting for emissions caused by air freight. The implementation of the food miles concept would also hamper international trade and may be abused for protectionist purposes. In this context, carbon labelling is a better alternative than food miles in addressing concerns about carbon emissions associated with international trade.

With regard to carbon disclosure through labelling, countries such as Japan, the Republic of Korea and Thailand have all adopted carbon footprinting programmes on a voluntary or mandatory trial basis (Asian Productivity Organization, 2010). The Republic of Korea is pioneering one of the most progressive policies, which requires all new appliances and vehicles produced for the domestic market to display the CO_2 emitted per hour of use and kilometres driven, respectively. Another good example is Japan's Carbon Footprinting Pilot Programme, which was brought into force at the national level in 2009. For firms seeking to display the Carbon Footprint Label on their marketed products, the CO_2e of GHGs emitted over the entire product's life cycle must be calculated and verified, and the methodology for doing so must be approved by the specified government institution (Japan, 2009). Calculating a product's carbon footprint over its entire life cycle has been made easier in Japan by the establishment of a national Life-Cycle Index database that, as of early 2010, contained more than 900 individual indices (Asian Productivity Organization, 2010). Other countries, such as Malaysia, are also working diligently to build their national life-cycle index databases. According to SIRIM,[99] as of May 2010 Malaysia's database contained slightly more than 40 individual indices.

Carbon standards and labelling schemes are important mechanisms for influencing consumer behaviour and promoting business competitiveness. However, compliance is expensive and cumbersome for many developing countries, as the exact measurement of carbon content over the life cycle of a particular product is difficult and because there is no uniformity in such standards

Carbon standards and labelling schemes are not without problems. First, the costs of conformity and certification are often prohibitively high for developing countries that lack the capacity to conform to standards, which are sometimes deemed to be too restrictive. Such standards, and the labels that go with them, would hamper exports from developing countries. The administration and transaction costs associated with carbon labelling are also significant. The cost of labelling is also likely to vary according to the methodology or standards adopted. A complex methodology for measuring a carbon footprint would increase the cost of data collection and calculation of the carbon footprint as well as the cost of verification. However, a simpler methodology would mean that it would be less reliable and increase the possibility for loopholes. Furthermore, it would be almost impossible to have a measure of carbon emissions of products on a life-cycle basis, particularly for emissions due to transport, as they not only vary from market to market but also depend on the mode of transport (Nanda and Ratna, 2010). Another problem relates to the many different standards prevailing in different markets. For that reason, international standards and labels have emerged. This issue is further explored in the following section.

B. International carbon standards and labels

The carbon standard and labelling schemes described above are imposed at the national level. A bewildering array of different standards prevailing in different markets clearly poses a huge obstacle for many enterprises, particularly SMEs, in developing countries and undermines their export competitiveness. Standardizing life-cycle analysis, labelling, GHG management and carbon footprinting methodology across countries and international markets is therefore a key factor for promoting international trade of and investment in CSGTs as well as reducing the costs to suppliers for meeting numerous and often differing criteria. Such costs can be relatively higher for small-sized green exporters from developing countries that lack economies-of-scale and seek to enter multiple international markets. While the internationalization of technical product standards is still lacking, there are various international NGOs that issue standards evaluating the carbon-footprint of a certain product or production process, i.e. to what extent a particular production process (or product) contributes to, or reduces GHG emissions, or to what extent a climate mitigation project

[99] Formerly known as the Standards and Industrial Research Institute of Malaysia.

contributes to GHG emission reduction. Such an exercise is necessary for developing climate-smart labels and certification schemes.

The ISO 14000 series is a good example of a global system of generic standards developed by ISO to address environmental management, i.e. standards to minimize harmful effects on the environment caused by the activities of an organization, and to achieve continual improvement of its environmental performance.[100] In particular, ISO has developed its 14025, 14040/44, 14064/65, and 14067 (under development) standard series. ISO 14025 establishes the principles, and specifies the procedures, for developing Type III environmental declaration programmes and Type III environmental declarations,[101] which are primarily intended for business-to-business use; however, their use in business-to-consumer communication under certain conditions is not precluded. Examples of ISO 14025 Type III certified labels in Asia and the Pacific include Japan's Eco Leaf and the Republic of Korea's Environmental Declaration of Products. ISO 14040/44 explains the principles of, and framework for life-cycle analysis. The 14064/14065 series relates directly to GHG emissions and is explained in table II.6. The ISO 14067 series, which is still under development, builds on the life-cycle analysis framework of 14040/44 by providing a uniform quantification methodology for calculating GHG emissions for carbon footprinting of goods and services.

Various governments throughout the region have already started providing financial incentives for companies to gain accreditation. Singapore, for example, through SPRING Singapore provides grants to local companies participating in the Standards Implementation for Productivity (SIP) pilot project, covering as much as 70 per cent of the qualifying costs for adopting ISO 14064 greenhouse gas management standards (Green Business Times, 2010). One option for increasing intraregional trade would be to agree on a common definition of climate-smart goods, a methodology for calculating a product's carbon footprint and a green label.

A non-product-related but well-known GHG emissions-related standard is the Gold Standard, which is the only independent global standard for creating high-quality emission reductions projects developed under the Kyoto Protocol Clean Development Mechanism. The Gold Standard was first developed by the World Wide Fund for Nature, South-South-North and Helio International in 2003. The latest version was issued in July 2008. The Gold Standard has developed into a non-profit foundation under Swiss law. An additional Voluntary Gold Standard, a methodology for use within the voluntary carbon market, was launched in May 2006.

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[100] See www.iso.org/iso/iso_catalogue/management_standards/iso_9000_iso_14000.htm.

[101] An environmental declaration (or label) is a claim that indicates the environmental aspects of a product or service. (An environmental label or declaration may take the form of a statement, symbol or graphic on a product or package label, in product literature, technical bulletins, advertising or publicity, among other methods.) A Type III environmental declaration is an environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information. A Type III environmental declaration programme is a voluntary programme for the development and use of Type III environmental declarations, based on a set of operating rules.

Table II.6. ISO standards on GHG emissions

ISO Standard	Description
ISO 14064-1:2006	Specifies principles and requirements at the organization level for quantification and reporting of GHG emissions and removals. It includes requirements for the design, development, management, reporting and verification of an organization's GHG inventory.
ISO 14064-2:2006	Specifies principles and requirements, and provides guidance at the project level, for quantification, monitoring and reporting of activities intended to cause GHG emission reductions or removal enhancements. It includes requirements for planning a GHG project, identifying and selecting GHG sources, sinks and reservoirs relevant to the project and baseline scenario, monitoring, quantifying, documenting and reporting GHG project performance and managing data quality.
ISO 14064-3:2006	Specifies principles and requirements, and provides guidance for those conducting or managing the validation and/or verification of GHG assertions. It can be applied to organizational or GHG project quantification, including GHG quantification, monitoring and reporting carried out in accordance with ISO 14064-1 or ISO 14064-2. In addition, ISO 14064-3:2006 specifies requirements for: selecting GHG validators/verifiers; establishing the level of assurance, objectives, criteria and scope; determining the validation/verification approach; assessing GHG data, information, information systems and controls; evaluating GHG assertions; and preparing validation/verification statements.
ISO 14065:2007	Specifies principles and requirements for bodies that undertake validation or verification of GHG assertions.

Source: International Standard Organization at www.iso.org.

The World Resources Institute and the World Business Council for Sustainable Development developed the Greenhouse Gas Protocol (GHG Protocol) which is "the most widely used international accounting tool for government and business leaders to understand, quantify and manage GHG emissions".[102] The GHG Protocol has two subsets:

(a) The Corporate Accounting and Reporting Standards (Corporate Standard), which are "methodologies for business and other organizations (including public sector organizations) to inventory and report all GHG emissions they produce."[103]

(b) The Project Accounting Protocol and Guidelines, which "are geared towards calculating reductions in GHG emissions from specific GHG-reduction projects".[104]

[102] See www.ghgprotocol.org/about-ghgp.

[103] Ibid.

[104] Ibid.

In a recent development, two new draft GHG Protocol standards – the Product Life Cycle Accounting and Reporting Standard and the Corporate Value Chain Accounting and Reporting Standard – have been developed with the purpose of providing methods for accounting for emissions associated with individual products across their life cycles, and of corporations across their value chains.[105]

There are many other sets of voluntary project-related standards set by various NGOs. For example, the Climate, Community and Biodiversity Alliance (CCBA) is a partnership of international NGOs and research institutes seeking to promote integrated solutions to land management around the world. With this goal in mind, CCBA has developed the Climate, Community and Biodiversity Standards that enable investors, policymakers, project managers and civil society observers to evaluate the social and environmental impacts of site-based forestry, agriculture and other land-use climate change mitigation activities.[106]

Such standards are also useful to governments. At the Copenhagen Conference, CCBA, in cooperation with CARE International and local government institutions in Nepal, Ecuador and Tanzania, released a set of global standards for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) programmes. Known as the REDD + Social and Environmental Standards Initiative, the standards provide countries with a way of demonstrating the social and environmental benefits of their REDD programmes, both their own citizens and to the wider international community.

These standards also provide safeguards against the potential negative social and environmental impacts of REDD that are of concern to indigenous peoples and other people depending on forests for their living. The Initiative is unique in the way that it is (a) developing global standards that can be applied across all countries implementing REDD, (b) using a global public consultation process, and (c) the fact that the governments and civil societies of REDD countries are at the forefront of the initiative.[107] Other global forestry-related standards to measure the performance of projects aimed at offsetting carbon emissions and promoting sustainable forest management include the Voluntary Carbon Standard and CarbonFix standards.[108] The Forest Stewardship Council is also increasing its role in setting standards and providing tools for responsible forest carbon accounting.

There are also specific sectoral bodies that issue standards related to GHG emissions and/or climate change mitigation in their respective areas. Some of these bodies, in turn, are organized under an umbrella organization known as the ISEAL Alliance, which is the global association for social and environmental standards. ISEAL develops guidance, and helps strengthen the effectiveness and impact of established and emerging voluntary

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[105] See www.ghgprotocol.org/sixty-corporations-begin-measuring-emissions-from-products-and-supply-chains.

[106] See www.climate-standards.org/pdf/CCB_Standards_Rules_Version_June_21_2010.pdf.

[107] See, for example, www.conservation.org/newsroom/pressreleases/Pages/New-REDD-Social-Environmental-Standards.aspx.

[108] See: http://v-c-s.org/ and www.carbonfix.info/.

standard systems.[109] ISEAL also has a Code of Good Practice for Setting Social and Environmental Standards that sets out requirements for the process by which standards are developed and revised and for the structure of a standard. The International Civil Aviation Organization's Committee on Aviation Environmental Protection, sets standards for emissions generated by aircraft engines. There are no global vehicle fuel efficiency and emission standards, nor are there any for specific industries. Rather, these standards are set by national regulators; however, some have the potential to evolve into global standards for GHG emissions in specific industries, particularly those developed in the European Union and the United States.

C. Policy recommendations

Based on the above discussions, the following recommendations are proposed with regard to the development and use of standards as a tool to mitigate GHG emissions:

(a) Carbon and energy efficiency standards are an important tool for mitigating GHG emissions. Therefore all countries should actively participate in the development and enforcement of such standards. Developing countries will also benefit from such standards, as some have a competitive advantage in energy-efficient products. They should actively participate in developing and enforcing such standards rather than remain passive. In developing national and international standards and labelling schemes, issues such as clear product information, labelling and language should be taken into account;

(b) In developing national standards, involve all stakeholders, including business and consumers, and ensure that those standards are consistent with national public policies on climate change mitigation;

(c) National standards should conform, to the maximum extent possible, to existing international standards, not pose an unnecessary obstacle to international trade, and they should be WTO-compliant. In particular, national and international standard-setting bodies should conform to the Code of Good Practice as annexed to the WTO TBT Agreement. For that purpose it is important, when designing carbon and energy efficiency regulations, labelling and certification programmes, to use objective criteria and impartial conformity assessment procedures;

(d) Standards should be harmonized across industries so that small-sized suppliers do not have to conform to multiple standards imposed by their various customers. This is primarily a business responsibility. Businesses in leading positions in any value chain should collaborate, preferably through a particular industry association or chamber (where one exists) to publish a reference manual and guide on prevailing standards for the use of smaller suppliers and consumers alike;

[109] See www.isealalliance.org/content/about-us.

(e) Developing countries should proactively address the issue of standards and labelling by developing the capacity to conform to them as a means of developing international competitiveness in the emerging market of CSGTs and climate-smart services. As standards are, to a large extent, consumer driven, they will not be removed or relaxed easily unless a clear case can be made that they are used for protective purposes; however, this would involve a costly and lengthy dispute settlement process.

CHAPTER 10

PROMOTING THE TRANSFER AND DEVELOPMENT OF CLIMATE-SMART TECHNOLOGIES

A. Rationale and overview

It is argued in this report that trade and investment can contribute to mitigation of GHG emissions if producers switch from using fossil fuel-based technologies to using CSTs, particularly RETs. This switch requires both sustained and concerted efforts to improve transfer of CSTs and develop national level capacities to develop such technologies. Technology transfer is a term used to describe not only the flow of equipment, but also the facilitation of access to the knowledge skills and information needed to properly make use of it (ICTSD, 2008b). The different modalities through which technology can be transferred include direct purchases, licensing or franchising, FDI, joint ventures, cooperative research arrangements, exports of products and capital goods, exchange of scientific and technical personnel, and education and training or government assistance programmes (Metz and others, 2000).

Hayes (2010) pointed out that much of the technology needed to respond to climate change was the same as that needed to solve other sustainability problems. CSTs are therefore an important part of environmentally sound technologies (ESTs) and the discussion in this chapter is also relevant to ESTs in general.[110] Many CSTs already exist but require further development and commercialization. Examples are applications in information and communication technology (ICT) such as the smart grid and nano-technologies (e.g. for insulation of buildings). Box II.11 identifies CSTs of relevance to the agricultural sector.

IPCC Working Group III on Climate Change also concluded that the “range of stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are currently available and those that are expected to be commercialized in the coming decades. This assumes that appropriate and effective incentives are in place for the development, acquisition, deployment and diffusion of technologies, and for addressing related barriers” (IPCC, 2007).

The development and application of climate-smart technologies, in particular renewable energy technologies, is central to mitigating climate change. For this reason, concerted efforts are needed at the national and regional levels to develop and remove barriers to transfers of such technologies

[110] A holistic overview of issues related to the development and transfer of ESTs can be found in Berkel, 2008.

Box II.11. CSTs of relevance to the agricultural sector

CSTs can generally be separated into four distinctive categories that have special relevance to the agricultural sector: greenhouse gas mitigation technology; energy efficiency technology; clean energy technology; and new environmental technology.

First, greenhouse gas mitigation technology in agriculture includes mitigation technology for reducing methane and nitrous oxide in farmland, soil organic carbon storage technology, technology for improving intestinal fermentation of ruminant animals and animal manure treatment facility, and technology for biomass utilization and fossil fuel reduction. Nevertheless, greenhouse gas mitigation technology is not widely used in rural areas due to the low level of technology acceptance among farmers.

Second, energy efficiency technology includes technologies for improving heat recovery ventilators and heat exchangers. Technology development in this area has progressed to such a great extent in some countries (e.g. the Republic of Korea) that heat exchanger improving technology for warm air heaters and exhaust heat recovery facilities for warm air heaters are already in the distribution stage. Technology development and formulation of complementary plans for achieving economic efficiency should continue so that energy efficiency technology can be easily accessible in rural areas.

Third, clean energy technology refers to a technology that utilizes clean energy sources or RETs, such as geothermal power, solar power (photovoltaic), wind power, and multifold thermal covers and water filter protection curtains. Clean energy technology also involves the development of production models for cellulose crops to produce bio-ethanol, such as canola, sweet potatoes for ethanol and C4 (non-food crops), and cellulose ethanol.

Fourth, new environmental technology includes: bio-crop protection agents using natural materials, biological pesticides such as environmentally-friendly micro-organisms and natural enemies: development of urban building-type plan systems for crop production through the convergence of agriculture and cutting-edge technologies (such as nanotechnology, biotechnology, information technology and environment technology); and commercializing new convergence green technology, including the production of rice bran products using supercritical fluid (materials at temperatures and pressures above critical level) and the introduction of bio-refineries for rice.[a]

Source: Kim and others, 2007.

[a] Bio-refinery refers to a technology that does not use oil to produce industrial materials and energy, but produces raw materials for the energy industry, such as renewable biomass (rice, rice bran and corn), to prepare for oil depletion, and to significantly reduce climate change and environmental pollution.

However, effective technology transfer entails more than just the transfer itself. The transferred technology needs to be properly diffused and adopted and adapted to fit local needs and requirements. In other words, without local capacity, skills or opportunities to effectively access or utilize transferred technology, the transfer of technology is not effective (UNCTAD, 2010). Technology transfer and diffusion are also not automatic, easy and predictable processes. Technology transfer and development are basically functions of trade and investment, and these processes require an enabling environment. In addition, many of the problems associated with technology transfer arise because of issues related to the sharing of the “value and benefits” that accrue due to the transfer of a useful technology, such as CSTs.

Studies indicate that it takes an average of 24 years for energy sector inventions to reach a level of wide-scale use in the market, and as much as three years just to register a patent. Achieving the mitigation targets set within the Copenhagen Accord will necessitate reducing this timeframe for the diffusion of CSTs by at least half (Lee, Iliev and Preston, 2009). It is against this background that some form of compromise and revision must be made.

UNCTAD (2009) argued that climate-friendly technological change advances faster when it benefits from public support, particularly public funding for R&D. Already, many Asia-Pacific countries are promoting a wide spectrum of technologies and goods that can be termed as climate-smart, including technologies related to energy conservation, improvement of energy efficiency, and new and RE technologies. The focus varies widely among countries in the region depending on the specific needs and availability of resources in the respective countries (table II.7). Most countries have adopted a multi-pronged approach for R&D, innovation, prototype development, commercialization, demonstration projects for wider applicability and dissemination, technology transfer etc. Many of the strategies chosen for the promotion of climate-smart goods and technologies include private sector participation, FDI, public-private partnership (PPP), and R&D collaboration and partnerships.

Table II.7. CSTs promoted by selected Asia-Pacific countries

Countries	Technology focus
Bangladesh	Solar water heaters, solar photovoltaics, grid-connected PV, solar and wind hybrid, solar and diesel hybrid, improved stoves, solar cookers (box type), solar cooker (parabolic), solar dryer, solar wood-seasoning plant, solar home system, solar water pumping, centralized solar electrification/mini-grid, improved biomass cooker, biomass briquetting machine, biogas plants, biomass gasifier, wind power (with battery), grid-connected wind power, wind and diesel hybrid, water pumping wind mill/irrigation and micro-hydro.
China	Family-use photovoltaic power system, small-scale photovoltaic power plants, solar energy building, solar water heater, solar greenhouse and solar stove, energy-saving lamps and wind-power generation equipment. Energy-conserving and new energy cars, coal-bed methane and natural gas hydrate, in-process energy conservation of large-scale coal-fired generation units, distributed generation systems, MW-class wind power generation units, fuel cells, nuclear fuel recycling and nuclear safety, clean coking processes and equipment, semiconductor lighting. Integral utilization of waste electromechanical products and plastic resources, biogas, biomass briquette and biofuel, low-temperature waste heat power generation, coke dry-quenching, top pressure recovery turbine, clinker production using calcium carbide slag in the dry process, disposal of waste in blast furnaces and rotary kilns. Geothermal heat pump technologies.
Fiji	Solar home systems, solar photovoltaics, hybrid power systems, small hydro-power projects, biofuel.

Table II.7. *(continue)*

Countries	Technology focus
India	Renewable energy technologies, integrated gasification combined cycle technology. Supercritical coal combustion technologies.
Indonesia	Biofuel (bio-diesel and bio-ethanol), geothermal energy.
Malaysia	Technologies related to RE, energy efficiency and solid waste management.
Nepal	Micro-hydro power, solar, biomass energy (biogas, briquettes, biofuel and biomass gasification).
Pakistan	Renewable energy technologies.
Philippines	Medium-scale wind pump, wind turbine generators, micro-hydro battery, micro-hydro power plant, solar PV technology, polycrystalline silicon solar panels, solar water heaters, solar dryers, biodiesel, smokeless charcoal briquettes for cooking, biomass cook stoves, improved cook stoves, biomass-fired power plants, biomass integrated gasification combined cycle, cogeneration, biomass gasifier system, biomass-fired boilers, ovens, furnaces, kilns, pyrolysis, liquefaction, densification (briquetting), alcohol-based fuels, coconut-based fuels, ocean thermal systems, ocean current energy systems, wave energy systems, hydrogen-based fuels, landfill gas, mini-, micro- and pico-hydropower plants, LPG systems for diesel-run vehicles, waste cooking oil systems for vehicles.
Sri Lanka	Dry-batch biogas plant, large-scale biogas-cum-organic fertilizer production plant, micro-hydro turbine, solar water heaters and distillers. Paddy husk-fuelled bakery oven, wood gas stove, solar- and sawdust-operated vegetable dryer, saw dust/paddy husk fuelled incorporated with a blower, solar home systems and village hydro-power projects.
Thailand	Ethanol, biodiesel, heat/power generation from biomass, biogas, power generation from MSW, cogeneration, wind turbine, solar cell and small hydro-power projects.

Source: Asian and Pacific Centre for Transfer of Technology.

While developed countries continue to lead in CST innovations, selected emerging developing countries such as China and India are starting to make key contributions. Developing countries worldwide accounted for 23 per cent ($26 billion) of new investments in energy efficiency and conservation, and RE in 2007, of which 82 per cent took place in Brazil, China and India (UNEP, 2008a).[111] In 2005, China was seventh in overall RE patenting and second only to Japan in geothermal and cement inventions, two core potential sources of emissions cutting (OECD, 2008).[112]

[111] UNEP, 2008a as cited in World Bank, 2010.

[112] OECD, 2008 as cited in World Bank, 2010.

Despite the many efforts to innovate and diffuse CSTs, they fall far short of what is required. Neither public nor private funding of energy-related research, development and deployment is remotely close to the amounts needed (World Bank, 2010). In fact, government funding globally for R&D in energy was actually reduced from about $20 billion in 1980 to just over $10 billion in 2007. It has also fallen as a share of government R&D budgets, to less than 4 per cent in 2007 (IEA, 2008). Both government and private funding for R&D thus needs to be seriously scaled up, and more government funding for R&D needs to be redirected towards the development of low-emission, energy-efficient technologies. In the absence of sufficient technology development capacity in most developing countries, they will continue to depend on technology transfer from external sources. Most often, these sources are TNCs and an enabling environment for climate-smart FDI is therefore essential. This issue is discussed in chapter 7.

A number of proposals have been put forward by ESCAP members seeking to address this problem. India's 2008 *CleanNet* proposal at COP14 in 2008, for example, calls for the establishment of climate technology development and diffusion centres in developing and least developed nations. It references the joint World Bank and United Nations Consultative Group on International Agricultural Research as a paragon (Mathur, 2008). The proposal received wide support from the G-77 countries.

B. Barriers to effective transfer of climate-smart technologies

The fact that CSTs are at different stages of development means that CST transfer involves both vertical transfer (from the R&D stage through to commercialization) and horizontal transfer (from one geographical location to another). Barriers to transfer and appropriate policy responses often vary according to the stage of technology development as well as the specific source and recipient country contexts (Ockwell and others, 2008). Table II.8 lists the principal barriers to the effective transfer, adoption and diffusion of CSTs. These barriers can be divided into eight categories: institutional; legal; political; technological; economic; information-related; financial; and cultural.

Global Climate Network (2009) identified three levels of barriers. One level exists "in practice", where the lack of skills to plan and implement technology transfer projects as well as weaknesses in policies to direct technology flows can act as a barrier. Second, barriers can occur "in principle" where, historically, technology transfer, trade and investment have been linked in controversial debates split along developed-developing country lines. Third, the interpretation and implementation of Article 4.5 of the United Nations Framework Convention on Climate Change (UNFCCC) – which stipulates that developed nations have an obligation to promote, facilitate and finance, as appropriate, transfer of environmentally sustainable technologies (ESTs) and know-how to developing countries – can also create a barrier. This is due to a mismatch in perception of the scope and extent of initiatives needed to realize this obligation. The second- and third-level barriers place the transfer of CSTs in a political context.

Table II.8. Typical barriers to transfer, adoption and diffusion of CSTs

Type	Example
Institutional and legal	Lack of legal and regulatory frameworks, including adequate protection for intellectual property rights, limited institutional capacity, excessive bureaucratic procedures and unclear arbitration procedures.
Political	Instability, interventions in domestic markets (for example, subsidies), lack of coordinated policies.
Technological	Lack of infrastructure, limited collaborative R&D, lack of technical standards and institutions for supporting those standards, low technical capabilities of manufacturing firms, and lack of a technology knowledge base.
Economic	Non-transparent markets, high costs and capital intensity of RETs, subsidies and trade barriers that inhibit uptake of CSTs.
Information	Lack of technical and financial information and lack of a demonstrated track record of many CSTs.
Financial	Lack of access to investment capital and financing instruments.
Cultural	Consumer preferences and social biases.

Source: USAID, 2007.

At the “practice level” the following specific barriers can be identified:

(a) A lack of capacity at the user level to make a business case for the transfer of a specific technology, search for available CSTs, choose from among various technology options, negotiate the terms of transfer, implement the technology transfer project, use the transferred technology effectively and improve operations through innovation;

(b) An absence of a coherent set of supportive policies to induce critical CSTs. The policy mix needs to explicitly prioritize preferred technologies, establish carbon standards, and provide targeted financial and fiscal incentives.

In the case of the other two layers, specific barriers that have attracted attention are those related to intellectual property and finance. IPR protection is at the core of innovation but it is also accepted that an extensive scope or level of protection can be a barrier to technology transfer (ICTSD, 2008b; Srinivas, 2009). The need for IPR also varies greatly, depending on the type of technology.[113] According to Hall and Helmers (2010), the presence of a “double externality” problem (i.e. environmental and knowledge externalities) implied that patent protection might not be the optimal instrument for encouraging innovation in the area of climate-smart technology, especially given the range and variety of green technologies as

[113] For example, patents play an important role in the innovation of biotechnology, but much less in the area of irrigation technologies (Hall and Helmers, 2010).

well as the need for local adaptation of technologies.[114] Thus, they noted, a need existed for additional policy intervention (through carbon taxes etc.). They also argued that it was highly unlikely that a single, universal mechanism characterized the nexus between IPR and the generation and diffusion of green technologies across countries. Only in emerging developing countries, such as Brazil, China and India, does IPR play a significant role in both (climate-smart) technology development and transfer from developed countries. There is a considerable amount of literature which argues that as long as the majority of new patents in CSTs are registered in developed countries, IPR will be a key political issue in international negotiations (Global Climate Network, 2009). In this regard, there have also been calls to amend the WTO Agreement on Trade-Related Intellectual Property Rights (TRIPS). Box II.12 explores this issue further.

Box II.12. TRIPS and transfer of CSTs

The UNFCCC and the Kyoto Protocol require Parties to promote and cooperate in the development and diffusion, including transfer of technologies that control, reduce or prevent GHG emissions (i.e. CSTs). In this regard, the TRIPS Agreement is seen by many as an obstacle to the effective transfer of CSTs. The key instrument for IPR protection in the context of climate change is the patent. Developing countries have argued that their access to CSTs is restricted due to patents held by the companies that developed these technologies. From a development perspective, it is clear that that the interests of the owners of IPR are properly balanced with those of developing countries, and that international IPR rules advance broader public policy objectives.

However, the TRIPS Agreement does have flexibilities for developing countries regarding patent rights. These flexibilities include, but are not limited to, compulsory licensing, parallel importation, exemptions to patentability, exceptions to patent rights and competition policy. The Agreement explicitly promotes environmental, public health, and development goals and gives members some discretion to determine when those goals should override the normal TRIPS restrictions. These flexibilities have already been employed to promote the availability of affordable essential medicine in the developing world.

Article 8 of the Agreement also recognizes that measures “may be needed to prevent the abuse of intellectual property rights by right holders or the resort to practices which …adversely affect the international transfer of technology.” The TRIPS Agreement also upholds the principles of MFN and national treatment. The provisions, principles and flexibilities of the TRIPS Agreement should be fully exploited to promote the transfer of CSTs (ICTSD, 2008b). For example, CSTs could receive special treatment like that afforded to essential medicines (Littleton, 2008). In addition, pro-competition provisions in the TRIPS Agreement could be strengthened as was done in the case of pharmaceuticals. It has also been suggested that special compulsory licensing provisions should be adopted for transfer and development of CSTs while the patentability of climate-related inventions could be limited and their length of protection shortened (Third World Network, 2008).

[114] Environmental externalities are negative externalities associated with pollution where the social costs exceed the private costs. Knowledge externalities take two forms: non-excludability, which means that other actors cannot be excluded from accessing and using the knowledge produced by the original source; and non-rivalry or non-exhaustibility of knowledge, i.e. if one actor uses some specific knowledge, the value of its use is not reduced by other actors’ also using it. As a result, firms can acquire and use information generated by others who have no effective recourse (Hall and Helmers, 2010).

Box II.12. *(continued)*

At COP15 in Copenhagen, Brazil, China and India proposed that new green technologies be made subject to compulsory licensing. In particular, China, India and Pakistan, among others, have asked for the development of criteria on compulsory licensing for patented ESTs, joint technological or patent pools to disseminate technologies to developing countries at low cost, time-limited patents, and the provision of fiscal incentives to technology owners to obtain differential pricing. Another proposal is for an expedited compulsory licensing process for clean energy technologies. Another option promulgated by India was to establish a global fund that could buy out IPRs of green technologies and then distribute those technologies free, in a way that is similar to what is done with HIV/AIDS drugs (Kogan, 2010).

CST research, development, and deployment often require a high up-front investment, especially when compared to carbon-intensive alternatives. The Bali Action Plan emphasizes the need for developed nations to support developing countries with finance. The issues involved in attracting FDI and venture capital for development of CSGTs are discussed in chapter 7.

C. Policy recommendations

In view of the above discussion, the following recommendations for the effective transfer and development of CSTs are proposed:

(a) Strengthen effective national innovation systems and R&D capacity. National innovation systems remain weak in many countries in Asia and the Pacific. However, such systems are important for building the capacity of countries to absorb and integrate the knowledge needed to ensure that technology transfer is successful. Efforts are particularly needed at the national level to enhance R&D support. Many of the following recommendations will also help to strengthen national innovation systems;

(b) Reward "climate-smart" innovation and R&D. National innovation systems need to incorporate incentive schemes and rewards for climate-smart innovation such as "innovation prizes" or the buying out of associated patents (OECD, 2009). Research has indicated that the rationale for policy intervention in this area is particularly strong. However, R&D alone would not be sufficient to mitigate GHG emissions. Carbon prices would still be necessary (OECD, 2009).

(c) Promote transmission of CST through linkages (UNCTAD, 2010). While the transfer of technologies from a parent company to a subsidiary in a host country is one aspect, the other is the effective transfer of the technology from the subsidiary to a local company. Modalities include raising capacity of local enterprises to enter into joint ventures with TNCs or to integrate into TNC-dominated supply chains. The remaining recommendations below would also contribute to achieving this objective;

(d) Use public-private partnerships to build absorptive capacities of domestic enterprises. Public-private partnerships can play an important role in creating a critical mass of skills in developing nations to help firms, especially SMEs, to plan and implement technology transfer projects with a business focus while boosting their capacity to absorb cutting-edge CSTs and adapt them to local circumstances (UNCTAD, 2010);

(e) Set up CST clusters and parks. Related to this approach, one way to foster increased R&D and support technology transfer in a particular technology is to concentrate technology firms, suppliers and ancillary services in technology clusters such as dedicated industrial parks. This has happened in the Chinese wind energy sector. At present, there are three major local clusters, all of which are located in special economic development zones in large cities in the north-east, i.e. Tianjin, Baoding and Shenyang (Ho, 2010);

(f) Link R&D to practical use and commercialization of CSTs. It is important that R&D and the technological improvements that it yields lead to commercialization and actual use of the technologies, in order to avoid the "valley of death" where innovations lie dormant without being commercialized;

(g) Specify policy targets for promoting CSTs. While many countries tend to have generic policy statements supporting the adoption and utilization of CSTs, greater specificity is needed with regard to promoting a desired energy mix, emissions reduction, energy efficiency and conservation, often by sector. Lack of specificity often leads to sub-critical efforts by firms. Specificity is also required with regard to the targeted technology. Technology targeting also needs to include an FDI targeting strategy. For example, the Republic of Korea has targeted FDI, R&D and technology transfer in key sectors such as smart grids and LED panels;

(h) Introduce CSTs in national and regional value-chains. Countries need to look at the role of CSTs in value chains in a holistic manner, and to formulate policies to promote their adoption, initially in value chains that are energy-intensive and are critical for sustaining and enhancing economic growth. Such policies must be backed by suitably designed financial, fiscal, legal and regulatory instruments that can attract capital investments in CSTs;

(i) Improve access to finance, with the focus on venture capital. The lack of access to finance is a barrier with significant international and national political implications. There can be no "one size fits all" approach, especially in developing countries facing constraints on public expenditure. Thus, suitably designed economy-wide and market transformation incentives are needed at the national level to attract finance. Very often, an existing technology gets "locked-in" within its operational setting because of system and network externalities. Incentives must help to overcome such "lock-in" that can prevent firms from switching over to climate-smart technologies. Public-private partnerships in mobilizing finance through joint management and development of venture capital firms investing in high-risk CST development are also required. Other financial instruments are discussed in chapter 8;

(j) Pay special attention to agriculture. The agricultural sector is particularly sensitive to climate change, and increasing incidents of drought and flooding affect millions of livelihoods. Increased attention should be given to technologies that enable better livestock and waste management (mitigation), and help in developing crop varieties that are resistant to drought, flooding, heat, salinity, and new pests and diseases (adaptation) (ADB, 2009b; and FAO, 2008). Increased investment in biotechnology, including genetically modified crops, are important for both mitigation and adaptation purposes (ADB, 2009a);

(k) Strengthen the national IPR regime. While the evidence of the role of IPR in the transfer of CSTs is still inconclusive, preliminary findings have indicated that IPR can play an important, if not sufficient, role in the transfer of CSTs to more advanced developing countries with a high level of domestic competition, such as China and India (ICTSD, 2008b). The level of IPR-related difficulties may not be the same for all CSTs. Therefore, it may be useful to identify CSTs where there are little or no IPR barriers. These can be publicized widely. In the case of CSTs where IPR barriers are high, thereby hindering their effective deployment and diffusion, measures, such as guarantees for strong IPR enforcement and joint public-private sector collaboration for developing locally appropriate CSTs, could be explored (Global Climate Network, 2009);

(l) Pay special attention to the needs of least developed countries. Studies have shown that IPRs do little to promote the transfer of technology to least developed countries and may even be an obstacle to indigenous technology development. They therefore need to be adapted to suit the special conditions prevailing in those countries (ICTSD, 2009).

Some innovative mechanisms to promote the development and transfer of environmentally sound technologies in general, and CSTs in particular, are presented in table II.9.

The history of technology-based development in the Asia-Pacific region during the past six decades has shown that, without strong and clearly demonstrated political commitment to bring in new technologies, the barriers faced in their introduction cannot be overcome. The development and transfer of CSTs must be promoted enthusiastically by the political leadership as a “win-win” opportunity to foster inclusive and sustainable development. Such a commitment will make it easier to discuss and implement the remedial actions proposed above.

IEA (2010b) has developed low-carbon technology roadmaps as a strategic planning tool for selected areas and sectors including: carbon capture and storage; cement; electric/plug-in hybrid electric vehicles; nuclear power; concentrating solar power; photovoltaic power; and wind energy. Additional roadmaps are under preparation for the following sectors: biofuels; biomass for heat and power generation; cleaner, high-efficiency coal; efficient industry processes in other emissions-intensive sectors; energy efficient/low-carbon buildings (heating and cooling); energy-efficient/low-carbon buildings (design and operation); geothermal energy; hydrogen production and fuel-cell vehicles; smart grids; and vehicle efficiency. The roadmaps assess the current technologies available in these sectors as well as measures to be taken to increase the adoption of these technologies. These technologies were selected for their CO_2 emission reduction potential, market readiness, and coverage of demand-side and supply-side emissions in the buildings, industrial and power sectors.

Table II.9. Innovative mechanisms to promote technology development and transfer

Mechanism	Rationale	Issue to consider
Publicly supported centres for technology development and transfer	Green revolution model of technology diffusion: makes technologies available to developing countries without IPR protection	Suitable for mitigation or only for adaptation technologies?
Technology funding mechanism to enable participation of developing countries in international R&D projects	Resultant intellectual property rights could be shared; patent buyouts could make privately owned technologies available to developing countries	Is there sufficient incentive for participation by developed-country private sector technology leaders?
Patent pools to streamline licensing of inventions needed to exploit a given technology	Developing-country licensees will not have to deal with multiple patent-holders	What are the incentives to patent-holders? Would government regulation be needed?
Global R&D alliance for research on key adaptation technologies	Model of research on neglected tropical diseases	Is such an approach suited to mitigation technologies?
Global clean technology venture capital fund	Fund located with a multi-lateral financing institution that will also have the rights to intellectual property	Will new technology ventures be viable commercially if they do not own intellectual property?
Eco-Patent Commons for environmentally sustainable technologies	Approach initiated by the private sector to make certain environmentally sound technologies available royalty-free on a “give-one, take-one” model	Voluntary, private incentives appear weak. What about those companies without a patent to contribute?
Blue Skies proposal of European Patent Office: differentiated patent system with climate-change technologies based on a licensing of rights	Complex new technologies based on cumulative innovation processes need to be treated differently from, for example, pharmaceuticals	Appears to address concerns similar to those addressed by the patent pools proposal; more specifics are needed on implications for technology access
More favourable tax treatment in developed countries for private sector R&D performed in developing countries	More proactive, technology-push approach by governments of developed countries	May face domestic political constraints
Technology prizes	Reward innovation without awarding intellectual property rights to innovators	Requires a well-specified research objective

Source: United Nations, 2009.

CHAPTER 11

CLIMATE-SMART ENTERPRISE DEVELOPMENT AND THE ROLE OF SMALL AND MEDIUM-SIZED ENTERPRISES

A. Issues

Despite the apparent impact of climate change as well as the urgent need to adopt and implement CSTs and related initiatives, many SMEs do not consider climate change to be an immediate concern. Therefore, they do not have any form of low-carbon strategy at present, unless they are an energy-intensive business or wish to present a clean and green image. Yet climate change offers many opportunities for SMEs and start-up enterprises to increase their competitiveness, both in the domestic market and overseas, by developing unique and innovative CSGTs. Such indifference could be due to one or more of the following three reasons: (a) the presence of other immediate business concerns; (b) no requirement demanded or imposed by their clients with regard to undertaking strategic moves to go clean and green; and (c) going clean and green is deemed to be a costly affair (Lee, 2010). In addition, in the absence of clear and stricter government regulations, many SMEs do not have any incentive to adopt “green” business practices (Harris, 2010).

Given the breadth and diversity of the millions of SMEs across the Asia-Pacific region, it is impossible to say whether climate change factors would indeed drive costs up. While it is true that there would be an ever-increasing rise in costs for inputs such as fossil fuels, there may well be cost savings when new CSTs are made available on a wider basis (World Bank, 2010). It is also true that there may be a rise in costs due to compliance with new “green” regulations but, equally, governments may also provide financial incentives for SMEs to reduce their carbon footprint and implement best practice models (e.g. in the form of industry grants to purchase energy-efficient process equipment and make the necessary adaptations to building facilities). Timely attention to these matters in strategic management would help SMEs to ensure long-term competitiveness and turn them into business leaders (ESCAP, 2008).

In any case, enterprises can no longer ignore the need for a commitment to balancing environmental and financial performances. More critically, climate change poses a genuine threat, especially to SMEs, when taking into consideration the fact that these smaller enterprises are, by and large, less well-equipped than large enterprises, including TNCs, and do not have the necessary financial muscle and technology know-how to meet the requirements of a clean and green economy. However, by virtue of their smaller size, SMEs can be quicker and more flexible in their responses than larger companies. Promoting innovation and quick adoption of CSTs would enhance the competitiveness of SMEs (Keong and Mei, 2010). Furthermore, the adoption of “green” practices does not have to be expensive. It is not always a matter of just adopting CSTs but also an issue of “good housekeeping” and being energy-efficient.

Enterprises that anticipate government regulations, and adopt climate-smart practices and technologies, are likely to emerge as stronger competitors and business leaders in the longer term

Another reason why SMEs should adopt climate-smart strategies is the rising awareness, both among their immediate customers (such as TNCs and other large enterprises) and end-consumers (i.e. the public), of the impact that products have on the environment in general, and on global warming in particular. As demand for “green” products is rising and becoming more sophisticated, TNCs are responding with implementing their own eco-labels. As TNCs are often important customers of SMEs, these enterprises feel compelled to follow suit and adapt their products and processes to meet the new quality requirements. Even when SMEs sell directly to the public, more sophisticated and environmentally-aware consumers will drive a similar process. Such consumers are likely to recommend and spread the word about businesses that have a reduced carbon footprint, engage in clean and green practices, supply environmentally-friendly products and otherwise practice the principles of CSR.

More importantly, more sophisticated end-consumers are willing to spend a little extra or, in some cases, much more in order to obtain climate-smart goods and services as well as purchase from clean and green businesses. This process is driving the emergence of climate-smart and “green” global value chains, led by TNCs that derive their competitiveness from adopting climate-smart business practices and producing CSGTs, and which demand a similar approach from their suppliers all through the value chain (see chapter 7).[115]

There can be no doubt that climate change does offer the prospect of numerous new business opportunities. At the same time, the prime issue facing businesses, big or small, is the direct and indirect impact of new legislation that may be passed by their governments. Ultimately, businesses – including SMEs – will have to adapt to the new legislative regime or risk exposure to higher operating costs. Businesses that adapt early will find the cost of changing operating practices manageable, compared with acting later. For example, if and when a particular government imposes a levy to improve energy efficiency, SMEs with significant energy inputs to their production process will face greater exposure to the impact of higher pricing. If their competitors (in other countries that do not impose a similar levy) do not face similar cost increases, the operations of these SMEs will be severely affected. This will result in the cost of compliance being passed down from buyers to sellers (and from large to small enterprises) throughout the value chain, ultimately affecting every entity in the chain. All businesses will then be affected by such regulatory measures in response to climate

[115] A good example of helping SMEs adopt climate-smart practices to be effective suppliers in global value chains is the assistance provided by Better Factories Cambodia, an International Labour Organization programme for garment factories in Cambodia, to make them more energy efficient. The assistance is provided in cooperation with the Garment Manufacturers Association of Cambodia (GMAC) and the International Finance Corporation (IFC). The first step was the conducting of a benchmarking survey of energy performance in the Cambodian garment manufacturing sector (survey results available at www.betterfactories.org/content/documents/1/Energy%20Performance%20in%20the%20Cambdia%20Garment%20Sector.pdf).

change. However, those businesses that pre-empt and anticipate such legislation by adopting RE or energy efficiency practices at an early stage may well be in a better position to compete. In addition, some studies have shown that RE and energy efficiency creates more jobs per unit of energy than fossil fuel (Copenhagen Climate Council, 2009). As SMEs are principal providers of employment in any given economy, the contribution of SMEs to “green” job creation is also potentially substantial.

A practical way for SMEs to achieve energy efficiency and conservation apart from “good housekeeping” is through the adoption and utilization of CSTs. Many SMEs perceive CSTs to be expensive and only practical for larger enterprises, in particular TNCs. In fact, many larger companies and corporations have already begun to assess, through application of CSTs, ways to reduce their energy consumption and thereby reducing their overall costs of doing business (Australian Information Industry Association, 2009).

Although recycling technologies and other clean and green innovations are often too costly and price-prohibitive for SMEs, inventive products and new production techniques together with government support have made it achievable and cost-effective for SMEs and micro-enterprises to adopt clean and green production processes. It is therefore expected that more SMEs will follow suit sooner or later, even if it means that the initial investment in CSTs may lead to higher initial costs. One way to create synergies is to create eco-industrial parks linking larger enterprises with SMEs. SMEs could use waste from one production facility as a production input for another facility – and even to capture heat for energy for the whole park. This way they can also produce their energy locally from biogas, rather than electricity from the mains supply.

All businesses will be affected by climate change in one way or another, and they should factor such impacts into their risk planning. In the manufacturing and energy sectors, it is anticipated that economic competitiveness will increasingly be determined by carbon intensity and resource efficiency. Responses by governments, civil society and businesses will affect the way businesses operate in the future.[116]

B. Policy recommendations

Virtually all developing Asia-Pacific economies support their SMEs in one way or another, including through financial assistance (not only by improving SME access to funding, but also by lowering the cost of finance) and through assistance in the form of training for workers and entrepreneurs, technology extension services, marketing assistance and business development services. However, Asia-Pacific economies do feel a compelling need to provide critical support to their SMEs in overcoming key barriers for their transition towards a green and climate-smart economy. Often, businesses rather than governments help create environmental awareness of other businesses and strengthen their competitiveness in CSGTs. One example is Singapore (box II.13).

[116] “Greening business in Asia and the Pacific (2010): A guide for policymakers”, United Nations, unpublished.

Box II.13. Business-to-business cooperation in "greening" business: Green Business Times.com

A good example of business helping businesses adopt "green" practices is Green Business Times.com. Established in 2008 by Green Future Solutions, Green Business Times is the first on-line publication in Singapore with a focus on business and the environment. Green Future Solutions (www.greenfuture.sg) itself is a business that promotes environmental awareness among SMEs through consultancy services, publications, news, websites and speaking engagements.

In one if its websites (www.greenbusinesstimes.com/2010/01/12/4-simple-green-strategies-for-small-and-medium-enterprises-smes), Green Business Times offers four simple green strategies for SMEs: (a) reduce risks; (b) reduce costs; (c) increase revenue; and (d) enhance brands. Reducing risks refers to the need to identify aspects of business that have environmental impacts, such as the use of resources, and discharges, such as waste and emissions, into the environment. The improper use of resources and discharges constitutes risks to the business. Identifying these risks with a view to reducing them gives SMEs an edge in competitiveness. Reducing costs refers mainly to enhancing efficiency of using resources, such as energy and water, enhancing the efficiency of business-related transport and other measures such as the establishment of a recycling facility. Increasing revenue refers to exploring and meeting the demand from more sophisticated and environment-aware consumers. Enhancing brands would follow the first three strategies and would build SMEs' credibility and reputation on the basis of a proper marketing strategy while avoiding charges of "greenwashing". On another website, Green Business Times presents five principles for companies to avoid "greenwashing" (www.greenbusinesstimes.com/2008/10/08/5-principles-for-companies-to-avoid-greenwashing).

While such services provided by companies may either be part of their CSR programmes or at the core of their business, and therefore not free, they go a long way in enhancing awareness among SMEs of trends and developments as well as issues to be addressed in becoming environmentally and climate-friendly.

In addition to current initiatives, the following additional initiatives could be considered for promoting climate-smart business development, particularly SME development. These initiatives, which are part of wider efforts aimed at the "greening" of business in general, include:

(a) Promoting climate-smart entrepreneurship and providing comprehensive support to new and promising climate-smart SMEs through incubation programmes. Governments could strengthen an enabling "green business environment for promoting entrepreneurship and firm creation, i.e. for businesses oriented towards green innovation and development and application of CSTs. Policies should aim at minimizing entry barriers and exit-market costs and setting up "green" business incubator programmes, which are already being implemented in Western markets, such as Europe (Business Green, 2011). As the term suggests, incubator programmes[117] are designed to help

[117] Not every young enterprise/SME, particularly in Asia, prefers to be attached to clusters or incubators, despite the apparent economies-of-scale and value-added inputs that may available. This may be because, in being located so close to other firms of a similar type, a high staff turnover rate or the risk of commercially sensitive information leaking out in common areas are more likely.

young enterprises/SMEs make it through the first but yet critical stages of business development, as they seek to graduate to the level of a sustainable business. Once new firms are formed, it is important to raise their awareness of climate-smart business opportunities, and available CSGTs and climate-smart services by connecting them to existing knowledge networks. Such a move would strengthen the overall role of SMEs in the low-carbon economy – either as end-users, producers, innovators, and/or integrators of skills and technologies;

(b) Linking climate-smart TNCs with domestic enterprises through SME integration into regional and global value chains, and the formation of industry clusters. It is important to forge linkages between climate-smart TNCs and domestic SMEs as local suppliers and subcontractors of parts and components for climate-smart production processes or assembly of final products. The challenge is that many domestic SMEs may not have the required capacity; however, a successful link with a climate-smart TNC may go a long way in developing such capacity. The goal is to integrate domestic SMEs into regional and global climate-smart value chains. This goal can be achieved through substantive enterprise development policies (see below) that are closely linked and coordinated with investment (and trade) policies. In this regard, the SEZs mentioned in chapter 7 can also contribute to this goal to the extent that domestic SMEs are located and integrated in such zones.

A related policy is the establishment of industry clusters consisting of SMEs working in industries that are either supporting or related to climate-smart TNCs. SEZs or CleanTech parks are useful modalities for setting up industry clusters, which can be quite sophisticated, bringing together manufacturers, suppliers and R&D centres. The relationship can also work in reverse. In China, for example, leading domestic companies producing wind power turbines in the Binhai New Area, near Tianjin, have been able to attract foreign investors in parts and components as well as domestic suppliers.[118] A CleanTech park exists in Singapore. The integration of domestic enterprises into climate-smart value chains is both an enterprise development policy from the domestic SME perspective and an investment policy from the foreign investor's perspective, as the availability of local suppliers is a major determinant of climate-smart FDI (particularly the efficiency- and market-seeking types);

(c) Enforcing consistent and predictable climate-smart rules and regulations. Governments should take proactive action to put clean and green-driven growth on a level-playing field with conventional growth through the implementation and enforcement of appropriate "green" legislation. Not only would such legislation send out unambiguous market signals, which are essential to the creation of market certainty for businesses to plan their long-term investments, it would also provide clear directions and incentives for potential new market entrants. In general, regulatory reforms and standards can strengthen emerging

[118] See UNCTAD, 2010 (box IV.11).

green markets and open new ones. Policies should aim at removing barriers to SMEs' participation in expanding global and regional green markets, and value chains;

(d) Establishing climate-smart government procurement schemes for SMEs. For example, India procurement rules stipulate that certain goods must be purchased from SMEs even if prices are up to 15 per cent higher than those offered by the competition (WSP Group plc, 2010);

(e) Improving access to credit for climate-smart SMEs. Adequate access to credit is a chronic problem for SMEs in general and even more so for those that adopt green practices or want to produce green products, as their track record in this area is often even worse and the risks are high. However, the availability of credit allows firms, especially SMEs, to seize opportunities provided by technologies and innovation. In this regard, governments – either directly or through their SME development banks – could provide special tax incentives or financial assistance to those SMEs investing in CSGTs. They could also provide credit guarantees for bank loans.

Many governments, given their potential for overcoming the lack of collateral among SMEs, have normally supported credit guarantee schemes (ADB, 2009c). The attraction of foreign venture capital funds and the development of government-backed domestic ones is also useful in mobilizing risk capital for investment in climate-smart SMEs. Many countries of the region provide financial assistance to climate-smart enterprises, particularly those investing in the RE sector. India, Malaysia and the Republic of Korea are among Asian countries that have special financial incentive schemes for "clean" SMEs;

(f) Providing climate-smart technology support (see chapter 10). Businesses are key players in the process of structural transformation (i.e. the process through which an economy engaged in the production of traditional, low value-added and low productivity goods and services, moves to producing a more diverse set of modern, high-productivity and greater value-added goods and services). After all, it is firms that undertake production and make decisions on modifying fabrication processes, improving product qualities, constructing new products, applying new marketing methods and tapping new markets.

These decisions are deeply interconnected with issues of technological capability and incentives to invest in innovative efforts. Limited technological capability and a lack of information on markets and products are key constraints for SMEs. In the Asia-Pacific region, most governments have put in place a variety of programmes and services to help their SMEs improve their knowledge about, and gain access to promising technologies, production methods and markets (including export markets) (ADB, 2009c). In some cases, governments have also subsidized the development of low-cost production technologies for use by smaller enterprises;

(g) Promoting climate-smart human resources development. Of course, a properly educated and trained workforce would be critical to helping SMEs make the transition to climate-smart activities and production methods relatively easily. In this regard, skills development and training policies at the national and industry levels will play a key role in facilitating the structural adjustment required by the transition to climate-smart growth. In particular, there is a need to consolidate the training efforts provided by institutes of higher learning (such as universities and polytechnics) and vocational technical training institutes to address such needs. It is also important that skills development matches the needs of climate-smart enterprises;

(h) Promoting CSR. While the adoption of CSR goes beyond the concept of the climate-smart enterprise, the idea that enterprises should adopt inclusive and sustainable practices, and contribute to inclusive and sustainable development would also mean that enterprises are climate-smart. Short of legislation, governments could encourage enterprises to adopt CSR principles and become a signatory of the global compact that comprises principles on environmentally sustainability as well. The adoption of such principles would not have to lead to higher costs. Instead, it should give businesses a competitive advantage in times when consumer sentiments are changing and consumer awareness of environmental problems is rising. Again, early mover advantages apply.

CHAPTER 12

REGIONAL COOPERATION MECHANISMS IN SUPPORT OF CLIMATE-SMART TRADE AND INVESTMENT

Introduction

The previous chapters essentially focused on national level policy actions to promote climate-smart trade and investment. However, as trade and investment are cross-border phenomena, their effective promotion requires (sub)regional and global cooperation among countries. This chapter reviews some of the regional mechanisms that can be considered in support of climate-smart trade and investment. These mechanisms would also be inputs from a trade and investment perspective to the regional strategy on low-carbon green growth that is being prepared by ESCAP. In particular, apart from RTAs and IIAs, non-binding cooperation mechanisms that help trade and investment in CSGTs and climate-smart services and the transfer of CSTs, can be considered. In fact, some subregional level cooperation mechanisms already exist. While these mechanisms may not be specifically aimed at trade and investment promotion, they do either promote or at least have a significant impact on trade. Therefore, these mechanisms are briefly reviewed in section A. Section B explores other possible mechanisms for regional cooperation in tackling climate change in trade and investment-related areas through the expansion of many of the recommendations made in the national policy context.

A. Existing (sub)regional trade- and investment-related cooperation mechanisms for addressing climate change

As in the case of trade, there are no Asia-Pacific wide obligations and standards related to GHG emissions or other areas related to climate change. There are no regional or bilateral agreements on “climate change”, or GHG emissions reduction or mitigation. In some cases, countries have signed bilateral environmental agreements, usually as side-agreements to FTAs such as the New Zealand-China Environment Cooperation Agreement. One of the latest developments was the April 2010 signing by Japan and Malaysia of the Japan-Malaysia Cooperation Initiative for Environment and Energy. The Initiative outlines some 20 areas of cooperation, many of which are related to, or have implications for climate change policy; they include environment preservation, chemical management, waste management and recycling, conservation of biodiversity, energy conservation, RE, and standard and conformity assessment. While the Initiative does not contain trade-related provisions or obligations, it does contain a commitment to cooperate in all areas covered. Such cooperation would have implications for the formulation of trade policy and the introduction of “green” technology.

At the subregional level the issue is being addressed within organizations such as ASEAN and APEC, but these organizations have not issued legally-binding commitments. The 2007 Singapore Declaration on Climate Change, Energy and the Environment commits

ASEAN member countries to “the common goal of stabilizing atmospheric greenhouse gas concentrations in the long term, at a level that would prevent dangerous anthropogenic interference with the climate system”. It also commits ASEAN members to the implementation of appropriate mitigation and adaptation measures, including, inter alia, encouraging the deployment of clean technology in the ASEAN subregion through various means, such as investment, technical and financial assistance, and technology transfer. In addition, there is the 2002 ASEAN Agreement on Transboundary Haze Pollution and the 2007 ASEAN Declaration on Environmental Sustainability, both of which are not directly linked to climate change mitigation and adaptation but contain actions that have clear implications with regard to that purpose.

Most recently, ASEAN countries have made increased efforts to address climate change, although the emphasis is on cooperation rather than on binding commitments. Responding to climate change and addressing its impacts has been identified as one of 10 priority areas in the ASEAN Socio-Cultural Community (ASCC Blueprint) 2009-2015. While the linkages with the ASEAN Economic Community are not directly obvious and, as yet, no ASEAN Working Group on Climate Change exists, there are proposals in that direction. In November 2007, ASEAN leaders endorsed the development of an ASEAN Climate Change Initiative (ACCI). ACCI is a consultative platform for further strengthening regional coordination and cooperation in addressing climate change; in addition, undertaking concrete actions in response to its adverse impacts is envisaged. The scope of collaboration through the ACCI will include: (a) policy and strategy formulation; (b) information sharing; (c) capacity building; and (d) technology transfer.[119] Although ASEAN has no specific set of GHG emission standards, there is a set of ASEAN Green Hotel Standards. It also has mechanisms for the harmonization of each ASEAN member’s environmental laws and standards, including those concerned with air pollution, although GHG emissions have not yet been singled out.

ASEAN has a well-functioning institutional structure to promote energy cooperation among its members, including mechanisms for the promotion of energy efficiency and for exchanging information on policies, technical information, projects and plans for RE. However, cooperation in energy has no immediate links with cooperation in the mitigation of, and adaptation to climate change. Also, energy cooperation falls under the ASEAN Economic Community while environmental cooperation falls under the ASEAN Socio-Cultural Community.

The linkages between energy, environment and climate change are also recognized within the APEC framework. APEC addresses climate change within the context of energy cooperation, which, in turn is conducted under the framework of the Energy Security Initiative. An Energy Working Group exists to promote cooperation in the area of energy and has four working groups that all do work related to climate change, i.e. on clean fossil energy, efficiency and conservation, energy data and analysis, and new and renewable energy technologies. In 2007, APEC leaders adopted the Declaration on Climate Change, Energy Security and Clean Development in Sydney, which aims to reduce energy intensity by at least

[119] See http://environment.asean.org/index.php?page=overview.

25 per cent by 2030 (with 2005 as the base year). APEC leaders also decided to establish the Asia-Pacific Network for Energy Technology to strengthen collaboration on energy research in the region, particularly in areas such as clean fossil energy and RE sources. The eighth APEC Energy Ministers Meeting in 2007 further designed modalities for the development and deployment of cleaner and more efficient energy technologies. Information sharing on policies and standards for cleaner energy takes place through mechanisms such as the APEC Energy Standards Information System, and most recently, the APEC Peer Review Mechanism on Energy Efficiency.[120]

In a wider context, APEC addresses trade in climate-friendly goods within the context of its Committee on Trade and Investment, which has developed a work programme for the liberalization and facilitation of trade and investment in environmental goods and services, including R&D, and an on-line Environmental Goods and Services Information Exchange. The APEC list of EGS has formed a basis for the identification of a short-list of climate-friendly goods used in this study.

Collaboration on climate change within the framework of the South Asian Association for Regional Cooperation (SAARC) has recently stalled, although mechanisms for such cooperation exist. For example, a SAARC Technical Committee on Environment study, conducted in the early 1990s on the impacts of GHG emissions on the subregion, recommended regional measures for sharing experiences, scientific capabilities and information on climate change. The findings of the study contributed to the establishment of the SAARC Plan of Action on the Environment (1997) and Common Environment Programme (1998).

In the area of energy, a SAARC Working Group on Energy has existed since 2004. SAARC ministers for energy met for the first time in 2005. The meeting resulted in the establishment of an Expert Group on Energy that formulated a road map outlining the options and potential of energy conservation and energy-efficiency measures in the SAARC subregion. These activities are currently being undertaken by the SAARC Energy Centre in Islamabad. In the meantime, at its fifth meeting in Bhutan in 2009 the Working Group established four expert groups, including two groups on RE and technology/knowledge sharing (including energy efficiency, coal etc.). Energy ministers in 2009 also adopted the concept of “Energy Ring” and a Road Map on Energy Efficiency and Energy Conservation.[121] However, although the intention towards cooperation is clearly present, implementation of the above-mentioned initiatives has fallen short.

Pacific island developing States, within the framework of the Pacific Forum Secretariat, adopted the Pacific Island Framework for Action on Climate Change, 2006-2015, which comprises a regional and national level, multi-stakeholder approach to mitigating and adapting to climate change. They also developed the 2002 Pacific Islands Energy Policy and Plan,[122] which was subsequently divided into two separate items: a Pacific Islands Energy

[120] See www.apec.org/apec/apec_groups/som_committee_on_economic/working_groups/energy.html.

[121] See www.saarc-sec.org/areaofcooperation/cat-detail.php?cat_id=55.

[122] See www.forumsec.org.fj/resources/uploads/attachments/documents/Pacific%20Islands%20Energy%20Policy%20and%20Plan%20%28PIEPP%29%20October%202002.pdf.

Policy and the Pacific Islands Energy Strategic Action Plan. These initiatives include cooperation modalities in the development of RE sources for the Pacific. There are no binding obligations.

In addition to these initiatives, many small-scale bilateral or regional cooperation mechanisms and assistance programmes are provided by international organizations.[123]

B. Recommendations for enhanced regional cooperation in promoting trade and investment in climate-smart goods and technologies

There is certainly scope to enhance regional cooperation in promoting trade and investment in CSGTs and climate-smart services. In some cases, regional cooperation mechanisms in this area do not have to be established from scratch, but can expand on national-level initiatives and existing subregional initiatives outlined above. Taking into account the discussion in the previous sections, this section provides some recommendations for consideration by policymakers and businesses.[124]

1. Regional trade and investment cooperation partnership for mitigation of, and adaptation to climate change

UNCTAD (2010) advocates a global partnership to further low-carbon investment for sustainable development. Given the difficulties in achieving a consensus on a global agreement on mitigation of climate change in general, such a partnership may perhaps run into similar difficulties. It is therefore proposed that smaller-scale partnerships, covering both trade and investment, are explored at the regional or subregional level. The purpose of such partnerships would be to reduce or eliminate barriers to trade and investment in CSGTs and climate-smart services, and to forge cooperation in a variety of areas. Any form of regional partnership will probably be more successful if it involves developing countries only, particularly given the potential for enhanced South-South trade and investment in CSGTs. On the other hand, given the technological edge of developed countries such as Japan, their inclusion in such partnerships may be also beneficial; however, issues such as standards and IPR may be formidable stumbling blocks in forging a consensus among developed and developing countries.

A regional partnership would also facilitate cooperation among partner countries in pushing for a multilateral agreement on the liberalization of EGS in the Doha negotiations, and in coordinating their negotiation positions accordingly. The formation of a regional common view and approach to multilateral negotiations would certainly facilitate the multilateral negotiations in this area.

[123] For a comprehensive overview of such programmes, see Cosbey and others, 2008.

[124] The recommendations presented in this section do not suggest any form of regional cooperation that may undermine the international negotiations taking place within the context of UNFCCC. While ESCAP, as a regional arm of the United Nations, could potentially take the lead in some of these regional initiatives, it obviously remains the prerogative of individual ESCAP member countries to decide whether, in what way and by whom the recommendations should be implemented.

Smaller partnerships, often involving a developed country, already exist with a focus on technical assistance. For example, the Asia-Pacific Partnership on Clean Development and Climate is a non-binding partnership established in 2002 between Australia, Canada, China, India, Japan, the Republic of Korea and the United States, which focuses on the development and deployment of cleaner and more efficient technology through cooperation and information sharing. The partnerships proposed in this report, however, focus on increased cooperation in the promotion of trade and investment in CSGTs, which are elaborated on in the following subsections. While there would be no political consensus or support for a region-wide legal agreement, ideally a regional partnership or a number of (sub)regional partnerships could be forged that covers all possible areas of cooperation in trade and investment in CSGTs. At a less ambitious level, provisions on cooperation, liberalization and facilitation of trade and investment in CSGTs and climate-smart services could be incorporated within the framework of existing RTAs and economic partnership agreements (e.g. AFTA, APTA, SAFTA and large-scale bilateral FTAs such as the ASEAN-China FTA – see subsection 3).

2. Review the possibility of a regional cap-and-trade system

A regional trade and investment cooperation partnership, as proposed above, could include the establishment of a regional cap-and-trade or emission trading scheme (ETS). Such a system could include regional projects related to REDD and REDD+ as well. On the one hand, such a system would go beyond regional trade and investment cooperation, as envisaged in this study. On the other hand, such a system would give an important impetus to trade and investment. For that reason, this subsection briefly reviews the relevance of a regional ETS in the context of promoting trade and investment in CSGTs.

In principle, the success of a regional cap-and-trade system requires a minimum of regional integration, ample liquidity, proper legislation and incentives, verification and monitoring mechanisms, and sufficient investment funds. A regional ETS has been relatively successful in Europe, although recent irregularities and fraud have also raised concerns about the European emissions trading system (see box II.14). The main reason why cap-and-trade schemes have been the preferred solution in some cases is that they remove uncertainty about the level of emission reductions (UNCTAD, 2009). A few economies in Asia and the Pacific have voluntary and limited (pilot) ETS or are studying the feasibility of introducing one, including Australia, China, Japan, New Zealand, the Republic of Korea and Hong Kong, China. Bilateral ETS between Japan and Indonesia as well as Japan and Republic of Korea have also been proposed. From previous experience with such schemes, the following lessons should be taken into account in developing a regional scheme.

First, there is a need for liquidity. The market for carbon emissions does not work well in Japan and New Zealand because it is really too small to be effective. Second, insufficient investment funds have also undermined the effectiveness of these schemes. Especially in voluntary markets such as Australia, this has proved to be a problem. Third, weak legislation in most countries and the absence of an international agreement on carbon emissions provides a disincentive for investment. Fourth, price volatility can be a problem. The European Union ETS faced carbon price volatility due to its over-allocation of allowances

Box II.14. European GHG Emissions Trading Scheme

The European Union ETS is the largest multinational cap-and-trade system in the world and a major cornerstone of the European Union's climate change policy. Introduced in 2005, the European Union ETS was inspired by the Kyoto Protocol for European Union member States to meet their emissions obligations, but was actually enacted before the Protocol became legally binding in international and European Union law. The European Union ETS has a relatively decentralized structure that gives individual member States responsibility for setting targets, allocating permits, determining verification and enforcement, and making some choices about flexibility. It is also a "cap-within-a-cap," seeking to achieve the Kyoto targets while only covering about half of the European Union emissions. It is linked with other cap-and-trade systems.

The European Union ETS covers more than 12,000 energy intensive facilities across the 27 European Union member States that emit about 50 per cent of the European Union's CO_2 emissions and 40 per cent of its GHG emissions. It also operates in Iceland, Liechtenstein and Norway. A "phase I" trial trading period began on 1 January 2005 before the start of the Kyoto Protocol's obligations. Phase II began in 2008, covering the period of the Kyoto Protocol. Phase III, which will begin in 2013, is designed to reduce emissions by 20 per cent from 1990 levels by 2020, and 30 per cent if an acceptable international agreement is reached by 2012. Airlines will join the scheme in 2012.

Carbon credits traded under the European Union ETS are called European Union Allowances. Each European Union member State develops a National Allocation Plan for each trading period, which is approved by the European Commission. In each National Allocation Plan, member States propose and justify the total number of allowances created for the trading period, provide a list of covered installations and explain how those allowances are to be distributed. The emissions cap is converted into allowances (one allowance equals 1 mt of CO_2), which are then distributed by European Union member States to installations covered within the system. The allocation method involves issuing 90 per cent of allowances freely and allowing 10 per cent to be auctioned. Penalties for non-compliance include paying a price of €100 for each excess metric ton of CO_2. Trading volume under the ETS has grown rapidly and is, by far, the largest ETS worldwide, valued at more than $118 billion in 2009.[a]

The ETS has been relatively successfully in overcoming various challenges associated with operating such a scheme, (e.g. determining the appropriate level of the cap, the price on emissions, allocation of allowances to companies [including over-allocation] and aligning it with an appropriate incentive structure). Effectively, there is no restriction on banking or borrowing of allowances within any given multi-year trading period though there are restrictions with regard to inter-period trading. The European Union ETS distributed free allowances, as opposed to the auctioning of allowances. The auctioning of allowances allows for the proper establishment of market prices and in reflecting the marginal cost of emission reductions. As such, auctioning emission allowances provides greater incentive for member parties or companies to reduce emissions.[b] Free allowances can and have led to windfall gains[c] and less incentive to reduce emissions. The European Union has proposed that from the start of Phase III there will be a centralized allocation of permits, not National Allocation Plans, with a greater share of auctioned permits. The latest challenge has been a series of fraud cases in the ETS, including a cyber attack on selected national carbon markets. This shows the need for appropriate oversight and regulation. Also, proceedings have been launched by the EC against several countries for failing to submit their National Allocation Plans on time.

Box II.14. *(continued)*

Despite the success of the European ETS in triggering a market in carbon credits, the overall impact on reduction of GHG emissions under phases I and II is unclear. Because of the challenges noted above as well as the trial nature, the impact was rather limited under phase I, but improvements in the verification of baseline data among other improvements may well show a bigger achievement under phase II (Parker, 2010).

Source: Ellerman and Joskow, 2008.

[a] Ecosystem Marketplace and Bloomberg New Energy Finance, "Building bridges: State of the voluntary carbon markets, 2010", Washington, D.C. and New York. http://moderncms.ecosystemmarketplace.com/repository/moderncms_documents/vcarbon_2010.2.pdf.

[b] Climate Institute (see www.climate.org/climatelab/Emissions_Allowance).

[c] Refers to the higher electricity prices and consequent higher corporate profits that resulted from the free allocation of allowances (Ellerman and Joskow, 2008).

in the first trading period, which drove carbon prices to zero. Other problems include the lack of incentives as well as problems associated with verification, monitoring, coordination among participants and transaction costs.

Kruger, Oates and Pizer (2007) stated that three fundamental decisions were essential for establishing an emission trading market. The first includes defining who will participate in the market, including the emissions emitting entities that can buy and sell permits, which determines the overall demand. Second, a cap must be specified that sets the supply in the market through determination of the number of available permits. Third, the market must be established through the allocation of permits among the emissions-emitting entities, either through free allocation or via auctioning. These three fundamental decisions require an authority, either a central commission or an institution, to implement such decisions and with the support of participating countries. The Asia-Pacific region lacks a central authority or institution to take the lead on establishing and/or implemented an emissions trading market.

As such, establishing a regional ETS in the Asia-Pacific region will take considerable time, energy, investment and substantial assistance from the governments of the developed world as well as international organizations. According to ADB (2009b) and the United Nations (2009), the major functional prerequisites required before introducing a regional ETS in the Asia-Pacific region are adequate institutions and governance systems. Additionally, developing countries will undoubtedly face substantial costs through investments in training and education, in acquiring the proper regulation and monitoring of financial instruments (United Nations, 2009).

Although a regional ETS may still be feasible in the long term, in the short-to-medium term, it is suggested that developing countries consider a combination of large-scale investments and active policy interventions with strong political and multilateral support by developed country governments, especially with regard to financial and technological transfers (United Nations, 2009). The region should follow closely with the developments of other ETS, such as the Australian ETS, to look for possible partnership opportunities.

3. (Sub)regional initiatives to liberalize and facilitate trade in CSGTs and climate-smart services

As discussed above, many regional and bilateral trade agreements involving one or more Asia-Pacific countries or economies have been signed, are in force or are under negotiation. Some already provide comprehensive coverage, including most if not all CSGTs identified on the ESCAP list. Many others are shallow and risk overlapping, duplication or conflicting commitments, particularly with regard to rules of origin. Others are more comprehensive and take the form of economic partnership agreements or, in the case of ASEAN, economic communities, although no level of integration similar to that existing in Europe exists in Asia. There is clearly scope to consolidate or even integrate many of these agreements with the purpose of arriving at a comprehensive Asia-Pacific wide trade agreement that:

(a) Is broad in scope, covering trade in goods as well as in services (and possibly investment, IPR and other areas of economic cooperation, see below);

(b) Is deep in commitment, i.e. constitutes zero tariffs on most goods, has limited and reasonable NTMs, and accords MFN and national treatment in most if not all services sectors;

(c) Has relatively flexible and easy rules of origin allowing for cumulation;

(d) Is open to new membership.

Such an agreement would automatically cover CSGTs, climate-smart services and investment. While such an agreement is desirable, it is not expected to become reality in the near future. For a similar reason, it would be difficult to garner political will to conclude an Asia-Pacific Trade (and Investment) Agreement on CSGTs and climate-smart services. Obviously, the negotiations of such an agreement would run into similar difficulties as those encountered at the multilateral level with regard to the precise definition of CSGTs, even though it might perhaps be easier to arrive at a consensus among a smaller group of countries than among all countries of the world.

ASEAN already has free trade in most goods and, to some extent, in services covering most if not all CSGTs by any definitional criterion. AFTA could therefore be a convenient starting point for such a consolidation exercise, given that it has FTAs with a variety of other Asian countries including China, which is very active in the area of developing and producing CSGTs. APTA could also consider focusing on the liberalization of CSGTs and climate-smart services in its next round of preferential trade negotiations.

The idea is to accord maximum preferential treatment to imports of CSGTs (preferably zero tariffs) with flexible, liberal and easy rules of origin, and relaxed standards and technical regulations. This would be possible if a consensus on the definition of CSGTs could be formed. This obviously remains the sticking point. Another problem to be overcome is that of ensuring the participation of countries in regional initiatives that have little to gain from participation or those that aim to be “free riders”. It will have to be accepted that, for some countries, participation may result in a net loss but a regional gain (OECD, 2009).

An alternative to a region-wide broad trade agreement would be regional sectoral agreements targeting the most energy-intensive sectors. Such an approach has been suggested at the international level (Kim, 2009), which would clearly be preferable; but again, a regional sectoral agreement could be good starting point.

4. (Sub)regional initiatives to liberalize and facilitate investment in CSGTs and climate-smart services

A regional climate-smart trade and investment cooperation partnership would include modalities for cooperation in the area of investment in CSGTs and climate-smart services. Most recent RTAs already have chapters on investment and, if the coverage is substantial, no separate provisions on CSGTs or EGS would have to be made. As it will take time to arrive at a meaningful consolidation at the regional level of such RTAs, modalities for regional cooperation in promoting investment in CSGTs could, in the meantime, be envisaged based on the global partnership proposed by UNCTAD (2010).[125] As a start, such partnerships could be promoted at the subregional level. They can be either informal or, preferably, in the form of a comprehensive agreement and could include the following elements, depending on the level of ambition and political will:

(a) Harmonization of investment regulations and incentives for climate-smart investment;

(b) Accord pre- and post-establishment MFN and national treatment for climate-smart investment from partner countries and, possibly all countries of the world;

(c) Establish a regional credit guarantee facility for high-risk climate-smart investment;

(d) Undertake joint climate-smart investment promotion and targeting activities, (e.g. road shows, investment fairs and forums);

(e) Exchange lists of promoted climate-smart sectors/industries where partner countries could encourage investments from other partner countries and initiate promotional activities;

(f) Develop cross-border special economic zones for climate-smart investment;

(g) Establish a joint database for supporting industries and technology suppliers among partner countries and a database to enhance the flow of investment data and information on investment opportunities in partner countries;

(h) Establish a joint climate-smart investment promotion committee with participants from the various IPAs in each partner country.

[125] UNCTAD (2010) proposed the following elements of a global partnership: (a) establishing "clean" (i.e. climate-smart) investment promotion strategies; (b) enabling the dissemination of "clean" (i.e. climate-smart) technologies; (c) securing IIAs' contribution to climate change mitigation (and adaptation); (d) harmonizing corporate GHG emissions disclosure; and (e) setting up an international climate-smart technical assistance centre.

Such a partnership in climate-smart investment would require both the cooperation of investment-policymaking bodies and ministries in the partner countries and the IPAs in the partner countries. Institutional mechanisms for such coordination and cooperation would have to be established (e.g. in the form of joint consultation committees). The role of IIAs has been discussed above.

5. Other supporting (sub)regional initiatives

A regional climate-smart trade and investment cooperation partnership can contain other (sub)regional initiatives of in support of trade and investment in CSGTs and climate-smart services. To the extent, that such initiatives may currently not be viable at the regional level, they may be considered at the subregional level – i.e. in the context of ASEAN, SAARC, the Economic Cooperation Organization, the Shanghai Cooperation Organization among others – or within the framework of existing RTAs and economic partnership agreements. Some suggestions follow, but they are not intended to be exhaustive.

In finance:

(a) Levy a regional carbon tax or strive at least for harmonized taxes on carbon emissions. As discussed above, carbon taxes have inherent advantages over EST;

(b) Disburse regional level subsidies for CSGTs and coordinated phase-out of fossil fuel subsidies. Regional level subsidies for CSGTs would be available and of the same amount for any climate-smart enterprise and investment operating in any of the partner countries;

(c) Establish a regional development fund for the development of, and trade and investment in CSGTs. In the absence of consensus on a global “Green” Fund, a regional level development fund may be considered consolidating and strengthening existing ones. A regional venture capital fund could also be considered as part of a wider development fund. Such a fund could be hosted by ADB or set up as a separate entity by the partner countries of the proposed regional partnership or existing RTA, possibly with support of national development banks or Sovereign Wealth Funds. Preferable, the Fund could also be a public-private partnership. ADB already employs similar funds (see box II.15). The issue is whether there is scope to consolidate all regional funds into one coherent and comprehensive fund for multiple purposes related to strengthening “green” development through CST support, and the promotion of trade and investment in CSGTs and climate-smart services.

In standards:

(a) Develop (sub)regional product standards and technical regulations for CSGTs, to promote intraregional trade and investment. Such standards should conform to international standards as much as possible. Ideally, global and regional standards should replace national standards to improve transparency and reduce compliance costs for businesses. Where global harmonization is not

Box II.15. ADB's climate-smart development funds

ADB is one of the active regional players in advancing the climate change agenda in the Asia-Pacific region. ADB has been investing heavily in programmes and projects designed to help countries move on to a low carbon growth path, and in 2008 and 2010 it spent almost $1.8 billion on clean energy projects ($1.3 billion in 2009), up from $226 million in 2003. It is now targeting annual investments of $2 billion by 2013 (see www.adb.org/Clean-Energy/default.asp).

Donor countries, including Australia, selected European Union countries, Canada, Japan, the Republic of Korea and the United States, have pledged $6.5 billion for two global climate investment funds: the Clean Technology Fund and the Strategic Climate Fund. The climate investment funds are being made available to multilateral development banks, including ADB, for climate change-related investments. ADB has planned to channel more than $700 million from these new investment funds to its developing member countries.

The Clean Technology Fund supports the deployment of low carbon energy technologies such as wind, solar, hydro and geothermal power as well as energy efficiency measures for industry, commercial buildings and municipalities. Activities supported by this fund will receive co-financing from ADB's regular operations, and this is expected to mobilize additional financing, both from the public and private sectors.

The Strategic Climate Fund will support pilot programmes on climate resilience, forest investment and scaling up RE use for low-income countries, with the end goal of demonstrating effective climate mitigation and adaptation interventions that can be expanded and replicated in future. For example, a successful adaptation programme undertaken in a delta region such as Bangladesh could potentially be replicated in other countries with similar geography.

The two funds are designed to be interim financing tools, and will be discontinued once the UNFCCC completes deliberations on a new global programme for addressing climate change and the new financial mechanisms needed to support it. Money released by the Strategic Climate Fund will be in the form of grants. The Clean Technology Fund will issue concessional loans with interest on the loans as low at 0.25 per cent for up to 40 years. Risk mitigation instruments such as guarantees and equity will also be available. The money can be tapped for public and private sector initiatives.

In addition to participation in these funds, ADB also has an Asia-Pacific Carbon Fund, initiated in 2007, for support to climate-smart technology and RE projects as well as the Clean Energy Financing Partnership Facility also initiated in 2007, which provides grant financing for improving energy security and for moving to a low-carbon economy. An Asia-Pacific Fund for Energy Efficiency has also been proposed.

Sources: www.adb.org/Media/Articles/2009/13091-asian-climates-changes-funds/; www.adb.org/Clean-Energy/default.asp; and ADB, 2009a.

possible, attempts towards subregional and regional harmonization should be made. This would be conducive to intraregional trade;

(b) Regional harmonization of carbon emissions standards (such as fuel emission standards from vehicles), labelling and certification schemes, and conformity assessments should also be pursued. A website could be established for that purpose to act as a focal point, information source and collaboration tool;

(c) Develop regional transparency and disclosure mechanisms for enterprises in partner countries to report their GHG emissions;

(d) Countries, at a minimum, should strive towards mutual recognition of climate-smart standards (and standards in general).

In technology development and transfer:[126]

(a) Promote (sub)regional cooperation in CST development (Srinivas, 2009). In particular, promote (sub)regional innovation systems linking national innovations systems to create synergies and efficiencies in technology development;

(b) In particular, and at a minimum, form a regional R&D alliance which would pool national resources for regional level R&D and testing;

(c) Establish cross-border CST clusters and climate-smart science parks. Such an infrastructure is closely related to the attraction of climate-smart FDI;

(d) Set up regional databases on supplies and customers of CSTs (and, in a wider context, also covering ESTs). APCTT's current databases and search engines could provide a template or be adopted and further developed as the leading region-wide online database for this purpose;

(e) Form (sub)regional partnerships to facilitate intraregional transfer of CSTs. Some countries, such as China and India, are emerging as innovators in the area of CST. Such technologies could be transferred to other less developed countries of the region through partnerships and technical assistance programmes as well as through intraregional FDI. As one of ESCAP's regional institutions, APCTT plays an active role in promoting and facilitating the intraregional transfer of environmental sound technologies in general, and CSTs in particular. This role is reviewed in box II.16;

(f) Set up a regional technology venture capital fund (see above).

Technical assistance and aid-for-trade:

(a) Identify target areas for technical cooperation and aid-for-trade in capacity-building for development of, and trade and investment in CSGTs and climate-smart services. This includes the attraction and implementation of climate-smart investment (e.g. development of human resources, infrastructure, supporting industries, SMEs, information technology, industrial technology, R&D) and the coordination of efforts within partner countries with other international organizations involved in technical cooperation. While aid for climate-smart trade can be mobilized from traditional sources in developed countries, there is considerable scope for South-South aid-for-trade, particularly from the more developed countries such as China and selected ASEAN countries to least developed countries in their region/subregion;

[126] Rene van Berkel, 2008. Study prepared for ESCAP. Op. cit. (footnote 41).

(b) A regional technical assistance centre could be set up in ADB or ESCAP for the purpose. Such a centre would focus on providing technical assistance, but would not act as a provider of capital for climate-smart investment projects (which is the purpose of the regional development fund proposed above).

Box II.16. Facilitating CST transfers through advisory services: the role of APCTT

Since the late 1980s, APCTT of ESCAP has been providing advisory services to facilitate technology transfer in several areas of technology, including CSTs. Individual inquiries are received from firms (especially SMEs), research and development institutes, universities, government agencies and individuals who wish to buy or sell technology. The following examples of CST transfer facilitated by APCTT are illustrative in this regard.

In 2007, APCTT provided advisory services to an SME from Maharashtra, India to commence discussions with a firm in Moscow to obtain technology to manufacture rice straw-based gasifiers and fuel briquettes using municipal waste water and organic waste. A large Indian firm, based in Mumbai, seeking technology to generate power from rice husk fly ash was also introduced to a firm in Baroda, India. Through APCTT's intervention, an SME from Haryana, India established communications with an international university based in Bangkok, to gain access to biogas-based technology for power generation. In 2008, the Centre helped an SME based in Chittagong, Bangladesh to initiate a technology transfer initiative with a leading Government of India technology commercialization agency in order to obtain technology to manufacture solar-power based inverters for running water pumps.

Considering the intensifying interest in RETs, in 2008 APCTT added a new category showcasing RETs on its technology4sme.net website. During 2009-2010, APCTT facilitated contacts between an Indian company and an Australian business firm for bio-diesel production technology transfer and helped a Canadian company to establish contacts in China for the transfer of technology related to solar and wind power. Furthermore, it helped to establish contacts between a Japanese business intermediary and some technology-based business firms in Nepal and Thailand in order to facilitate the transfer of technology related to mini-hydro power and geo-thermal energy. The Centre is currently intensifying its initiatives to support the transfer, adoption and utilization of CSTs in the Asia-Pacific region.

Source: Asian and Pacific Centre for Transfer of Technology.

EPILOGUE

IMPLEMENTING THE POLICY RECOMMENDATIONS

This study has provided a cogent argument that climate change is a real phenomenon that is expected to severely affect trade and investment, the driving forces of economic growth and poverty reduction of all Asian and Pacific economies. The region is particularly prone to natural disasters. Such disasters are expected to increase in terms of frequency and intensity in many Asian and Pacific countries, particularly those with long coast lines. Many of the disasters are expected to result from climate change.

The only way to mitigate climate change is by a comprehensive reduction of GHG emissions. While trade and investment activities are important contributors to GHG emissions, either directly or indirectly, they are also part of the solution. Trade and investment are needed in order to develop, produce and trade CSGTs and climate-smart services, particularly RE goods and technologies. The R&D and actions needed to develop and commercialize those new “green” products and technologies will largely be funded from private sector investment; access to these products and technologies by all economies is provided, to a large extent, by international trade. For that reason, this study argues that countries, individually and collectively, need to liberalize and promote trade and investment in CSGTs and climate-smart services. This can be done directly, through removing at-the-border and behind-the-border obstacles to trade and investment as well as indirectly by adopting climate-smart energy, financial, technology and enterprise development policies.

Apart from national-level action, regional cooperation is strongly advised and this study has proposed regional cooperation partnership to promote trade and investment in CSGTs and climate-smart services. Three important conditions can be identified to guarantee that national and regional policies will be successful.

First is the need for political will and leadership. Most economies in the region have adopted firm time-bound targets for GHG emissions reduction and/or increase of RE in overall energy supply in their NAMAs. However, it is believed that these efforts, while laudable, are largely insufficient to prevent global warming. This means that global warming and climate change will occur, regardless of the expected scenario. Current mitigation efforts should therefore aim at postponing the worst effects to allow the implementation of adequate adaptation measures. The promotion of trade and investment in CSGTs is central to such mitigation efforts. The policies presented in this study for that purpose are by no means revolutionary or new in any sense. However, if they are not properly implemented in a coherent, consistent and coordinated manner, they will help policymakers to pay lip service to the cause, but will do little to mitigate or adapt to climate change.

Clearly, governments and businesses alike need to be convinced of the urgency of the problem posed by climate change as well as the need for global and regional cooperation with a view to promoting trade and investment in CSGTs. Capacity-building, awareness creation and facilitating the sharing of knowledge, experiences and best practices among countries and stakeholders are important modalities in this regard; however, they are not sufficient to adequately and effectively address climate change. Therefore political leadership and policy advocacy are required coupled with widespread awareness creation. Unfortunately, the political climate in some advanced countries of the world appears to be moving in the opposite direction, partly as a result of the global economic crisis. While the crisis has offered opportunities for promoting trade and investment in CSGTs, in some countries any effort towards mitigation of climate change is seen as a cost detrimental to business revival. Such an attitude is very irresponsible and shifts the responsibility for cleaning up to later generations who will face much higher costs and much more irreparable damage.

On the positive side, this attitude also paves the way for some emerging regional countries to take the lead instead. China and the Republic of Korea, in particular, have the potential to emerge as strong leaders in this regard. Although China's GHG emissions have risen rapidly during the past few decades, mainly as a result of the country's economic success, China is probably among the most aware countries of the environmental costs of development and the urgency to address these costs. It is China that has taken a global lead in the development and utilization, investment and export of CSTs, pushed by a pro-active government. Likewise, the Republic of Korea, with its "green growth" platform, plays an important role in policy advocacy and is leading by example.

ESCAP, as the regional arm of the United Nations, has a responsibility to raise awareness on climate change in the region and propose constructive solutions based on regional cooperation. The solutions presented in this study have focused on the promotion of trade and investment in CSGTs. Such solutions would complement the work of UNFCCC, which is basically a negotiation platform to address mitigation of climate change at the global level.

The successful implementation of the proposed recommendations is a function of political will and leadership, effective technical and financial assistance, and solid public-private partnerships

Second is the need for technical and financial assistance, i.e. aid for climate-smart trade and investment for those countries that are willing but not in a position to develop or apply CSTs, either because they do not have the capacity and/or because they have no effective access to them. Many face continued deforestation, which is a root cause of GHG emissions but supports the livelihood of many poor people, either through slash-and-burn agriculture or through the employment and income generation provided by the forest-based industrial sector. Aid for climate-smart trade and investment is crucial and hardly a choice, as the failure of some countries to do their part in mitigating climate change will affect all others. A comprehensive effort, preferably at the global level but certainly at the regional level, is needed to replace fossil-based fuels to RE sources (particularly solar and wind power, and biomass. Those countries that do not have the capacity to do so will need urgent international assistance. Such assistance should be an important aspect of any global or regional trade and investment cooperation partnership, and should become a focus for both bilateral and multilateral official development assistance.

Third, the promotion of climate-smart trade and investment in particular, and the mitigation of climate change in general, requires the proper cooperation of all stakeholders as well as careful coordination of policies among concerned government ministries and agencies at the central and local government levels. Furthermore, as trade and investment are principally business activities, solid public-private partnerships are required for following up on the recommendations made in this study. While neither governments nor businesses can do it alone, both have an important role to play. The roles of governments and markets, as outlined in ESCAP (2009a), provide important guidance in this regard. Such partnerships are important not only in the area of co-financing but also in the area of advocacy and awareness creation. Ultimately, it is businesses that can develop the climate-smart products, services and technologies that the world needs to effectively mitigate climate change; however, governments have the prime responsibility for providing the enabling environment, sending the right policy signals and providing the proper incentives.

This study is only one of many addressing the issue of climate change, and is certainly not the only one focusing on trade and investment. It will also not be the last. However, the need for policy advocacy and pointing out the urgency of the issues covered requires ongoing discussion and analysis. Hopefully, in that regard, this study has made a useful contribution, and that policymakers and business leaders will take notice of its recommendations.

Annexes

Annex A. Climate change adaptation in the agricultural sector: A road map for the Republic of Korea

The Republic of Korea has adopted a roadmap for adaptation to climate change in the agricultural sector, which contains seven major categories covering 19 areas for action:

(a) R&D (breeding, production technology development, base technology development, resource management innovation and climate information system);

(b) Infrastructure management (farmland management, agricultural water management and agricultural facility management);

(c) Provision of economic means (provision of grants);

(d) Legal and institutional improvement (insurance system expansion, resource management system setup and formulation of plans for each region);

(e) Manpower training and education (manpower training and education/public relations);

(f) Monitoring (assessment of adaptation and vulnerability);

(g) Technology and management applicable to farm households (production technology management, soil management, water management and management of farm household finances).

As climate change will occur over a considerable period, the roadmap has set a target year of 2030, to be achieved in three phases: (a) a short-term base build-up phase (2010-2013); (b) a mid-term take-off phase (2014-2019); and (c) a long-term settlement phase (2020-2030). The seven major categories in each of these phases are presented in the following table.

Roadmap for implementing the adaptation measures in the agricultural sector for the Republic of Korea

Adaptation measures	Base build-up phase (2010-2013)	Take-off phase (2014-2019)	Settlement phase (2020-2030)
R&D	• Develop new breeds that are in great demand and resistant to heat. • Popularize new cultivation technologies for fertilization and sowing. • Prepare maps for suitable places for cultivation and crop distribution. • Research to identify physiological effects of global warming. • Develop forecast models to prevent blights, pest and weeds. • Develop and utilize early warning systems. • Develop water resource management systems to prevent natural disasters including drought and flooding.	• Popularize breeds adapted to global warming. • Provide information about adaptation to global warming and develop training systems. • Promote crop transformation evaluation studies. • Improve early warning systems of climate change induced weather disasters. • Promote facilities to optimize the efficiency of water utilization. • Promote the water resource management system in prevention against natural disasters such as drought and flooding.	• Develop an adaptation system to global warming. • Convert to an agricultural production system that takes advantage of global warming. • Develop a crop transformation evaluation system. • Further strengthen an early warning system • Popularize the farming simulator • Promote the water resource management system in prevention against natural disasters such as drought and flooding.
Infrastructure management	• Popularize the technologies for reducing carbon emission from rice fields and dry fields. • Popularize no-tillage farming methods. • Establish standards for water-saving irrigation. • Modernize agricultural infrastructure. • Popularize energy-saving technology for the protected horticulture.	• Promote the reduction of carbon emission from rice fields and dry fields. • Expand the no-tillage farming methods. • Popularize the standard for water-saving irrigation. • Improve automated agricultural water management. • Develop further energy-saving technologies for the protection of horticulture.	• Promote the reduction of carbon emission from rice fields and dry fields. • Settle the no-tillage farming methods. • Develop a tele-metering/ tele-control (TM/TC) system. • Develop energy-saving fusion technology[a] for the protection of horticulture.

Adaptation measures	Base build-up phase (2010-2013)	Take-off phase (2014-2019)	Settlement phase (2020-2030)
Economic means	• Pay a carbon grant to the agricultural population who practice low-carbon farming methods. • Introduce investment incentive for water saving. • Support high-efficiency irrigation systems.	• Expand carbon grants for low-carbon adaptation methods. • Promote investment incentives for water saving. • Charge for the use of water.	• Promote carbon grants for low-carbon farming methods.
Legal and institutional improvement	• Expand the insurance system for agricultural disasters. • Expand the insurance system for damages caused by floods and storms. • Operate a farm household income stabilization programme. • Establish a global warming adaptation committee. • Introduce a system for calculating crop damage. • Formulate a long-term development plan for rural villages. • Set up special task force teams for main areas of production.	• Promote the insurance system for agricultural disasters. • Promote the insurance system for damages caused by flood and storm. • Set up farm income stabilization programmes. • Set up a global warming adaptation committee. • Develop a system for calculating crop damage. • Arrange a long-term development plan for rural villages.	• Promote the insurance system for agricultural disasters. • Promote an insurance system for damages caused by flood and storm. • Set up farm income stabilization programmes. • Operate a global warming adaptation committee. • Develop a system for calculating crop damage and support systems.
Public relations and education	• Train people specialized in agricultural risk management. • Train consultants specialized in risk management. • Expand education of farm households in insurance schemes for crop disasters and overall risk management.	• Train people specialized in agricultural risk management. • Utilize consultants specialized in risk management. • Popularize the manual on adaptation to global warming. • Develop adaptation education systems.	• Train people specialized in agricultural risk management. • Improve the manual on adaptation to global warming. • Strengthen a systematic education system for each subject related to adaptation to global warming.

Adaptation measures	Base build-up phase (2010-2013)	Take-off phase (2014-2019)	Settlement phase (2020-2030)
Monitoring	• Introduce an impact assessment model for productivity forecast and biological changes. • Develop an agricultural ecosystem monitoring system.	• Utilize the impact assessment model for productivity forecast and biological changes. • Operate system for assessing the environmental impact on crop growth. • Make mid/long-term forecasts of world food demand and supply.	• Develop a system for assessing the environmental impact of alternative water use on crop growth. • Make mid/long-term forecasts of world food demand and supply.
Technology and management applicable to farm households	• Control crop growth rate, greenhouse cultivation, agricultural chemicals and weeds. • Cultivate crops adapted to climate change. • Fertilize the soil by improving the alkali content. • Install water management systems for individual farm households. • Utilize risk avoidance crop insurance.	• Fertilize the soil by improving the alkali content. • Prepare an irrigation schedule to enhance the efficiency of water use. • Participate in the income stabilization programme. • Diversify farm household revenues through crop diversification.	• Change the places of cultivation to places with favourable climate conditions. • Fertilize the soil by improving the alkali content. • Prepare an irrigation schedule to enhance the efficiency of water use.

[a] Energy-saving fusion technology incorporates convergence of biotechnology, energy technology, and information technology.

Annex B. Relevant WTO provisions affecting policy options to tackle GHG emissions

WTO Agreement/Article	Description	Implications
General Agreement on Tariffs and Trade (GATT)	**Principal WTO Agreement covering trade in goods**	**Restricts use of popular trade policy instruments for environmental purposes, e.g. import bans and restrictions**
Article I	General Most-Favoured Nation treatment	Countries, in imposing border measures on imports/exports, cannot discriminate between similar products from WTO members.
Article II	Schedule of concessions	Tariffs and other border charges may not be higher than the bound rates contained in countries' schedules.
Article III	National treatment	Products entering a market must receive the same treatment as similar domestic products, i.e. no discrimination in treatment between imported and domestically produced goods.
Article V	Freedom of transit	Goods in transit will not be subject to unnecessary delays or restrictions and will be exempt from customs duties and from all transit duties or other charges imposed in respect of transit, except charges for transportation.
Article VIII	Fees and formalities connected with importation and exportation	All fees and charges of whatever character (....) imposed by a WTO member on or in connection with imports or exports (....) will not represent an indirect protection to domestic products or a taxation of imports or exports for fiscal purposes.
Article X	Publication and administration of trade regulations	All trade regulations, charges, agreements decisions etc. need to be published promptly in a transparent and easily accessible manner.
Article XI	General elimination of quantitative restrictions	Prohibits quantitative restrictions (e.g. quotas) on imports and exports.
Article XIII	Non-discriminatory administration of quantitative restrictions	Prohibits discrimination in the prohibition or restriction on imports or exports of any product destined for, or coming from another WTO member.
Article XVI	Subsidies	Elaborated in the Agreement on Subsidies and Countervailing Measures.

WTO Agreement/Article	Description	Implications
Article XVII	State trading enterprises	To be read in conjunction with the Agreement on Government Procurement (plurilateral agreement). Requires non-discriminatory treatment by state trading enterprises.
Article XVIII	Government assistance to economic development	Economic development may be interpreted to include sustainable development. This would allow exceptions from standard WTO rules.
Article XX	General exceptions	Allows for exceptions to the standard rules that would allow measures necessary to protect human, animal or plant life or health and those related to the conservation of exhaustible natural resources. Could be used to justify restrictions for environmental purposes, but those measures should not be used as a disguised restriction on international trade.
Article XXII	Nullification or impairment	Allows for country actions if that country considers that the action of another country nullifies or impairs benefits accruing under GATT, even when the action of the other country is in conformity with GATT.
Article XXIV	Customs unions and free trade areas	Should be considered in conjunction with the Enabling Clause. Allows RTAs under certain conditions. Those RTAs may have clauses on environment and climate change beyond those contained in GATT.
Article XXVII	Withholding or withdrawal of concessions	Allows for withholding or withdrawal of concessions, e.g. based on environmental considerations, but requires consultations that have substantial interest.
Article XXVIII	Modification of schedules	Similar to Article XXVII. Consultation and compensation may be required.
Agreement on Subsidies and Countervailing Measures	Covers provisions on subsidies and countervailing measures on trade in goods	Prohibits specific export subsidies. Where subsidies are allowed, they may be subject to countervailing measures if serious injury can be demonstrated.

WTO Agreement/Article	Description	Implications
Agreement on Agriculture	Covers provisions on trade in agricultural goods	Allows for export subsidies if scheduled, but subject to reductions. Scheduled for elimination by 2013. "Green" box subsidies (which cause minimal trade distortions) are allowed, including direct payments under environment programmes. AoA takes precedence over other WTO agreements in cases of conflict.
Agreement on Sanitary and Phyto-Sanitary Measures	Covers provisions on the use of standards and regulations to protect animal, plant and human health	GHG emission standards may be imposed if it can be shown that such emissions are a health hazard, but must be based on proper scientific justifications.
Agreement on Technical Barriers to Trade (TBT)	Covers provisions on the use of public technical standards and regulations	Allows technical standards and regulations related to GHG emissions, but should not be an unnecessary barrier to trade. Should conform to existing international standards. Will be subject to transparency, mutual recognition and non-discrimination provisions.
General Agreement on Trade in Services (GATS)	Covers trade in services, including environmental services	Environmental services are not well-defined. GATS allows for exceptions to MFN. National treatment only where scheduled. Covers FDI in environmental services (mode 3: commercial presence).
Agreement on Trade-Related Investment Measures (TRIMS)	Prohibits certain performance requirements for FDI such as local content for export products (as they are considered trade-distorting)	Does not allow policies that require local content in FDI projects aimed at development, including projects aimed at mitigating GHG emissions.
Agreement on Aspects of Trade-Related Intellectual Property Rights (TRIPS)	Provides minimum international standards on IPR, but has flexibilities built in.	Patent provisions may hamper developing countries' access to climate-smart technologies, but contain flexibilities such as compulsory licensing. Exceptions to patenting may be possibly granted on the basis of protection of human, animal, plant health or life.

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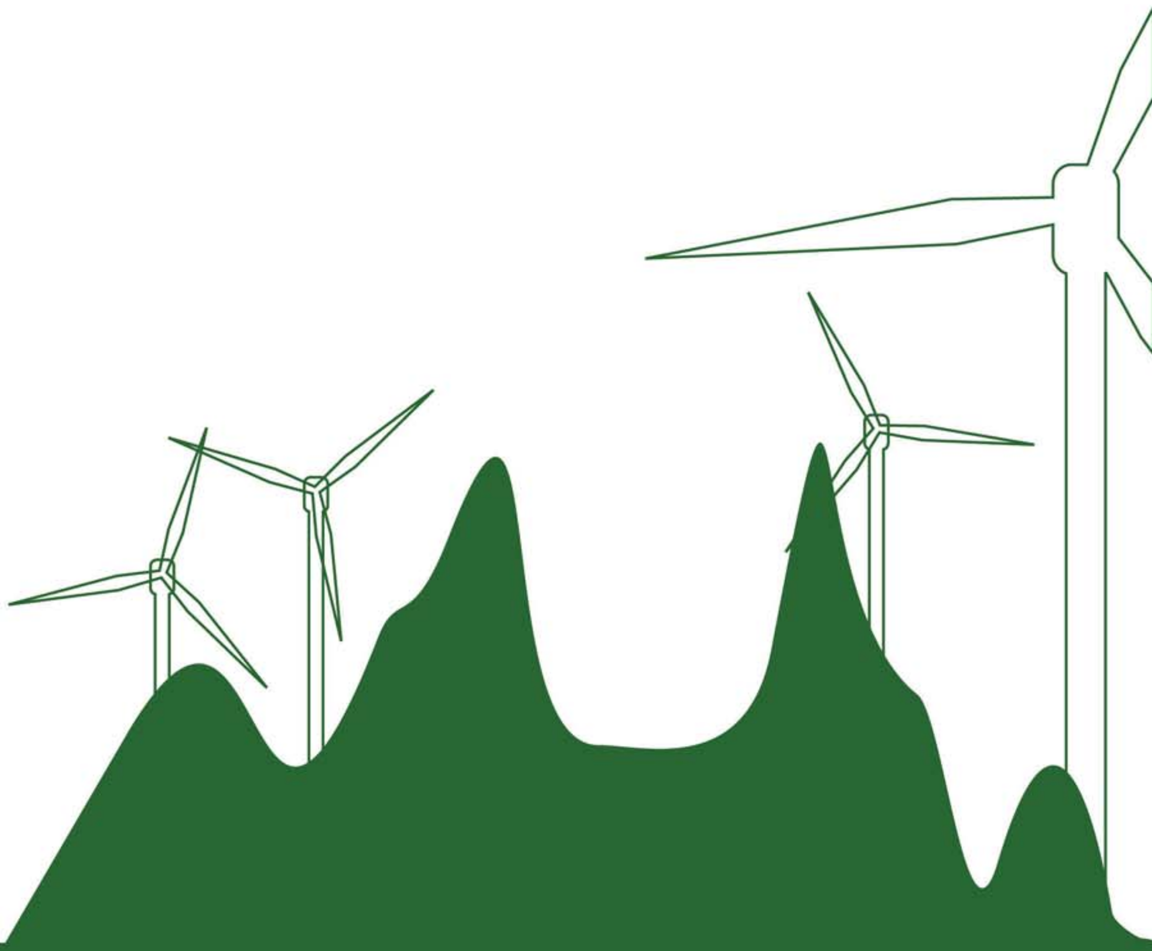
United Nations publication
Sales No. E.12.II.F.10

ISBN: 978-92-1-120645-6
ISSN: 1020-3516
ST/ESCAP/2614



USD $45
ISBN 978-92-1-120645-6

United Nations publication
Printed in Bangkok

April 2012—300