Chapter 2

Aligning Actions on Climate and Development: Asia at the Crossroads

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Summary

Climate change is real and Asia is already experiencing its adverse impacts. The Intergovernmental Panel on Climate Change (IPCC) predicts that these impacts will become worse in the future. While the contribution of developing countries in Asia (hereafter referred to as 'developing Asia') to global greenhouse gas (GHG) emissions is increasing, the per capita emissions remain low and developmental challenges remain significant. Global estimates from the IPCC and the Stern Review, and limited evidence from Asia, suggests that the costs of inaction could be several times the costs of action. Thus, a multifaceted approach to enhance mitigation action and strengthen adaptation is needed.

The good news is that developing Asia offers some of the world's most cost-effective mitigation and adaptation opportunities. These possibilities exist in improving energy efficiency and renewable sources of energy, exploiting synergies among multilateral environmental agreements (MEA), integrating mitigation strategies into non-climate policies, and mainstreaming adaptation into development planning. The bad news is that climate policy has thus far received less attention than would be desirable from senior policymakers and politicians in Asia. The lack of attention has resulted in few policies that effectively integrate climate and development concerns, institutional structures that are chiefly designed to attract carbon investment from market mechanisms, and the absence of national policy frameworks for adaptation.

Developing Asia's participation in climate change negotiations has not been commensurate with its contribution/vulnerability to climate change. As a result, very few post-2012 regime proposals reflect Asian needs or aspirations. Developing a framework that reconciles global climate interests with Asian development priorities is critical. Rather than solely relying on the Kyoto-style "targets and timetables," a post-2012 framework may include (i) progressively increasing emission reduction and adaptation commitments or actions; (ii) new groupings of countries based on responsibility, capability, mitigation potential, and vulnerability; and (iii) a differentiated schedule of incentives and compliance provisions.

The deployment of low-carbon technologies will be important in Asia. This will require building synergies between United Nations Framework Convention on Climate Change (UNFCCC) and non-UNFCCC initiatives as well as other measures such as the joint ownership of intellectual property rights (IPR) and innovative financing. Adaptation should receive as much attention as mitigation in Asia. This will necessitate greater

adaptation financing and stronger financial mechanisms at the international level, enhanced cooperation on transboundary issues and sharing of best practices at the regional level, and effective integration of local knowledge into adaptation plans at the national and sub-national levels.

Despite considerable interest in Asia in the clean development mechanism (CDM), concerns regarding approval modalities, developmental benefits, post-2012 carbon credits, and geographic and technological inequity remain salient. In the short-term, strengthening human/institutional capacities and finding innovative options for underlying financing could remove some of these barriers. In the medium term, sector-based and policy-based approaches and the promotion of the developmental dividend could address additional barriers. Developmental co-benefits, if recognised and rewarded properly, could partly offset the costs of mitigating GHGs in Asia. Institutional frameworks and incentives to promote the implementation of policies with co-benefits, therefore, must be revisited in the short term. Metrics that enable the monitoring of co-benefits in a post-2012 regime should be developed for the medium term.

A roadmap to achieve rapid transformation of social, industrial and economic structures based on each Asian country's national circumstances is needed. Though developed countries should devise their own blueprints and make concerted actions to stabilise GHG emissions, developing countries in Asia must not wait to learn lessons from other regions. In doing so, it should be recognised that climate policy alone will not solve the climate problem.

1. Setting the context

As highlighted in Chapter 1, while the international community has been working to find effective solutions to the problem of climate change for the past 25 years, progress has been patchy and relatively slow. The year 2007, however, might have been a major turning point in global climate policy for several reasons. First, the awarding of the Nobel Peace Prize to the IPCC and the former US Vice-President Al Gore brought considerable awareness of the issue worldwide. The IPCC concluded that climate change was "unequivocal" and that it was "very likely" due to anthropogenic activities (IPCC 2007). Second, the publication of the Stern Review of the Economics of Climate Change in late 2006, and the convening of several high-profile meetings throughout 2007 (e.g. the United Nations (UN) Security Council meeting, the UN General Assembly thematic dialogue, the G8 Heiligendamm Summit, and the Asia Pacific Economic Cooperation (APEC) meeting) built up considerable political momentum. Third, and perhaps most importantly, the agreement on the "Bali Action Plan" at the 13th Conference of the Parties (COP13) to the UNFCCC, is expected to herald significant changes in international climate policy leading to an agreement on a new regime by the end of 2009 (box 2.1).

This chapter examines how Asia, a region that is culturally and politically diverse and that is experiencing unprecedented economic growth in some countries but enduring lingering poverty in other countries, can grapple with this complex challenge. It begins by demonstrating that Asia's contribution to global GHG emissions is increasing rapidly and that Asia will suffer significantly from the impacts of climate change. Later it is argued that mitigating such risks will require the region's climate policies to be resilient,

remaining flexible in the face of an inherently uncertain issue, while holding firm in the face of opposition from carbon-intensive industries and other vested interests. It is suggested that striking this balance will depend upon the adaptability of key sectors (forestry, water, etc. discussed in part two) and the strong alignment of climate concerns with sustainable development policies.

Box 2.1. The Bali Action Plan

The Bali Action Plan may be considered a significant milestone in the negotiations toward the post-2012 climate regime not only because it contains a roadmap, an agenda and a 2009 deadline, but also due to concurrent progress in discussions on all four building blocks of the climate regime beyond 2012 – mitigation, adaptation, technology and finance. In terms of mitigation, delegates agreed to consider "measurable, reportable and verifiable nationally appropriate mitigation commitments or actions by developed country Parties" and "cooperative sectoral approaches and sector-specific actions." An agreement on the management of the adaptation fund was reached, and discussion on reducing emissions from deforestation and financing mechanisms moved forward. In addition, there was agreement to start a strategic programme to scale up investment in the transfer of mitigation and adaptation technologies. Moreover, through the establishment of a separate ad-hoc working group on long-term cooperative action, an inclusive process with a long-term goal was created. Some of the implications of the Action Plan for developing countries in Asia are briefly discussed below.

The future negotiations will consider "nationally appropriate mitigation actions by developing country parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building in a measurable, reportable and verifiable manner." A key consideration is that the Action Plan secures various support mechanisms for mitigation efforts by developing countries, including "technology cooperation in specific sectors," "cooperation on research and development," "positive incentives and innovative means of funding," and "mobilization of public- and private-sector funding and investment." During negotiations, developing countries need to specify barriers to implementing mitigation actions, so that concrete support from developed countries can be institutionalised in the new climate regime. Similarly, obstacles to pursuing synergies between GHG mitigation and sustainable development must be identified. In addition, clarity on words such as *"measurable, reportable and verifiable"* must be improved as there is potential to interpret these words differently.

1.1. Asia's contribution to climate change

Recent estimates suggest that Asia accounts for 27% of the world's energy-related GHG emissions and this proportion is likely to increase to 40% by 2030. The region is predicted to experience a steady rise in the urban population,[1] a sharp increase in energy use[2] and motorization, and continued reliance on fossil fuels[3] and energy-intensive industries (IEA 2007, USAID 2007). The announcement in June 2007 by the Netherlands Environmental Assessment Agency that China surpassed the USA as the

largest emitter of carbon dioxide (CO_2) in 2006 may be of greater symbolic interest than substantive import (MNP 2007). However, it is part of a general picture (table 2.1) suggesting that the region has become and will continue to be a major source of emissions (IEA 2007).

Table 2.1. Energy-related CO_2 emissions by region in 2005

Region	Total CO_2 Emissions (million tonnes)	CO_2/ Pop. (tCO_2/ capita)	CO_2/ GDP ($kgCO_2$/ 2000$)	CO_2/ GDP (PPP) ($kgCO_2$/ 2000$ PPP)
World	27,136	4.22	0.75	0.50
OECD (excluding Japan and the Republic of Korea)	11,247	11.29	0.49	0.43
Middle East	1,238	6.62	1.58	0.91
Former USSR	2,303	8.08	4.39	1.10
Non-OECD Europe	263	4.87	1.73	0.61
Asia	9,295	2.75	0.97	0.48
Latin America	938	2.09	0.58	0.29
Africa	835	0.93	1.14	0.40

Source: IEA (2007)

While total emissions may be viewed with justifiable concern, they should not overshadow less troubling measurements, such as cumulative emissions since the industrial revolution and per capita emissions. For example, the majority of countries in Asia fall well below the world average of 4.2 tonnes per year of per capita energy-related emissions (table 2.2) (IEA 2007). Though the gap between per capita emissions in the developing countries of Asia and the developed world is sizable, legitimate reservations have arisen over the prospects of it narrowing. At the heart of such reservations lies the realization that the climate change fight cannot be won without the formulation of effective climate policies in all regions including Asia. And though there is a lack of consensus over how to move toward an effective climate policy in Asia, there is broad agreement that it is in the best interest of Asia to seriously address this issue.

1.2. Climate change as a challenge for sustainable development in Asia

The adverse impacts of climate change on sustainable development pose one of the main reasons why Asian policymakers should consider climate change more seriously. On a global basis, severe adverse impacts were reported by the IPCC. On a regional basis, however, the IPCC reported fewer observations in Asia than in other regions. For example, there were 2,000 observed significant physical and biological changes attributable to climate change in Europe, but comparable numbers were 106 physical and 8 biological changes in Asia (IPCC 2007). This shortage of observed impacts seems to be partly due to the difficulties in downscaling global models to national and local contexts, and more importantly due to the limited capacity to conduct such research in Asia (Srinivasan 2006a).

Table 2.2. Energy-related CO_2 emissions by selected Asian countries in 2005

Country	Total CO_2 Emissions (million tonnes)	CO_2/Pop. (tCO_2/ capita)	CO_2/GDP (kg CO_2/ 2000$)	CO_2/GDP (PPP) (kg CO_2/ 2000$ PPP)
Cambodia	4	0.27	0.66	0.11
China, People's Republic of	5,060	3.88	2.68	0.65
China, Taiwan Republic of	261	11.41	0.73	0.46
China, Hong Kong	41	5.87	0.20	0.19
India	1,147	1.05	1.78	0.34
Indonesia	341	1.55	1.64	0.45
Japan	1,214	9.50	0.24	0.35
Korea, The Republic of	449	9.30	0.70	0.47
Korea, DPR of	73	3.26	6.97	1.98
Malaysia	138	5.45	1.23	0.56
Mongolia	10	3.44	7.75	2.01
Myanmar	11	0.22	0.73	0.15
Nepal	3	0.11	0.48	0.08
Pakistan	118	0.76	1.28	0.36
The Philippines	76	0.92	0.82	0.20
Singapore	43	9.93	0.38	0.38
Sri Lanka	12	0.63	0.62	0.15
Thailand	214	3.34	1.36	0.43
Vietnam	80	0.97	1.80	0.35

Source: IEA (2007); Note: PPP=purchasing power parity; kg=kilogram

A recent review of 186 studies confirmed that most of the region's ecosystems are highly vulnerable to climate change (Preston et al. 2006). Data reported between 1990 and 2005, for instance, showed that precipitation increased in North and Central Asia, but declined in South Asia. If these trends continue, reduced rainfall will drive down cereal production 30% by 2050 in South Asia, a region that can least afford food shortages (IPCC 2007). Increased warming can accelerate glacier melts in the Himalayas, initially heightening the risk of river basin and glacier lake outburst floods (GLOF)[4] and then lowering freshwater availability in major river basins such as the Yangtze, Mekong, Yellow, Ganges, Indus, Brahmaputra, and Salween. Water shortage in these basins would threaten the livelihoods of millions by mid-century. Recent reports from China suggest a retreat of glaciers of up to 15% between 1964 and 1992.

Several other indirect impacts associated with climate change are projected to grow in scope and intensity. Warmer temperatures, for example, may degrade biologically diverse coastal and mangrove ecosystems in South and Southeast Asia, while increasingly variable rainfall could damage peat lands in Indonesia and Malaysia, which might further exacerbate climate change, as peat lands store large quantities of carbon[5] and are already shrinking due to intensified land clearing practices. A drier climate may result in an increase in the number and intensity of forest fires in boreal North Asia, which would release more carbon into the atmosphere. Perhaps the most deleterious of these indirect impacts, though, are vector-borne diseases such as malaria and dengue that will spread with warmer temperatures and diarrhoea that will proliferate with more frequent droughts and floods (table 2.3).

Table 2.3. Key projected impacts of climate change in Asia

Sector	Projected Impacts
Agriculture/ Forestry	• Increased risk of hunger in South Asia due to a 30% decline in cereal yields (266 million Asians may face hunger by 2080) • Increase in agricultural water demand by 6-10% or more for every 1^{o}C rise in temperature • Decline in net productivity of grasslands and milk yield • Increased frequency and intensity of pest outbreaks in forests & forest fires
Water	• Decline in water availability in India from ~1,820 m^3/yr to ~1,140 m^3/yr by 2050; may adversely affect >1 billion people. • Decline in annual flow of Mekong River by 16-24% by 2050 • Disappearance of Tibetan Plateau glaciers of <4 km length with a 3^{o}C rise • Shrinkage of glacier area by 80% over the Tibetan plateau from 500,000 km^2 in 1995 to 100,000 km^2 by the 2030s. • Deterioration of water quality due to salt water intrusion • Decline in fish larvae abundance in coastal waters
Health	• Exacerbation of cholera in South Asia due to increases in water temperature • Increased endemic morbidity and mortality due to diarrhoea all over Asia caused by floods and droughts • Increase in infectious diseases for livestock
Coastal/ Marine ecosystems	• Loss of 2,500 km^2 mangroves in Asia with a 1 meter sea level rise • Flooding of Red (5,000 km^2) and Mekong (15-20,000 km^2) river deltas • About 2.6-18.8 million people along the coasts of Southeast Asia may be at risk of flooding by 2100 • Large scale inundation and recession of flat sandy beaches affecting tourism • Loss of ~30% of Asia's coral reefs in the next 30 years

Source: IPCC (2007)

Some impacts, such as increased water demand, will emerge gradually and offer affected areas time to adapt, but abrupt effects such as GLOFs will not and may prove more costly. The biggest threats for Asia are arguably the increasingly frequent and more intense extreme climate events (table 2.4). Between 1950 and 2004, for example, Asia experienced 157 windstorms, causing 1,380 deaths, affecting 2,496,808 people, and costing about $5.9 billion (Preston et al. 2006). Heavy rainfall and seasonal typhoons mark much of coastal Asia's summer weather. A warmer climate can increase wind speeds of storms (Nordhaus 2006) that already level a costly toll on the region. The onset of heat waves would hit hardest those communities that lack the social and physical infrastructure to cope with prolonged stretches of extreme heat.[6]

Many parts of Asia will be vulnerable to yet another implication of climate change, sea level rise.[7] Rising sea levels are likely to present a challenge to low-lying coastal cities such as Bangkok, Hong Kong, Karachi, Kolkata, Mumbai, Tokyo, and Shanghai. They are likely to be even more challenging in the densely populated mega-deltas located at the mouths of the Ganges-Brahmaputra and Pearl Rivers. Unfortunately, sea level rise is likely to be most serious in poverty-stricken regions such as coastal Bangladesh, Vietnam and small island developing states (SIDS) in the Pacific where a 1 to 5 metre increase (by 2100) could submerge large swaths of land, displace many thousands of people, and heighten the likelihood of socio-political conflict as climate refugees seek new livelihoods elsewhere (NEF 2007). For instance, a one meter sea level rise may affect more than 10% of Vietnam's population, the highest percentage among 84 countries surveyed (Dasgupta et al. 2007).

Table 2.4. Some examples of non-linear effects of climate change observed in selected countries of Asia

Extreme Events	Recent Evidence
Heat Waves	
China	Increase in frequency of short term heat waves, warmer days and nights
Japan & The Republic of Korea	Increase in days with maximum temperature above 35°C; decrease in days with extremely low temperatures
India	Temperature between 45°C and 49°C during the summer of 2003; temperatures that reached 49°C in Andhra Pradesh caused an estimated 1,000 deaths
Mongolia	Increase in duration of heat waves by 8-18 days; decrease in duration of cold waves by 13.3 days over the past four decades
Intense Rains and Floods	
Bangladesh	Serious and recurrent floods; floods in 1987, 1988, 1998 and 2002 were particularly devastating; most recent severe flood in August 2007
Cambodia	Floods in 2000
China	Increase in frequency of extreme rains in west and south China, and floods along the Yangtze River; more frequent floods in northeast China since the 1990s; more intense summer rains in east China; severe floods in 1998 along the Yangtze River and in the northeast
India	Serious and recurrent floods in northeastern states, most notably during 2002, 2003 and 2004; floods destroyed nearly all of West Bengal's roads and transportation infrastructure in 2000
Japan	Increase in frequency of extreme rains over the past century; serious flood in 2004 due to torrential rains from ten typhoons; significant increase in maximum rainfall between 1961 to 2000
Nepal	Serious and recurrent floods
The Philippines	Landslides and floods in 1990 and 2004
Sri Lanka	Serious floods in the southernmost province in 2003
Vietnam	Increase in extreme rain events and resulting flash floods
Cyclones and Typhoons	
China	Increase in number and intensity of strong cyclones since the 1950s; 21 extreme storm surges from 1950 to 2004; of the 21, 14 occurred between 1986 and 2004
Japan	Number of tropical storms peaked in the mid-1960s and again in the early 1990s; densely populated port cities are extremely susceptible to strong storms
The Philippines	Increase in the frequency of cyclones in the Philippines Area of Responsibility (PAR) between 1990 and 2003; on average, 20 cyclones cross PAR, of which, eight or nine reached land

Sources: IPCC (2007); Preston et al. (2006)

On balance, the impacts of climate change will be most severe in regions that are heavily dependent on climate-sensitive sectors, suffer from inadequate provisions of health care and public services, and lack resources to invest in safeguards from the impacts of climate change. Unfortunately, this characterization applies to much of Asia. Furthermore, there is an increasing fear that the current impacts of climate change in vulnerable communities may make it difficult for many Asian countries to achieve the millennium development goals (MDG) by 2015. For instance, Sperling (2003) and Reid and Alam (2005) argued that climate change can severely impede progress on MDGs as it may affect the sources of income for poor families, including water resources, forests and crop land, which may then lead to social tensions within a community and increased hunger. Likewise, climate change may limit opportunities for children to receive primary education, as reduced crop yields may force them to work and

increased risks of disease may weaken their health, both of which will keep children out of school.

1.3. The costs of action and inaction in Asia

Assessing the economics of action (costs and risks of mitigation and adaptation policies) and inaction (costs and risks of impacts) of climate change is a huge challenge, as the outcomes of modelling are affected by several assumptions on the stabilization target and level; the emissions baseline, related technological change and resulting emissions; the discount rate; and the portfolio of technologies. The results would also be different if one considers long-term hidden costs. Indeed many earlier studies (Nordhaus 1991) overlooked non-market impacts such as effects on human health and ecological services. The most thorough analysis to date of the costs and risks of climate change revealed that a loss of up to 3% of global gross domestic product (GDP) might occur with a temperature rise of 2-3^{o}C above pre-industrial levels (Stern 2007). However, if direct impacts on human health are considered, costs could rise to 5-10% of global GDP. Amplifying feedbacks in the climate system could raise temperatures further and boost losses to 7-14% of global GDP. Finally, additional weighting for impoverished areas could raise the figure closer to 20% of global GDP. The UNFCCC (2007) estimated current global losses from climate change within the range of $160-330 billion, which are projected to increase to $850-1,350 billion by 2030.

On the other hand, the costs of action on a global basis are relatively low. Stern (2007) noted that the stabilization of emissions at the 550 parts per million (ppm) carbon dioxide equivalent (CO_2e)—the level that is likely to keep temperatures within 2-3^{o}C increase—would require expenditures in the range of only 1% of global GDP by 2050. IPCC (2007) reported that the global average cost of stabilizing GHG levels at 445–710 ppm ranges from less than 3% to a gain of 0.6% by the year 2030, which translates into an annual reduction in the GDP growth rate of less than 0.12% to less than 0.06%. A recent UNFCCC report indicated that additional financial flows of $200-210 billion will be necessary for GHG mitigation in 2030 to return global emissions to current levels (UNFCCC 2007). The World Bank (2006) estimated that costs of adaptation in developing countries alone would be around $9-41 billion per year. The costs of adaptation will increase further as mitigation action is delayed.

Although much of Asia is vulnerable to rising temperatures, varying precipitation patterns and rising sea levels, limited work has been done to assess the costs of action and inaction. Indeed this is one area that deserves urgent attention by researchers and policy makers. In Malaysia, for example, the initial national communication (NC) to UNFCCC estimated that a 1^{o}C rise in ambient temperature would cause a loss of about $12.4 million per year for the generation of 6,600 MW electricity due to a reduction in power output by 2% (table 2.5). Economic losses from sea level rise in the Krawang and Subang districts of Indonesia were estimated at $0.5 billion (PEACE 2007). A recent study in Indonesia projected a huge economic loss of $25.5 billion due to sea level rise by 2100, considering a loss of 90,260 km^2 with an estimated land value of $0.28 million per km^2 (Susandi et al. 2008). In China, losses from a 100 year high water tide were estimated to be $4.8 billion while costs of action were estimated to be $400 million. Paying for preventive action would therefore result in a net benefit of $4.4 billion (Hay and Mimura 2005). Stern (2007) reported that costs in India and Southeast Asia could range from 2.5 to 3.5% of annual GDP. The high end figure corresponds to

estimates that consider amplifying feedbacks that increase temperatures from 3.9°C to 4.3°C above pre-industrial levels. If weights are added for poorer regions, unpredictable non-linear effects and unabated emissions (which raise temperatures), then the respective loss estimates are expected to rise to 9-13% of annual GDP by 2100 (table 2.6). In view of the paucity of reliable estimates in Asia, some efforts are underway by the Asian Development Bank (ADB) and others to conduct Stern-review type studies in China and Southeast Asia. There is a further need to develop the capacity to use integrated assessment models that can evaluate these costs in developing Asia.

Table 2.5. Costs of climate change impacts in electricity sector in Malaysia

Climate change	Impact	Unit cost of impact	Estimated cost of impact	Adaptation /Mitigation
For every 1ºC rise in ambient air temperature	Loss in gas turbine power output by 2%	Loss of RM0.67 million per year per 110 MW gas turbine	About RM40 million per year for 6,600 MW capacity	Air intake cooling
	Loss of 2% of power output by hydro-turbines	Loss of RM0.9 million per year per 100 MW hydro-turbine	About RM18 million per year for 2,000 MW capacity	Precipitation enhancement
For every 1ºC rise in water temperature	Loss of 8% of power output by stream turbines	Loss of RM2.6 million per year per 110 MW steam turbine	About RM95 million per year for 4,000 MW capacity	Air cooled condensers
1m rise in sea level	Erosion of beaches fronting power station	Specific to a few stations. Currently RM2 million is spent annually to mitigate erosion problems at each station affected by coastal erosion.		Wave breakwaters Relocation of power plants
	Corrosion	RM3 million per year per station	RM18 million per year for six stations	Cathodic protection, painting

Source: Ministry of Science, Technology and the Environment, Malaysia. 2000. Note: RM: Malaysian Ringgit

Table 2.6. Projections of costs of climate change impacts in India and Southeast Asia by 2100

	Estimates that <u>do not</u> capture the full range of costs			Estimates that capture the full range of costs[8]		
	Loss in GDP	Additional people living on less than $2/ day/ year	Additional child deaths / year	Loss in GDP	Additional people living on less than $2/ day/ year	Additional child deaths / year
Temperature increase of 3.9°C	2.5%	24 million[9]	40,000	9%	100 million	165,000
Temperature increase of 4.3°C[10]	3.5%	34 million[11]	60,000	13%	150 million	250,000

Source: Stern (2007)

The above reports suggest that the costs of inaction would exceed the costs of action by several times. However, crafting an effective strategy to cope with climate change is not easy, as there are many uncertainties on the impacts and costs of action and inaction at the local level. The complexity is further compounded by the need to meet immediate developmental challenges such as the provision of access to energy. However, inaction because of either uncertainty or developmental needs is not an option either, as failure to address climate change may undo the development achieved to date. The best way to move forward is with concerted action that is based on the precautionary principle and which identifies "no-regrets" and "win-win" options[12]. In this context, the Bali Action Plan from COP13 is significant as it calls for measurable, reportable and verifiable actions by all countries.

There is another reason why Asia can and should address climate change and development in a more proactive and integrated manner. Asia is expected to build much of the infrastructure needed to accommodate its rapid economic growth in the near future, and most of the infrastructure is likely to remain for several decades. Therefore, it is essential to avoid a "lock-in" of outdated carbon-intensive technologies. There is also an urgent need to pursue a developmental path which is based on low carbon, resource efficient and qualitatively different practices and which offers improvements in the quality of life and does not negate the right to development. The design and implementation of developmental policies that duly consider climate change will be more effective, therefore, than treating climate change policies in isolation. Pulling off this transition, however, requires an informed appreciation for where Asia stands now, and concrete recommendations for where it should go in the future.

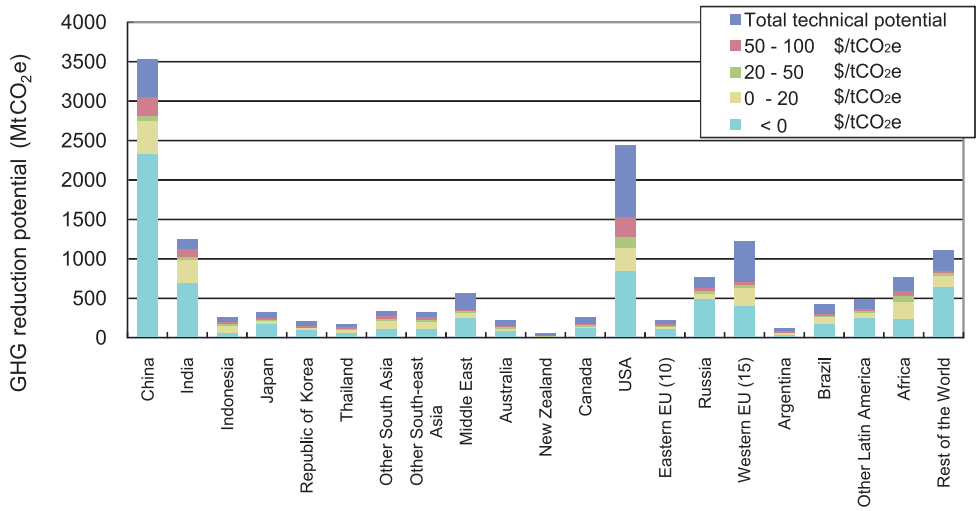
The aim of this chapter is to objectively assess potential opportunities (section 2) and barriers (section 3) for aligning climate change actions and sustainable development strategies, and then identify a few priorities (section 4) by which Asia can contribute to effective global action. The hypothesis is that development in Asia can be made more sustainable and climate-resilient if policymakers proactively integrate climate concerns into development strategies at all levels.

2. The good news: cost-effective climate actions

Though crafting effective climate policies will be challenging in Asia, the challenge may be manageable if attention is paid first to exploiting low cost mitigation and adaptation possibilities. The IPCC (2007) confirmed that mitigation options with net negative costs have the potential to reduce annual emissions in 2030 by around 6 $GtCO_2e$, accounting for about 10% of projected global emissions and that developing countries have greater mitigation potential than industrialised countries. Another study revealed that it would be technically possible to abate 26.7 $GtCO_2e$ by 2030 with measures costing less than €40 per tonne and that more than half of such abatement possibilities are located in developing countries (Enkvist et al. 2007). Three reasons account for such a high prevalence of low cost abatement options in developing economies – high populations, the lower cost of abating new growth as opposed to reducing existing emissions, and high potential for reducing emissions from deforestation (which accounts for nearly 20% of global emissions). A recent study confirmed that Asian countries offer several cost-effective GHG mitigation options (fig. 2.1) (Hanaoka et al. 2008).

The opportunities also stem from the effective integration of climate and development policies. The international community has long recognised the need for integrating climate concerns in national development planning. Article 3 of the UNFCCC states that "policies and measures to protect the climate system against human-induced change… should be integrated with national development programmes." National development planning can therefore work as a tipping point, enabling climate concerns and development objectives to be addressed simultaneously. The IPCC (2007) further supports this claim by stating that "it is very likely that significant synergies can be exploited in bringing climate change to the development community, and critical development issues to the climate-change community."

Figure 2.1. GHG mitigation potentials in 2020



Source: Hanaoka et al. (2008)

2.1. Energy efficiency and renewable energy

Improving energy efficiency (EE) is among the most cost-effective mitigation options available to Asia. For instance, increases in GHG emissions between 2000 and 2020 could be halved if only 20% of energy was saved by using current technologies more efficiently in existing industrial and power facilities in Asia (METI 2004). Many potential EE opportunities are located in China, the source of 80% of Asia's industrial growth over the past 25 years (IEA 2007). Steel production in China, for example, is four times less efficient than in Germany (Kraemer et al. 2007). Some models suggest China may have the world's largest technical emission reduction potential of approximately 3.5 $GtCO_2e$ by 2020 (Hanaoka et al. 2008). In India too, modelling studies revealed an abatement potential of 5 $GtCO_2e$ between 2005 and 2035 from energy options at prices below $10 per tonne of carbon equivalent (Sathaye et al. 2006).

These opportunities are not exclusive to China and India. Many countries in Asia have announced ambitious plans to construct energy facilities over the next 20 to 30 years. Because these facilities will not be retired prematurely, equipping them with low carbon technologies could dramatically reduce future emissions and mitigation costs. Modal

shifts and better urban planning offer similar low-cost mitigation opportunities in the transportation sector. Removing barriers to hidden efficiencies in the residential and commercial building sector could further save mitigation costs (IEA 2006). These measures will be important because many countries in Asia have yet to construct the majority of their building, transportation, and energy infrastructure.

An encouraging sign is that many countries in Asia have taken steps in this direction. For example, China's 11th Five Year Plan includes an ambitious 20% EE improvement target (The People's Republic of China 2006). The target was based on the 2004 National Development and Reform Commission's (NDRC) mid-term energy conservation plan that aimed to reach 1990 international EE levels by 2010 and catch up with international levels by 2020. If China can attain this goal, it would be equivalent to the world's largest CO_2 mitigation action. To achieve the goal, China initiated a number of special programmes such as "top 1000 enterprise energy action plan", "EE labelling mechanism" and "EE standards for products from major energy consuming sectors" (He 2006). Similarly encouraging is Japan's rich experience with EE and its "top runner" standards (see chapter 9). Both the experience and standards might prove instructive to other Asian countries. Recognising the importance of EE in GHG mitigation, Japan announced at the World Economic Forum in January 2008 the goal of improving global EE by 30% by 2020 through a five-year $10 billion aid package called "Cool Earth Partnership."

Improving EE is not the only cost-effective GHG mitigation opportunity available to Asia. GHG emissions can be reduced by introducing renewable energy (RE), which has considerable potential in the region. For example, the technical potential for solar photovoltaics (PV) across Asia is estimated to be around 860,000 TWh/year (de Vries et al. 2006). The recent increases in global oil prices and concerns over energy security have forced Asian countries to look at RE options more seriously than before. Another reason that RE may be desirable is that many rural areas in Asia are not connected to well-established power grids. These areas could benefit from standalone RE applications and "mini-grid" applications, which are cost-effective compared with grid extension. Such standalone RE applications would also afford poor communities in rural areas important benefits in terms of adaptation to climate change (through creating economic opportunities, widening the access to water resources, and decreasing urban migration).

It is against this backdrop that many countries in Asia have established RE institutions, set RE targets, and initiated RE deployment policies (both market pull approaches and technology push policies) in electricity, heating/cooling, and transportation. In India, a Ministry of Non-Conventional Energy Sources (renamed in 2006 as the Ministry of New and Renewable Energy) was created in 1992. The Ministry has launched research and development (R&D) programmes and helped engineer a shift from subsidy-driven dissemination initiatives to the commercialization of low carbon technologies. The Ministry also helped set a goal of using RE for 10% of new power generating capacity by 2010. India's policies (e.g. preferential tariffs, fiscal incentives such as accelerated depreciation, RE portfolio standards) to develop wind and solar power are now widely recognised to hold the potential to be replicated in other parts of Asia. China announced a RE law in 2005 that seeks to raise the share of RE to 15% by 2020.[13] Indeed solar water heating in China is now considered a successful model to be followed by other Asian countries. Indonesia, Japan, Malaysia, the Republic of Korea, Singapore, Thailand, and the Philippines have adopted similar RE policies and targets

(Srinivasan 2006b). For example, Indonesia and the Philippines launched special efforts to support independent power producers (IPP) through tax subsidies, investment and RE power purchase and price assurance policies. Investment in biofuels is growing rapidly in many countries (see chapter 5). China, India, Malaysia, the Philippines and Thailand have adopted ethanol blending mandates for transportation either at the provincial or national level and considerable scope exists to expand this option. Likewise, the opportunities for using biomass for district heating and combined heat and power are enormous in many parts of Asia.

Arguably the most encouraging sign is that Asia's private sector is becoming more interested in EE and RE investments. This involvement is demonstrated by the growing number of CDM projects in Asia. Out of 1035 approved CDM projects as of 1 May 2008, more than half are located in Asia. Similarly encouraging are emerging attitude and lifestyle changes. In Japan, for example, the Ministry of the Environment launched "cool biz" and "warm biz" campaigns that led to considerable emission reductions.

The opportunities for regional cooperation in the generation and utilization of electricity (based on RE such as hydropower) are great in Asia. Successful examples of cooperation, such as the transboundary power trade agreement between countries of the Greater Mekong Sub-region, have the potential to be replicated in other regions. Such transboundary agreements can accelerate collective efforts to build large hydropower stations, establish regional grids and enter into long term purchase contracts.

2.2. Opportunities outside the energy sector

Outside the energy sector, non-climate policies (agriculture, forestry, water, waste, trade, poverty alleviation, population control) offer significant opportunities for cost-effective mitigation in Asia. Chapters 4-7 cover some of these possibilities in detail. In this chapter, it merits underlining that there is a growing recognition that the UNFCCC's "climate-policy track" alone is unlikely to deliver sufficient emission reductions and a "non-climate policy track" will be needed (Kok and de Coninck 2004). This non-climate track would entail incorporating co-benefits into policy decisions and exploiting synergies with other MEAs. It also suggests opportunities for embedding climate change policies in sustainable development plans.

Asian policymakers should pay attention to the non-climate policy track mainly because of the low costs of mitigation through such approaches. The costs can be even lower when co-benefits such as increased energy security, reduced energy costs, and reduced impacts of air pollution on health are included (Vennemo et al. 2006). Transportation (box 2.2), waste management, energy, water, buildings and agriculture sectors provide opportunities to integrate development and climate concerns and generate substantial co-benefits. Co-benefits can also be realised from reducing methane emissions from natural gas and oil infrastructure in China, India and Thailand (Fernandez et al. 2004). For all these reasons, the Ministry of the Environment in Japan (MoEJ) has initiated a project to identify good practices in various non-energy sectors that generate climate benefits. In April 2008, the MoEJ launched the Asia-Pacific Gateway on Climate and Development (a web-based platform for sharing experiences and information on "co-benefits" activities, and on adaptation actions) in collaboration with the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

Box 2.2. Co-benefits in the transportation sector, Hyderabad, India

Many Asian cities have experienced rapid economic growth but public infrastructure has not grown accordingly. The combination of rapid urbanization and motorization has degraded the urban environment. Transportation policies often overlap with climate mitigation policies, which mean that transportation holds great potential for realizing co-benefits.

The United States Environment Protection Agency's (USEPA) Integrated Environmental Strategies (IES) project in the metropolitan area of Hyderabad, India focused on analysing co-benefits of transportation policies that would simultaneously reduce GHG emissions and improve local air quality. Transport sector policies related to a more effective public bus transit system were analysed including (i) dedicated bus lanes; (ii) priority for buses at stoplights and intersections; (iii) route rationalization; and (iv) transition to compressed natural gas (CNG) buses.

The study estimated that by 2021 there would be a 46% reduction in CO_2 emissions compared to the baseline scenario, while the resulting co-benefits would be 29,096 fewer deaths, 17,401 fewer hospital admissions for cardiovascular diseases, and reduced hospital admissions for respiratory symptoms. These co-benefits were valued at $50 million (the lowest estimate), taking into account only health benefits in the metropolitan area. If the same policies were adopted in other cities or non-health co-benefits were included, such as increased energy security and enhanced technological development, the benefits would be much higher.

Source: IES (2005)

Another possibility for the non-climate policy track is linking climate and development in cross-MEA implementation. The Convention on Biological Diversity (CBD), which emphasises species preservation, and the UN Convention to Combat Desertification (UNCCD), which focuses on sustainable land development, offer several potential cross-agreement synergies. Exploiting these synergies would reverse unsustainable land use practices, conserve biodiversity, protect ecosystem services, improve local community livelihoods, and deliver climate benefits. A concrete example of these synergies is the decision in September 2007 by Parties to the Montreal Protocol to an accelerated freeze and phase-out of hydrochlorofluorocarbons (HCFC), known for their significant contribution to climate change. The freezing of production of HCFCs by developing countries in 2013 and pushing up their final phase-out date by ten years to 2030 could result in a reduction of GHG emissions up to five times greater than the reduction that the Kyoto Protocol would achieve during its first commitment period.[14]

2.3. Development-friendly adaptation

As the world is already committed to a certain amount of global warming and the impacts of climate change are increasingly evident, adaptation policies and measures are crucial (UNEP 2007). In the future, Asian policymakers must pay equal attention to adaptation and mitigation. Just like mitigation, the high costs of adaptation present a hurdle. Fortunately, these costs can be reduced if adaptation measures are integrated

into sectoral and national development plans. Since virtually no sector will be excluded from the impacts of climate change, it is essential to ensure that adaptation concerns are built into development planning in all sectors.

In mainstreaming adaptation concerns into sectoral planning, however, it is important to fully utilise time-tested local coping strategies. Many communities in developing Asia have accumulated local knowledge to cope with weather-related disasters. While such strategies alone may be unable to cope with all impacts, opportunities for incorporating local knowledge into improved adaptation options are considerable in Asia.

Significant synergies exist between local adaptation activities and official development assistance (ODA) initiatives. The Japan International Cooperation Agency (JICA), for example, is undertaking research on a comprehensive flood mitigation project in Cavite Province in the Philippines (JICA 2007), which suffers frequent flooding from three rivers and high tides. The design of flood control measures in this project is being modified to cope with the possible impacts of climate change, such as a greater likelihood of more frequent floods because of sea level rise. It may be possible to apply the model used in Cavite Province to other vulnerable parts of Asia.

From a sustainable development perspective, risk management efforts have proven far more cost-effective than repairing future damage. More generally, it would be useful to align ODA, development finance, and country development funds in support of successful local coping strategies. Greater coordination between external funding and local policies could pay multiple dividends for communities and further reduce the costs of adaptation in Asia.

In conclusion, Asia offers considerable potential to undertake many cost-effective climate actions. Realizing this potential is, however, another matter. As section 3 will show, there are as many challenges as opportunities for Asia.

3. The bad news: climate policy challenges

Despite the considerable potential for cost-effective climate actions in Asia, there are signs that this potential may go unrealised. Climate change has not become the policy priority one might expect in Asia, and progress in integrating climate and development policies remains inadequate. Another area where change could be beneficial is the reactive (as opposed to proactive) stance that much of Asia has taken in international climate discussions. This section outlines such challenges before suggesting how they may be transformed into opportunities.

3.1. Climate change: A low order priority

For many years, climate policy was given less attention in Asia than other regions. In recent years, Asia's growth in GHG emissions and the region's vulnerability to climate change has drawn considerable media attention to the issue. However, many senior officials and politicians still treat climate policy as a low priority, though climate change will make it difficult for many countries in Asia to alleviate poverty and fulfil the MDGs.

There are numerous reasons for the limited attention. Limited understanding of the costs of action and inaction is partially to blame. Continued scientific uncertainties on local and national impacts are also partially at fault. Lack of knowledge on ways to decouple economic growth and energy consumption is another barrier. But most telling is that policymakers in developing countries of Asia prefer to meet basic developmental needs before addressing climate issues (IGES 2005; Srinivasan 2006a). To illustrate, large rural populations in Asia lack access to modern energy sources (e.g. nearly 54% of Indians lack access to electricity). Since there is a strong correlation between economic development (GDP) and energy consumption (Feinstein 2002; Modi et al. 2005), policymakers want to ensure these populations have access to reliable electricity. Many of the current sources of dependable energy (e.g. coal-fired power plants), however, will increase GHG emissions. Policymakers do not want to risk pursuing more innovative energy options that may turn out to be unreliable.

At a fundamental level, the reason climate issues are subordinated to development issues is perceived tradeoffs between economic development and climate actions (which is partly related to an institutional separation of climate change and development officials and their clientele, as discussed in chapter 8). A result of this view (and institutional separation) has been a lack of expertise in developing policies that integrate climate and development actions. This is apparent in the difficulties in designing measures to capture win-win opportunities such as improving energy end-use efficiency in commercial and residential buildings, and integrating climate policies and sustainable management practices in agriculture and forestry.

The relatively low status accorded to climate change is also related to natural resource endowments. India has large coal reserves (estimated to be about 234 billion tonnes (t) in 2002) and therefore has a carbon-intensive energy system. China also has a carbon-intensive energy structure, with coal accounting for 66-75% of primary energy consumption from 1980 to 2006. The reversal of policies to improve energy security, such as switching from oil to coal in Indonesia and Vietnam, and from forest protection to deforestation to grow biofuels in Malaysia and Indonesia, are similar illustrations of how easily exploited natural resource endowments can increase GHG emissions. For example, Indonesia's energy policy to rapidly expand coal-fired power generation will increase GHG emissions from coal burning by 20 times between 2005 and 2025 (PEACE 2007). Vested interests that support these unsustainable practices play an equally important role in keeping climate change below other issues on many policymakers' list of priorities. Another reason that climate change has yet to move up the list is that many policymakers in Asia consider it purely an environmental rather than a developmental issue. The limited influence of environmental ministries on developmental issues, which are usually under the control of more influential ministries, like finance and planning, continues to pose a barrier to enhancing the status of climate change in many countries.

3.2. Policy rhetoric and reality

The attention to climate change issues notwithstanding, many countries in Asia have introduced policies that indirectly affect GHG mitigation and adaptation (Chandler et al. 2002). Such policies are often enacted with a view to either address national concerns such as energy diversification and transportation management, or to meet international obligations to realise benefits from the global climate regime (table 2.7). While many countries have formulated policies and created new institutions (see chapter 8), in several cases these

measures and organisations have not performed as well as hoped. In fact, difficulties in implementing policies have often resulted in gaps between policy rhetoric and reality.

Some of these gaps can be found in the mitigation options discussed in section 2. For example, the 11th five-year plan of China seeks to reduce energy intensity by 20% per unit of GDP over the 2006-2010 period, which equates to 4.36% per year. However, energy intensity reduced by only 1.33% (Yang 2008) and 3.27% in 2006 and 2007 respectively. Likewise, India's ministry for promoting RE sources has struggled to transform the country's carbon-intensive energy structure. Elsewhere in Asia similar difficulties have been observed in the attainment of RE targets (e.g. the Philippines, Indonesia, Sri Lanka, and Thailand, among others) and utilization of alternate fuels (CNG, biogas, biofuels). An assessment of the installed RE capacity and technical potential in Asia found that only a fraction of capacity has been tapped to date. For example, the installed capacity of wind power in China and India is estimated at 0.1% and 11.9% of their potential, respectively. Similarly, biomass utilization in Indonesia and India is 0.9% and 1.76% of their potential (USAID 2007). Energy market distortions, legal and regulatory barriers, and institutional constraints led to widening the gaps between rhetoric and reality in RE policies in several countries.

Table 2.7. Institutional arrangements to address climate change in Asia

Country	Selected institutional arrangements, policies and measures
Cambodia	Creation of a national climate change committee; submission of a national adaptation programme of action (NAPA)
China	Mandatory EE standards for building construction through the promulgation of the Designing Standard for Energy Conservation in Civil Buildings (2006); establishment of a national leading group headed by Premier Wen Jiabao; announcement of a national climate change programme
India	Establishment of the Bureau of Energy Efficiency; RE targets; Establishment of a National Climate Change Committee
Indonesia	Climate Change National Action Plan of 2007; National Energy Policy 2005; Issuance of regulations regarding the national energy mix, EE, biofuels, etc.
Japan	Enactment of laws, including a three-stage approach, to promote global warming prevention activities to achieve the Kyoto targets
Lao PDR	Establishment of a Climate Change Steering Committee
Malaysia	Creation of a National Climate Change Committee, RE targets, and tax incentives for EE; mainstreaming EE in development plans
Maldives	Creation of the Ministry of Environment, Energy and Water; establishment of the National Energy Authority to undertake energy resource assessment to estimate the potential of RE
Mongolia	National programme on RE (2005)
Myanmar	Establishment of a National Commission for Environmental Affairs; promotion of the use of CNG, biogas and biofuels; implementation of greening projects in 13 sub-divisions of the country
The Philippines	Presidential Task Force on Climate Change in 2007; The Philippines energy plan focusing on policies for RE, EE, development of alternate fuels
The Republic of Korea	Third National Action Plan specifying 90 tasks for GHG mitigation
Singapore	National climate change strategy; EE programme office and master plan; co-funding of energy audits for industries; building efficiency standards, labels, and green vehicle rebates
Sri Lanka	Establishment of designated national authority (DNA) and development of national CDM policy framework; integration of CDM potential in National Energy Policy; setting a target that at least 10% of new energy should be from renewable sources
Thailand	Establishment of the National Board on Climate Change Policy and Thailand Greenhouse Gas Management Organization (TGO); Energy Strategy Plan of 2005 and promotion of RE under CDM

A brief review of current efforts points to similar gaps in adaptation policies. For example, NCs submitted to the UNFCCC reveal limited attention to adaptation (table 2.8). Few countries have national policy frameworks for adaptation. The measures to date largely include policy documents such as national adaptation programmes of action (NAPA) by least developed countries (LDC), disaster management plans, and enhanced research on adaptation in agriculture. The limited amount of attention devoted to adaptation is cause for concern given Asia's susceptibility to climate impacts.[15]

Table 2.8. Coverage of adaptation policies and measures in latest Asian National Communications

Country	Total number of pages	No. of pages describing impacts and vulnerability	No. of pages discussing adaptation policies
Bhutan	63	10	2
Cambodia	79	8	2
China	112	13	4
India	292	48	8
Indonesia	116	10	3
Japan	314	11	0.5
Lao PDR	97	two lines	one line
Malaysia	131	30	7
Maldives	134	30	10
Mongolia	106	18	7
Nepal	181	41	10
Pakistan	92	14	9
Papua New Guinea	83	20	6
The Republic of Korea	132	8	2
Singapore	75	5	one line
Sri Lanka	122	12	5
Thailand	100	15	2.5
The Philippines	107	20	12
Vietnam	135	17	4

Sources: National Communications submitted to UNFCCC

Similar gaps were also evident in implementing the Kyoto Protocol. Such gaps might be expected given that the first commitment period of the Kyoto Protocol had a very short timescale, modest emission reduction targets, and little consideration of adaptation (box 2.3). Gaps were also found in the implementation of CDM, a unique flexibility mechanism designed to offer developed countries low-cost mitigation opportunities while contributing to sustainable development in developing countries. Many Asian countries expected to benefit from the CDM, and established designated national authorities (DNA) to oversee the implementation of CDM projects. As of 1 June 2008, most of the UNFCCC Non-Annex I countries in Asia had established a DNA. However, many countries have yet to take full advantage of CDM. For example, Indonesia has the potential to develop CDM projects that could generate 235 million certified emissions reductions (CER) by 2012, but only 12 projects with a potential to generate 13 million CERs by 2012 were registered

to date (PEACE 2007; UNEP-RISO 2008). The mechanism's high expectations for technology transfer and finance have also yet to materialise in most countries. The lacklustre performance of CDM in terms of geographic equity and contribution to sustainable development is discussed in section 4.3.

Box 2.3. A critique of the Kyoto Protocol and its environmental effectiveness

The Kyoto Protocol was adopted on 10 December 1997 but only came into effect on 18 February 2005. It requires participating countries to reduce collectively GHG emissions by 5.2% compared to 1990 levels. So far it has produced no demonstrable reductions in emissions worldwide or even in anticipated emissions growth. For example, the most recent official projections for Annex B emissions in 2012 show that total emissions are likely to be at least 8% above 1990 levels. Several features of the Protocol have been criticised, including its focus on binding targets, which were decided without a careful analysis of each country's circumstances and incentives necessary for effective engagement, its limited effect in stimulating the development of low carbon technologies, its inability to achieve universal participation, poor design of its institutions to enforce the adopted targets, etc. On the positive side, the Protocol did create market-oriented institutions and rules—including international emissions trading, broad coverage of emissions sources and sinks, and some temporal flexibility in complying with emissions commitments—that will promote cost-effective attainment of emission reduction goals. It also created the architecture for an international regime that is likely to last for centuries and galvanised actions at sub-national levels in countries that did not ratify the Protocol. Most importantly, it helped set a price on carbon.

While the intentions at the time of adoption were laudable, the effectiveness of Protocol was gradually weakened over time through negotiations and rejection by some nations in 2001. The US withdrawal may have had the greatest impact in reducing its environmental effectiveness. In order to get many countries on board, major concessions (e.g. through inclusion of sinks) were made. The exclusion of sources such as international aviation, maritime transport, and deforestation is also seen as contributing to its reduced environmental effectiveness. There is a growing concern that the Protocol exposes participating countries to enormous costs, and that many firms and sources of GHG emissions that come under the Protocol could simply move their production to countries that are not yet covered. Possibly, an excessive focus on the Protocol has stifled discussion of alternative policy approaches. The Protocol was modelled on the Montreal Protocol but addressing climate change involves a far greater range of issues. Notwithstanding these concerns, the Protocol remains the only international legal instrument designed to lead the world towards GHG reductions needed to avoid the catastrophic impacts of climate change.

3.3. Asia's reactive stance in international climate negotiations

In addition to the gaps between rhetoric and reality, a related concern is Asia's largely reactive stance in international climate negotiations. Over the past three years, IGES has held a series of multi-stakeholder consultations on the post-2012 climate regime. A

recurring theme from these meetings is that Asia's influence on international climate negotiations has not been as proactive as might be expected given its contribution and vulnerability to climate change (IGES 2005; Srinivasan 2006a; Srinivasan 2008).

Deep divisions within the G77+China group of countries contributed to the difficulties in crafting a sound regional policy for a post-2012 climate regime. Most countries in the region, including large industrializing countries such as China and India and Annex I countries such as Japan, have yet to declare a position on the post-2012 climate regime. While Japan recently announced an ambitious plan to halve global emissions by 2050, the plan's implementation details or its implications for emissions from Asia's developing countries have yet to be released.

Some countries have initiated efforts to discuss the post-2012 climate regime. For example, Cambodia has begun discussions on the post-2012 regime at the technical and policy levels, while Indonesia has established a special working group to consider post-2012 issues. Most countries in the region, however, have adopted a "wait and see" approach. In many of these countries, uncertainty over the positions of Annex I parties and the lack of capable staff and funding in concerned ministries have slowed down progress in formulating a post-2012 position at the national level. In addition, the limited negotiation capacity of policymakers to reflect their concerns and aspirations presents a problem. The absence of a regional platform for developing a common position among Asian countries and inadequate coordination between various ministries, government officials and other stakeholders are also impediments.

Other barriers revealed in the consultations include the limited awareness of global negotiation issues by Asian policymakers and the private sector, limited attention by the national media to the implications of regime discussions on national policies, and a lack of technical capacity. In some countries (e.g. the Philippines and the Cook Islands), insufficient funds to address climate change issues made it difficult to attend international negotiations and engage in informed discussions on the future climate regime.

Formal processes to build a national consensus on the post-2012 regime have not been initiated in most countries but informal discussions have occurred. Non-governmental organisations (NGO) and academic institutions have coordinated many of these efforts, often with indirect support from advisory panels to the national governments. For example, informal discussions with businesses and industries are ongoing on a limited basis in India, Japan, Malaysia, and Thailand. Meanwhile, inter-ministerial meetings, which are usually held in connection with CDM approval processes at DNAs, have apparently facilitated understanding of post-2012 issues in China, India, Indonesia, the Republic of Korea, the Philippines and Vietnam. But discussions with key stakeholders on post-2012 climate regime issues have yet to begin in Bangladesh, Bhutan, Cambodia, Lao PDR, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Singapore, and Sri Lanka (Srinivasan 2006a).

3.4. Reversing current trends

Climate policy will remain a challenge in Asia if current trends continue. Indeed several technical, institutional, financial and capacity issues have delayed efforts to integrate climate concerns in development planning throughout the region. In view of the growing evidence that the costs of action would be lower than inaction, Asia must take

advantage of cost-effective climate actions and mainstream climate change concerns into ongoing sustainable development planning.

Since the world is already committed to a certain level of increased temperatures and rising sea levels, and mitigation efforts from developed countries alone will not suffice, Asia cannot afford to "wait and see" or follow the unsustainable development paths of industrialised countries. Instead, Asia should flip the historical energy model and bring about a decisive shift in development patterns through greater efficiency, decarbonisation, and socio-economic restructuring based on innovation and entrepreneurial problem solving. Long-term and predictable policy support to institutionalise such changes is also crucial. Section 4 focuses on four priorities for action in this direction.

4. Four priorities towards a low-carbon, climate-resilient Asia

All countries in Asia share a common goal of realising sustainable development and have developed many strategies to achieve that goal. Realising the vision of a low-carbon, climate-resilient society within the framework of sustainable development will require Asia to play a proactive and constructive role in (i) building a fair, effective, and flexible post-2012 climate regime; (ii) enhancing the region's adaptive capacity; (iii) utilizing market mechanisms more effectively; and (iv) building a low carbon society and exploiting developmental co-benefits.

4.1. The post-2012 climate regime

Climate change is a global phenomenon that requires a global response. Although developing Asia's historical contribution to climate change has been far below that of industrialised countries, its emissions are projected to increase sharply in the near future. It is therefore imperative that all countries act soon and together. The basis for action should be widely accepted principles in most MEAs and the current climate regime: common but differentiated responsibilities, the polluter pays principle, and precautionary approaches. The immediate priority should be to design a post-2012 regime that reconciles global climate objectives with Asian developmental priorities.

Designing such a framework will require effectively engaging Asian policymakers and other stakeholders. During previous international climate discussions, many countries in Asia failed to fully articulate their concerns and interests. The reasons for these failures include a lack of recognition of the linkages between climate change and sustainable development, fear of additional costs, insufficiency in international assistance to address climate change, and poor institutional and human capacities. Given the result of these failures—a regime that does not adequately reflect the interests of the world's rapidly growing economies—it is crucial that Asia's concerns and aspirations be incorporated in future negotiations.

4.1.1. Findings from IGES consultations

IGES consultations over the past three years revealed that many countries in Asia share concerns about energy security and economic growth, market mechanisms, technology, adaptation, finance and institutional and human capacity. Moreover, there

was a general agreement that future regime negotiations should (i) consider climate concerns in the broader context of sustainable development; (ii) streamline the CDM by reducing its complexities and uncertainties; (iii) place a greater emphasis on adaptation by building on existing funding mechanisms; (iv) facilitate the development, deployment and diffusion of climate-friendly technologies; and (v) provide further support to strengthen the capacity of negotiators, the private sector and financial institutions in the region. However, cross-national differences also existed on (i) ways to consider equity in the future climate regime; (ii) form, time and kind of involvement of developing countries; (iii) national preferences for climate-friendly technologies; and (iv) approaches and funding for adaptation, especially regarding the need for a separate adaptation protocol and the introduction of market-based mechanisms.

During the consultations, participants expressed several Asia-specific interests and priorities relevant to key elements of the post-2012 climate regime. The most salient remarks and recommendations are summarised below. For additional details, readers are encouraged to refer to IGES (2005), Srinivasan (2006a) and Srinivasan (2008).

(i) Future regime design and its implications

Asian stakeholders emphasised that the Kyoto Protocol must be the basis for the future climate regime, since much time and effort has already been invested in developing the global framework. All other initiatives must complement efforts taken under the Kyoto Protocol. In view of the IPCC findings on the need for global emissions to peak by 2015 to limit global temperature rises to 2-2.4^{o}C over pre-industrial times, participants stressed that industrialised countries should take the lead in setting ambitious GHG mitigation targets and show demonstrable progress in implementing their current commitments under the Kyoto Protocol. Stern (2008) suggested that developed countries should commit to cutting emissions by 80-90% from 1990 levels by 2050 together with credible interim targets.

The future regime should treat mitigation, adaptation, technology and financing in a more balanced manner. Further, it was recommended that the implications of the various regime proposals and targets (e.g. 50% global GHG reduction by 2050) on future prospects for development of Asian countries should be examined thoroughly.

Stakeholders recognised the need to differentiate developing countries in the future climate regime based on national circumstances, responsibility, capacity, mitigation potential, and adaptation needs. One anomaly noted is that some non-Annex I countries have higher GNP and per capita GHG emissions than a few Annex I countries. Commitments by developing countries could be different from those of industrialised countries, and might include policy-based or sectoral approaches. A forum specifically focusing on developing countries in Asia may help reach a consensus on such commitments. Strengthening the negotiating capacity of Asian developing countries, especially LDCs and SIDS, was considered crucial to increase their involvement in discussions on the future climate regime.

(ii) Energy security and development

Policymakers stressed that the future regime should enable economic development to proceed in a sustainable manner in developing Asia. Discussions on the future regime would benefit greatly from identifying linkages between the regime and processes that can help

countries achieve the MDGs. Since non-climate policies offer significant potential to reduce GHG emissions and enhance adaptive capacity, post-2012 regime discussions should focus on building synergies between climate initiatives and efforts in other sectors, including national development planning. Mechanisms to reward such efforts should also be created.

An analysis of 20 proposals for the post-2012 regime revealed that the efforts to reflect Asian concerns on development in climate negotiations have been limited. Top-down approaches, which were intended to achieve long-term stabilization of global GHG emissions, had a single criterion (e.g. emissions per capita) and very few indicators of direct relevance to Asia (energy security and development). In view of the lack of attention to sustainable development, it is recommended that the future climate regime identifies and facilitates the most pragmatic measures to mainstream climate concerns in energy and development planning, and supports the implementation of integrated development and climate strategies at various levels.

Some participants argued that international commitments based on energy intensity may not serve the interests of developing countries in Asia due to difficulties in predicting the future growth rates of different sectors and their shares of GDP, and due to close links between energy intensities and natural resource endowments in specific economies. However, the need for increasing EE levels by following approaches such as “top runner standards” in all countries was stressed.

Improving energy security and access through maintaining affordable energy supplies is crucial to achieving economic development and realizing climate benefits in Asia. Strategic international cooperation through effective investments, as well as policies and measures to improve EE and promote RE will play an integral role in achieving lower GHG emissions in the region and reducing vulnerability to regional and global energy insecurity. Since energy security is an issue on which both developing and developed countries share common interests, the future climate regime should facilitate further development of climate-friendly energy policies. This can be accomplished, for instance, by sharing good practices, setting standards and guidelines, building adequate human and institutional capacities, and initiating new partnerships for regional collaboration.

The future climate regime will not be effective unless it is sensitive to the diversity in developmental needs and aspirations of developing countries in Asia. Unsustainable development in the region will certainly lead to high GHG emissions that will exacerbate climate change. Future regime discussions should focus more on social and economic co-benefits from mitigation policies, thus helping LDCs achieve the MDGs and providing assistance to efficiency concerns in newly industrialised countries. Operational support from the climate framework, for example, by maintaining a registry of sustainable development policies and measures (SD-PAM) with synergies between sustainable development benefits and GHG mitigation, is critical to mainstreaming climate risks in the development agenda.

To further strengthen the recognition and rewarding of co-benefits in the future regime, it was suggested that (i) researchers should standardise rapid analytical methods to evaluate the developmental contribution of pledged policies (to be verified by an international body with more rigorous analytical tools); (ii) policymakers should conduct an assessment on integrated policies that stand to benefit the most from regime-related financial and technical support; and (iii) climate negotiators should gradually scale up these institutional reforms in multiple stages, beginning with voluntary pledges, piloting standardised tools and rewarding integrated policies.

(iii) Market mechanisms

Stakeholders noted that market mechanisms, such as CDM, are beginning to have a positive impact on developing countries in Asia. Options for employing "baseline and credit" or “cap and trade” mechanisms should be explored in all Asian countries. Further strengthening of CDM through simplified methodologies and the inclusion of additional sectors was considered crucial to improve geographic equity and enhance sustainable development benefits. The scope of CDM beyond 2012 may be broadened to include sectoral and policy-based approaches, while aligning with development policies in industrial and land use sectors. Sectoral approaches may be more successful if applied first in sectors that cater principally to domestic markets. In sectors that serve international markets, trans-national targets set by multinational corporations (MNC) and industrial associations may succeed. In developing Asia, coal-fired electricity generation, iron and steel, cement, and forest conservation appear to be good candidates for sectoral approaches, although specific challenges remain to be overcome in each sector.

Effective integration of sectoral approaches in a post-2012 climate regime requires considerable progress on at least three fronts: (i) step-wise institutionalization at national and international levels; (ii) preferential support and reliable incentives; and (iii) sector-specific initiatives by MNCs (in sectors such as iron and steel, cement, and aluminium). Collecting valid data from the energy emissions and technology standpoints to develop sector-specific benchmarks and performance indicators, building synergies between the UNFCCC and other initiatives, and accumulating useful lessons from programmatic CDM are crucial. Sectoral approaches, however, can only be a part of the solution, complementing but not replacing Kyoto-style economy-wide reductions.

(iv) Funding mechanisms

Participants noted that CDM can only be a supplemental source for financing clean energy in the region and that the mobilization of resources outside the UNFCCC is crucial. The post-2012 regime should promote synergies with new initiatives from multilateral financial institutions. The World Bank’s “Investment Framework for Clean Energy and Development”, “Carbon Market Continuity Fund” for purchasing post-2012 credits and “Carbon Facility for Low Carbon Growth” for GHG reduction through long-term investment and technology expansion are all important for moving Asia to a low carbon economy. Likewise, the ADB is developing a carbon market initiative to boost the alternative clean energy projects in developing countries, and will allocate $1 billion of annual lending for EE through a proposed Asia Pacific Fund for Energy Efficiency (ADB 2006). In May 2008, ADB launched a new Climate Change Fund with an initial allocation of $40 million to facilitate greater investments in developing countries in Asia and the Pacific to address the causes and impacts of climate change. Some participants suggested creating a major regional RE programme based on Asia’s natural resource endowments by establishing, for example, a specialised regional bank for RE. Such a bank could fund necessary R&D on RE and provide seed funding for renewable energy service corporations (RESCO) and matching funds for national subsidy programmes. To enhance investments and financial flows in the development and deployment of low-carbon technologies, creating a global R&D fund and linking financial contributions with emissions reduction commitments might be useful. The need for broadening the funding base for adaptation and creating new mechanisms to involve the private sector in adaptation was also highlighted (see section 4.2.4).

(v) Access to low-carbon technologies

Asian stakeholders expressed serious concerns about the ability of the current climate regime to facilitate the deployment of clean technologies in developing countries, as progress remains far below the levels required to change the GHG emissions growth trajectory in the region. Participants noted that further progress would be feasible if discussions on the future regime can lead to (i) improving finance to accelerate technological R&D cooperation; (ii) building synergies between technology initiatives within and outside the climate regime; and (iii) enhancing the flexibility of the IPR regime for low carbon technologies. It was stressed that the post-2012 regime should consider political feasibility (in terms of self-enforceability, provision of side-payments, and the fit with domestic interests and institutional arrangements) of technology-oriented proposals, while paying particular attention to the interests and capacity of provincial and local governments.

The post-2012 regime should proactively facilitate synergies with non-UNFCCC initiatives. For example, the climate regime can provide CDM opportunities in methane recovery and additional income for project developers, while the methane to markets (M2M) initiative and/or the Asia-Pacific Partnership (APP) can provide access to necessary technologies. Likewise, technologies for carbon capture and storage (CCS) may be transferred through the APP, if the future climate regime makes CCS projects eligible for CDM.

The future climate regime should create additional incentives for countries willing to move towards low-carbon technology pathways and adopt international technology standards. Some options to enhance the flexibility of IPRs for low-carbon technologies include (i) research collaboration with developed countries in the early stages of technology development leading to joint ownership of IPRs, and (ii) the creation of a multilateral technology acquisition fund, which could be structured to buy-out IPRs and make privately owned, climate-friendly technologies available for deployment. Compulsory licensing of high priority technologies may be considered along the lines of initiatives such as the US Clean Air Act. However, it is critically important to assess whether and to what extent IPRs are actual barriers to technology transfer. A domestic policy push, including the specification of contemplated climate actions by public authorities to the private sector, a flexible IPR regime, administrative coherence within developing countries and incentives from developed countries are all crucial to making vertical and horizontal technology deployments economically and politically feasible.

Ensuring additional finance through innovative public and private support mechanisms, including the creation of venture capital funds, is also critical to make the currently available technologies commercially competitive. The future climate regime should play a facilitative role in (i) determining the incremental costs associated with the acquisition of clean technologies that are relevant to Asia, and (ii) documenting the success stories of various policy instruments that can offset the higher costs of emerging technologies.

(vi) Adaptation

IGES consultations stressed that the future climate regime should pay as much attention to adaptation as it does to mitigation. Designing a separate protocol on adaptation may enhance its profile, but the process may require considerable resources and time in terms of negotiation. Participants stressed that the future regime should pay particular attention to (i) fair burden sharing mechanisms based on the “emitters pay,” “ability to pay” and “climate change winners pay” principles; (ii) adequate

and predictable levels of funding; (iii) innovative risk transfer mechanisms such as insurance; and (iv) mainstreaming adaptation into the sustainable development agenda. It was recommended that a combination of both “top-down” support and “bottom-up” engagement is crucial to advance the adaptation agenda. The future climate regime should facilitate mainstreaming by providing practical examples, improving capacities and requiring that all development policies undergo an “adaptation check.” Creating effective incentive schemes at the local, national and international levels was considered crucial for mainstreaming adaptation.

Since the demand for adaptation funds will increase in the future as climate change proceeds in the region, there is a need for (i) enlarging the funding base and developing flexible but clear guidelines to access adaptation funds; (ii) differentiating between actions that can be funded inside and outside the climate regime; and (iii) creating market mechanisms and incentives for the private sector to involve them in adaptation efforts. Options for establishing a mandatory global funding scheme, which is tied to both past and current GHG emissions by various countries, should become a greater priority. In addition, prospects for creating a regional adaptation fund based on a levy on foreign direct investment (FDI) in the region should be explored.

4.1.2. Assessment of post-2012 regime proposals

There is no shortage of proposals or alternative policy frameworks for the post-2012 climate regime. A recent count suggests that there are more than 120 proposals based on one or more elements of the future climate regime, namely: (i) goals (targets and timetables); (ii) participation (nature and type); (iii) actions (standards for certain sectors of the economy, financial payments and transfers, market-based mechanisms, technology development and transfer, and adaptation); (iv) institutions; and (v) compliance provisions. However, it is troubling that very few proposals have been made by negotiators and researchers from developing countries in Asia. In a few proposals, some involvement of researchers from developing Asia was noted but there was little evidence that they took the lead. Several proposals failed to reflect Asian needs, concerns, and aspirations mentioned earlier and none examined implications for the future development of Asian countries.

An attempt was made to assess strengths and weaknesses of various proposals in which involvement of Asian researchers and policymakers was evident (table 2.9). Some proposals (e.g. Kim and Baumert 2002, Kameyama 2003) support the continued use of targets and timetables, while others seek to promote greater integration between climate and development objectives (e.g. Heller and Shukla 2003). A few proposals focus on multi-stage approaches (Ott et al. 2004; Parikh 2007), while others take a more fragmented approach by focusing on single issues such as sectoral approaches or technology transfer or financial mechanisms (e.g. Dasgupta and Kelkar 2003; Chung 2006; Halsnæs and Shukla 2008). The proposals were then assessed on the basis of criteria such as distributional equity, cost-effectiveness, environmental outcome, and flexibility. Unfortunately, none of the reviewed proposals met all criteria, thereby demonstrating the complexity of developing a comprehensive, equitable and effective framework. A similar conclusion was reported by den Elzen (2002) and Bodansky et al. (2004) based on an analysis of more than 40 proposals. Since interests of various groups among developing countries (Alliance of Small Island States (AOSIS), Organisation of the Petroleum Exporting Countries (OPEC), Organisation for Economic Cooperation and Development (OECD), LDCs) vary widely with respect to the future

climate regime, future negotiations should focus on the use of various complementary policy tools that align with national developmental priorities and circumstances (such as technological cooperation, climate related trade rules, carbon taxation, carbon sinks, a global adaptation fund, forest preservation, biofuels, and energy infrastructure). This will enable more effective participation of developing countries in the future climate regime.

4.1.3. Suggestions for a possible new framework

Climate negotiators now face several dilemmas, such as (i) mitigation policies versus adaptation policies; (ii) mitigation targets versus financing, technology and adaptation targets; (iii) Kyoto-style market mechanisms versus domestic regulatory instruments; (iv) policy incentives versus restrictions and penalties; (v) climate-focused policies versus non-climate policies with climate benefits; (vi) multilateral actions under the UNFCCC and the Kyoto Protocol versus unilateral or bilateral initiatives by a few parties outside the UNFCCC.

Because achieving consensus among all of the UNFCCC parties on an equitable and effective multilateral framework has been difficult, several schemes involving only a few countries have emerged in recent years (G8, Gleneagles [G8+5], G20, APP, APEC, International Carbon Action Partnership [ICAP], and others). Indeed, some researchers now believe that the adoption of a bottom-up, country-driven approach to national mitigation commitments by like-minded countries may be more effective than a top-down global approach and that regional or issue-specific climate blocks might form in the future as has happened in trade negotiations (Sugiyama and Sinton 2005; Carraro 2006). However, as most countries in Asia favour an inclusive multilateral framework instead of a fragmented regime, strenuous efforts to ensure global participation are needed. Furthermore, bottom-up approaches have been incapable of demonstrating how significant emission reductions could be achieved to stabilise GHG concentrations. An inclusive framework may also avoid the possibility of a steep increase in GHG emissions by non-participating countries due to migration of emission-intensive industries from participating countries. Finally, an inclusive framework may allay concerns that a few countries would focus on mitigation and will divert attention from adaptation, technology and finance --- issues that are of equal or greater importance to developing countries in Asia.

Our preference, therefore, is for a multi-stage, multi-track, all-inclusive framework (fig. 2.2). The framework would be characterised by (i) progressively increasing emission reduction and adaptation commitments or actions; (ii) differentiated financial and technological incentives and compliance provisions; and (iii) a new grouping of countries based on responsibility, capability, mitigation potential and vulnerability. In this new grouping, the mean annual anthropogenic per capita emissions since the adoption of the UNFCCC in 1992 would serve as a proxy indicator for “responsibility,” while the United Nations Development Programme (UNDP) human development index (HDI) would indicate “capacity.” In addition, developing nations that contribute more than 1% of global GHG emissions would have more responsibility and potential for mitigation than others. The climate vulnerability index developed by the Oxford Centre for Water Research would act as a proxy indicator for “vulnerability.”[16] In this framework, the grouping of countries would be adjusted at the beginning of each commitment period; thus countries would graduate from one grouping to another over time, depending on changes in GHG emissions, HDI, etc. The grouping of developed and developing countries, largely reflects the current classification of Annex I and non-Annex I countries of the UNFCCC. This is mainly done to avoid renegotiation of the fundamental basis of the current climate regime.

Table 2.9. Preliminary assessment of selected proposals to which Asian researchers and stakeholders contributed

Proposal	Main features	Strengths	Weaknesses	Distributional equity	Cost-effectiveness	Environmental outcome	Flexibility
Basic needs or survival emissions or Human Development Goals with Low Emissions (Aslam 2002; Pan 2003; Pan 2005)	-Encourages developing country commitments through a bottom-up, country-driven process that is linked to human development goals. -Targets allow emissions to satisfy basic human needs, but limits emissions linked to luxury goods and services. Key elements include: Identification of development goals/basic human needs; voluntary commitments to low carbon paths via no-regret emission reductions in developing countries conditional on financing and obligatory discouragement of luxurious emissions; reviews of goals and commitments; an international tax on carbon.	-Focus on human development goals.	-Difficult to attract developed countries.	✓	-	-	-
Bottom-up or multi-facet approach, pledge and review (Yamaguchi and Sekine 2006)	-Each country creates its own initial proposal relating to what it might be able to commit to. Individual actions accumulate one by one. The collective effect of proposals is periodically reviewed for adequacy and – if necessary – additional rounds of proposals are undertaken.	-Global participation is feasible.	-	-	-	✓	✓
Development and climate (Heller and Shukla 2003)	-A multifaceted approach seeking to accelerate climate-favouring energy and transport systems by linking climate-specific national and international efforts with non-climate programmes supporting development paths with less climate impact. -Suggests (a) flexible input-based programmes, sectoral or indexed goals, or commitments for developing countries, (b) programmatic climate cooperation, (c) regional cooperation, and (d) targeted use of ODA.	-Focuses on integrating development and climate objectives.	-Does not discuss incentives for developed countries or ways to reduce emissions in developed countries.	-	-	-	✓
Dual Intensity Targets (Baumert et al. 1999; Kim and Baumert 2002)	-Developing countries have two types of targets, a relatively stringent but non-legally binding target, and a relatively weak, legally binding target.	-Encourages developing country participation.	-Implementation challenge for emission trading.	✓	-	-	✓

Dual Track (Kameyama 2003)	-Incentives for participation of developing countries. -A country has a choice between two tracks, a pledge of domestic policies and measures, or a binding emissions target.	-National circumstances are considered.	-Does not consider historical responsibility for emissions.	✓	-	-	✓
Expanded "Common but Differentiated" (Gupta and Bhandari 1999)	-Allocation of national emission targets on a per capita basis. -A transitional regime for Annex I countries until 2025.	-Equity issues addressed.	-Difficult to get developed countries involved.	✓	-	✓	-
International Agreements on Energy Efficiency (Ninomiya 2003)	-Negotiation of an international agreement on EE. -Develop international standards for appliance efficiency.	-Participation by the United States and major developing countries is expected.	-No compliance measures.	-	-	-	✓
Keep It Simple, Stupid (KISS) (Gupta 2003)	-Methodology for differential commitments to get developing countries involved in a future climate regime. -Twelve categories of countries, each with a different package of commitments.	-Equity and development issues addressed. -Technology transfer is mandated.	-Difficult to get developed countries involved.	✓	-	✓	-
Multi-Dimension Structure (METI 2004)	-Need for a multi-faceted approach by governments, industries, NGOs, and individuals.	-Participation of all stakeholders.	-Limited attention to cost or environmental outcome.	-	-	-	✓
Multi-stage proposal (Parikh 2007)	-Groups countries into three categories: Annex 1; Non-Annex 1 with per capita emissions above global average; Non-Annex 1 with per capita emissions below global average.	-Fair.	-May exclude major developing countries with high mitigation potential.	✓	-	-	✓
Orchestra of Treaties (Sugiyama et al. 2003)	-A system of separate treaties among like-minded countries or a decentralised approach, involving four building blocks, "a group of emissions markets (GEM)", "a zero emissions technology treaty (ZETT)", "a climate-wise development treaty (CDT)", and the UNFCCC (monitoring, information, funding).	-CDT addresses adaptation and technology transfer.	-Compliance is not addressed.	✓	-	-	✓
Per Capita Allocation (Agarwal et al. 1999)	-Several burden-sharing approaches based on equal per capita emissions entitlements.	-Equity issues addressed.	-Per capita basis indicators may exclude major emitters.	✓	-	✓	✓
Quantitative finance commitments (Dasgupta and Kelkar 2003)	-Annex I countries take on quantitative financial commitments – e.g. expressed as a percentage of GDP – in addition to emission reduction targets.	-Reduce uncertainty regarding cost.	-Incentives for developed countries to accept commitments are lacking.	✓	✓	-	-

Sao Paulo BASIC Proposal (BASIC 2006)	-Comprehensive proposal for a stable, long-term universal regime based on principles of equity, common but differentiated responsibilities and respective capabilities.	-Emphasis on equity -Adaptation, technology development and transfer and sustainable development are included.	-Modalities for implementation are vague.	✓	-	-	✓
South-North Dialogue (Ott et al. 2004)	-Proposal made by 14 researchers from all regions of the world including Asia, and defines six groups of countries that should take differentiated types of mitigation commitments. Developed countries are divided into two groups (Annex 1 and Annex II) and developing countries are grouped into four types based on responsibility, capacity and mitigation potential. Developed countries have quantitative mitigation commitments based on Kyoto-style targets. Among developing countries, newly industrialised countries (NICs) and rapidly industrializing developing countries (RIDCs) will have quantitative commitments while other developing countries and LDCs will have qualitative mitigation commitments focusing on policies and measures.	-Gradual involvement of all countries. -Enhanced focus on adaptation. -Recommends overcoming “block mentality”.	-Criteria for differentiation are vague and may become controversial during negotiations (e.g., per capita basis indicators could exclude major emitters) -Quantitative absolute commitments for NICs and RIDCs may be difficult to negotiate given uncertainties in future economic growth, and the need for providing energy access in many countries.	✓	-	✓	✓
Sustainable Development and Climate Finance Mechanism (SDCFM) (Halsnæs and Shukla 2008)	-Outlines an institutional mechanism to bring finance from an expanded carbon market to fund integrated policies (policies with climate and development benefits). -The mechanism (a) helps sellers and buyers agree upon standards for reporting and assessing GHG reductions and development benefits of integrated policies and (b) acts as a bridge between the voluntary and formal carbon markets.	-Expanded carbon market would compensate for many of the shortcomings of the CDM (e.g. overly stringent additionality rules).	-Decentralised monitoring might weaken the environmental integrity of the mechanism.	-	✓	-	✓

Three-track approach (CAN 2006)	-Comprehensive institutional architecture with three parallel tracks: 1. Kyoto track with legally-binding targets, 2. Greening (decarbonisation) track – introduce clean technology from developed to developing country, and 3. Adaptation track – provide resources to the most vulnerable regions.	-Encourages involvement of all countries. -Adaptation track designed to help vulnerable countries.	-Criteria for graduation may be contentious.	✓	-	-	✓
Unilateral CDM with certified emissions reduction (CER) discounting (Chung 2006)	-Provides an incentive for Non-Annex I countries for CDM. -Only a certain portion of CER is allowed to be sold to the entities of Annex I.	-Encourages participation of developing countries. -Deeper reduction of CO_2 emissions.	-Achieving consensus on discounting rates is difficult.	-	✓	-	-
United Nations Emissions Trading Scheme (Saijo 2006)	-Each country purchases emissions credits from the UN by auctioning. -Developing countries receive more revenue from selling emission credits than developed countries.	-Scheme can be adjusted depending on national circumstances and developmental priorities.	-Modalities of implementation are vague.	✓	-	-	✓

Sources: IPCC (2007), Bodansky et al. (2004).
Note: Tick marks represent stronger points of the proposals.

Figure 2.2. A diagram showing differentiated commitments and incentives in a future climate regime

		Developed countries (Current Annex I Parties)		Developing countries (Current non-Annex I Parties)				
Criterion	**Proxy Indicator**	**Group A**	**Group B**	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**
Responsibility	Per capita emissions	>4 tCO_2e	>4 tCO_2e	>4 tCO_2e	>2 tCO_2e	<2 tCO_2e	>2 tCO_2e	<2 tCO_2e
Capacity	Human development index	>0.90	0.75-0.90	>0.90	0.75-0.90	<0.75	>0.75	<0.75
Potential for Mitigation	Gross national emissions as % of global emissions	-----	-----	-----	>1%	>1%	<1%	<1%
Vulnerability	Climate vulnerability indicator (Oxford)	-----	-----	-----	Medium High	Medium High	High	High
Typical country fitting the criteria		Japan	Russia	Rep. of Korea	China	India	Fiji	Bangladesh
International Commitments	Mitigation	2013-2020 / 2021-2030						
	Adaptation							
National Commitments	Mitigation							
	Adaptation							
Incentives for Mitigation	Participation in market mechanisms	All types	All types	All types	CDM-type mechanisms only	CDM-type mechanisms only		
	Finance							
	Technology							
	Capacity building							
Incentives for Adaptation	Finance							
	Technology							
	Capacity building							

Notes: 1. This diagram provides only an approximate, not a precise, illustration of the varying commitments and incentives for different sets of countries.
2. The lengths of the bars illustrate how commitments and incentives compare across countries; they are only indicative and are not based on numerical data.
3. Areas shaded in black correspond with the period 2013-2020. Areas shaded in grey correspond with the period 2021-2030.

The framework has four distinguishing features. First, it divides developed and developing countries into sub-groups consistent with their national circumstances, responsibilities and capacities. Reaching consensus on such classification at the beginning of each commitment period may be complex and politically difficult but the proposal with its incentive and compliance provisions would achieve global participation and meet four important criteria—distributional equity, cost-effectiveness, environmental outcome and flexibility. Second, a longer commitment period of eight or ten years instead of five years would provide a more credible signal to the private sector. Third, the adoption of multi-track approaches and new types of commitments would enhance flexibility, thereby giving countries the freedom to achieve their goals in whichever ways suit them best. Fourth, the framework also makes adaptation commitments or actions mandatory for certain groups of countries through adequate recognition of the most vulnerable countries' needs.

The above framework is designed to promote convergence of per capita emissions over time and with a long-term vision of achieving per capita emissions around 1 tCO_2e and enhanced climate-resilience in all countries by around 2100. The idea that national emission entitlements should gradually converge towards equal per capita levels is again gaining attention after it has been recently outlined by the German Chancellor Angela Markel (Evans 2007). However, it is also recognised that GHG emissions in some developing countries with low to medium levels of HDI would continue to grow in the medium term (e.g. up to 2030) to meet their social and development needs. The first and second periods of commitment for the above framework would correspond to 2013-2020 (in black on fig. 2.2) and 2021-2030 (in grey on fig. 2.2) respectively.

It must be noted that the threshold values suggested here are only *indicative*. In order to fully stabilise GHG concentrations near or below the critical 500 ppm threshold, the global average per capita GHG emissions will need to be around 2 tCO_2e by 2050 (Stern 2008). This is based on the logic that total anthropogenic GHG emissions will need to decline to less than 20 $GtCO_2e$ per annum by 2050 (population around 9 billion) from about 45 $GtCO_2e$ in 2005. In the framework proposed here, we used a two-stage approach for grouping of countries.

In the first stage, countries with per capita emissions greater than 4 tCO_2e (twice the targeted value of 2 tCO_2e for 2050) are identified. All the current Annex I Parties and several developing countries are above the 4 tCO_2e threshold. Those countries are then classified into three groups based on their HDI value (i.e., developed countries with HDI above 0.9, developed countries with HDI between 0.75 and 0.90, and developing countries with HDI above 0.9).

In the second stage, the remaining developing countries with HDI levels below 0.9 are classified into four groups based upon (a) the targeted value of 2 tCO_2e as a threshold, (b) their contribution to global emissions, and (c) the climate vulnerability indicator. As mentioned earlier, those countries that account for more than 1% of global emissions are considered to have a greater responsibility to contribute to the success of the future climate regime. It is also considered that those countries have greater mitigation potential than others. This is because some of those nations have large geographical areas and offer more cost-effective mitigation opportunities (including carbon sequestration). Further, some of those nations have access to technologies that can lower GHG emissions substantially. However, due consideration is given to provide additional incentives to those countries with lower HDI values and higher vulnerability indicators.

(i) Developed countries

In the above framework, GHG emission reduction commitments for developed countries (with per capita emissions of more than 4 tCO_2e and HDI above 0.75) would be deep and legally binding with strong compliance requirements. The targets would be based on sound science and reflect the latest IPCC guidance (e.g. 25-40% reduction by 2020 and 60-80% by 2050). To achieve these targets, the regime would include both national and international commitments for mitigation and adaptation (see fig. 2.2). "National commitments" would be agreed upon internationally but would be achieved chiefly within the host country (with some possibilities for using market mechanisms for mitigation). "International commitments" would be agreed upon internationally and then be implemented in the form of reportable, measurable and verifiable measures for technological, financial and capacity building support for mitigation and adaptation from developed to developing countries. The nature and magnitude of national and international commitments may vary with differences in levels of development. For example, developed countries with an HDI above 0.9 (Group A) would have *strong national* mitigation commitments and *strong international* mitigation commitments, as well as *strong international* adaptation (assistance) commitments. On the other hand, developed countries with an HDI between 0.9 and 0.75 (Group B) would have *substantial national* and only *limited international* mitigation commitments. Thus, Group A countries correspond to the current Annex II countries of the Kyoto Protocol while Group B countries are mainly the economies in transition (EIT). However, the nature and magnitude of commitments of both groups are different from those in the first commitment period of the Kyoto Protocol.

For Group A countries, threshold values for national and international commitments would be negotiated and adopted prior to the start of each commitment period. For example, at least 75% of the national commitment would be met through domestic actions, 15% through the use of flexibility mechanisms and 10% through efforts to promote technologies, enhance financial flows and strengthen capacity in EIT and developing countries. The average price per tonne of carbon emissions traded internationally over the preceding commitment period (initially 2008-2012) would form the basis for determining thresholds in the subsequent commitment period. For Group B countries, no such threshold values would be applicable, although they would be encouraged to promote the transfer of appropriate technologies to developing countries. Compliance requirements for Group A countries would be more stringent than those for Group B countries.

(ii) Developing countries

In the above framework, the nature and form of participation of developing countries would vary significantly from the current regime's emphasis on "targets and timetables." Five groups of countries are envisioned with varying levels of *national* commitments and associated incentives. All groups would have domestic commitments for mitigation and/or adaptation but the nature and extent of the commitment would vary. The nature and magnitude of incentives would also vary. The framework assumes that most developing countries will graduate from one group to another over time, which in turn involves differentiated commitments and incentives.

- Group 1 includes industrialised developing countries with high per capita emissions (e.g. above 4 tCO_2e) and high HDI levels (e.g. above 0.90). Typically, the group may include OECD non-Annex 1 countries (e.g. the Republic of Korea, Mexico),

and countries with levels of economic development similar to those of OECD countries (e.g. Singapore). For this group, the *national* commitments for the first commitment period (2013-2020) and subsequent commitment period (2021-2030) would be similar to those for Group B developed countries, with additional flexibility on compliance requirements, perhaps through borrowing arrangements. As an incentive, countries in this group would be allowed to participate in all types of international emissions trading, and would be eligible for technological and financial flows and support to enhance institutional and human capacities, mainly for GHG mitigation. Group 1 countries will receive only very limited incentives for adaptation from the international regime.

- Group 2 includes countries with large gross national emissions (>1% of global emissions), per capita emissions above 2 tCO_2e, HDI above 0.75, and a medium high level of vulnerability. Typically, a country like China would fit this description in Asia. In the proposed framework, countries in Group 2 have important obligations for global climate stabilization not only because of their high national contributions to global emissions but also due to rapid growth in their per capita emissions and HDI recently. Many studies confirmed that attaining GHG stabilization targets (e.g. 500 ppm) to avoid dangerous levels of climate change would be impossible without effective mitigation strategies by this group. As a start, therefore, this group would commit to nationally appropriate sectoral EE targets by 2020 supported by technological and financial flows from international financial institutions and Group A countries. Also further actions such as (i) setting economy-wide goals with full consideration of various sub-national circumstances and factors such as “embedded emissions”; (ii) fuel economy standards for automobiles and enhanced efficiency standards for buildings and other infrastructure; (iii) RE targets; and (iv) measures to improve carbon sequestration would be necessary. In this context, it is heartening to note that considerable progress is already evident in countries like China, where fuel efficiency standards are much higher than in the US (UNDP 2007).

  During the first phase of commitment (2013-2020), sectoral targets for Group 2 would be subject to the same compliance provisions applied to Group 1 countries. The actions in other areas, however, would be “no lose” targets on a “pledge and review” basis and no penalties would be applied for the lack of compliance. From the year 2021 onwards, however, the same compliance provisions applied to Group 1 countries would apply to Group 2 countries in all types of commitments and actions, except for those related to carbon sequestration. The countries would be eligible to sell emission reduction credits not only through those achieved from sectoral EE target realisation plans, but also project-specific emission reductions in sectors without targets. Group 2 countries would receive, in general, more incentives than Group 1, especially for GHG mitigation in the form of participation in CDM-type mechanisms and additional financial and technological flows from developed countries. To realise sector-wide EE targets and achieve the most cost-effective emission reductions worldwide, developed countries would provide technological assistance to priority sectors in Group 2 countries commensurate with the targets set for 2020. Support from international financial institutions, carbon markets and non-UNFCCC initiatives such as APP would be crucial in this regard. Through effective involvement in market mechanisms, countries in this group would be expected to bear most of their own adaptation costs. However, some form of support in adaptation technologies and capacity strengthening would be provided, especially during 2013-2020.

- Group 3 includes countries with large gross national emissions (>1% of global emissions), low per capita emissions (e.g. below 2 tCO_2e) and lower HDI levels (e.g. below 0.75). Typically, a country like India would fit this description in Asia. This group would strengthen EE and RE goals, fuel economy standards for automobiles, efficiency standards for buildings and other infrastructure, and actions designed to conserve forests during the first period of 2013-2020. In addition, nationally appropriate targets in one or two sectors would be taken up with support from the international regime. Provided that HDI levels reach satisfactory levels, this group of countries is expected to take on a similar role as that of Group 2 during the period of 2021-2030. Group 3 countries would be eligible to sell project-specific emission reductions in all sectors. All types of incentives—finance, technology and capacity strengthening—would be provided largely for GHG mitigation and partly for adaptation. In general, the extent of support would be more than that in Group 2 but it would decrease in the period 2021-2030.

- Group 4 countries are characterised by limited gross national emissions (<1% of global emissions), per capita emissions above 2 tCO_2e, HDI above 0.75, and high climate vulnerability. Typically, a country like Fiji would fit this description in the Asia-Pacific region. This group would not be required to take up mitigation commitments but should commit to adaptation actions and their integration into national development plans. Internationally, they are expected to support adaptation efforts in other developing countries with lower HDI, and share information on good practices. They would receive limited incentives in the form of technology and capacity strengthening for mitigation, and all forms of incentives for adaptation.

- Group 5 includes countries with low gross national emissions, low per capita emissions and low HDI levels (mostly LDCs) and high vulnerability indicators. Typically, a country like Bangladesh would fit this description in Asia. They would be required to internationally pledge adaptation actions such as integration of adaptation concerns into their national development plans, and show progress in adaptation actions through an international review mechanism. They would be eligible for all types of incentives primarily for adaptation.

Whatever the precise form may be, all actions will need to be realistic and supported by commitments, with mechanisms to ensure measurable, reportable and verifiable progress. Insofar as GHG mitigation is concerned, the outcome of optimal or cost-effective “national” climate actions in various countries in Asia could be more than the outcome of “international” commitments made by these countries. As the above framework relies on a differentiated and wide-range of incentives, further work on innovative options to enable financial and technological flows for mitigation and adaptation in developing Asia is necessary. For this to happen, more effective involvement of the private sector, especially those segments of industry that are increasingly contributing to the growth in emissions such as aviation, must be considered. An aviation levy, a global carbon tax on traded commodities and a levy on FDI are likely to raise adequate amounts of funds to be used as incentives in the above framework. In addition, efforts to reduce inter- and intra-regional, high- and low-income group disparities in GHG emissions should be promoted, recognised and rewarded in all countries. Such proactive and effective participation of various countries in the future climate regime may ultimately lead to achieving a low-carbon climate-resilient society in Asia.

4.2. Enhancing adaptive capacity of Asian populations and ecosystems

As noted in section 3, adaptation has received only limited attention both at the international level and at the national level in Asian countries, even though projected climate hazards in Asia are severe, and the region has many vulnerable populations and ecosystems. Even if GHG emissions were stabilised now, climate change impacts are going to be felt in Asia for a long time. Enhancing the adaptive capacity of Asian populations and ecosystems, therefore, is a crucial step for achieving sustainable development in the region and will require multiple efforts at temporal (short, medium and long term) and spatial (international, regional, national and local) levels (table 2.10).

In the short term, Asian countries should focus on measures such as flexible farming systems, traditional weather-resistant farming practices, improved disaster preparedness and public awareness. In the medium to long term, early warning and monitoring systems and hazard mapping, and measures such as reforestation (with both mitigation and adaptation benefits), engineering of structures in coastal areas, and land use planning will be crucial, but can be initiated now.

Table 2.10. Steps to enhance adaptation at different levels

Level	Examples
Local	➢ Identification of strategies for facilitating proactive micro-adaptation with the participation of local communities and local governments ➢ Exchange of best practice guidelines and lessons learned at the local level
National	➢ Mainstreaming climate change in national and sector development planning, through changes in policies and institutions, including technology deployment ➢ Strengthening the capacity of national institutions to seek complementarities among the environment and development frameworks by linking NCs and NAPAs with poverty reduction strategies and MDGs ➢ Prioritising short, medium, and long-term adaptation actions which have a direct bearing on the livelihoods of vulnerable communities ➢ Involving the private sector in adaptation activities by providing necessary incentives such as tax exemptions ➢ Integrating alternative livelihood strategies for extreme climatic events through national disaster management plans, including the dissemination of seasonal climate forecasts
International	➢ Developing an international consensus on the scope of adaptation and means to enhance the availability and access to adaptation funds ➢ Identifying and building on inter-linkages between various forms of communication (scientific, implementation and reporting linkages) ➢ Supporting the Clearing House mechanisms for the UNFCCC and the Kyoto Protocol at the regional and international levels ➢ Building synergies among subsidiary bodies of CBD, UNCCD and UNFCCC ➢ Awareness raising, education and public participation

Source: Srinivasan (2006b)

No country in the region has an overall national policy framework in place on climate change adaptation. The development of such a policy framework, however, requires a system of legal frameworks that stipulates rights and responsibilities, institutions at various levels and clearly defined roles for various players. The recent initiative by China's Ministry of Science and Technology to develop a national adaptation policy framework, which sets out roles and responsibilities for different levels of governments

as well as the private sector to streamline responsibilities among different institutions, can be a good model for other countries to emulate.

4.2.1. Regional cooperation on adaptation

To strengthen national capacity to address adaptation, opportunities for regional cooperation must be addressed soon. As most countries in Asia experience similar climatic hazards, regional strategies are likely to be more cost-effective than multiple national and sub-national actions. Cooperation is especially relevant in developing regional climate scenarios and models to monitor and evaluate climate change impacts and methods to quantify the costs and benefits of adaptation.

Regional cooperation on adaptation can ensure proper coordination, optimization, cost-effectiveness and efficiency of transboundary sectoral adaptation policies and measures such as integrated river basin management, forest fire management and early warning systems. It would also help Asian countries to minimise reactive, costly and un-planned adaptations or mal-adaptations in response to climate disasters. Regional cooperation will further enhance capacity in “climate proofing” current and future investments, and in ensuring that MDGs in any country are not at risk. Finally, institutional capacity in the region for generating high quality climate information with improved regional predictions, and for providing uniform and comparable adaptation assessment data for all countries can be enhanced. Regional cooperation can be most effective if there is policy convergence, institutional transparency, effective stakeholder participation and adaptation priorities identified on the basis of political consensus and sound science.

Several adaptation activities may be coordinated at the regional level in Asia. These include (i) creating a more consistent framework for adaptation and guidelines for mainstreaming adaptation concerns in all policy areas; (ii) a regional adaptation facility to identify and finance projects of regional significance; (ii) developing a common reporting mechanism on adaptation strategies and measures; (iv) disseminating success stories from databases containing examples of adaptation actions and options; (v) coordinating adaptation measures for transboundary issues such as river basin management; and (vi) capacity strengthening, education, and related efforts aimed at raising public awareness. Ongoing regional and sub-regional initiatives (e.g. Association of South East Asian Nations [ASEAN] peat land management initiative) can be a good starting point.

4.2.2. Mainstreaming adaptation concerns into development planning

Adaptation to climate change will have an impact on many policy areas in Asia. Therefore, strategies to integrate adaptation in existing and upcoming legislation and policies are crucial. In many Asian countries, the need for mainstreaming climate concerns is acknowledged, but progress is slow due to difficulties in finding appropriate points of intervention. Several barriers have been identified, including information barriers, lack of incentives and institutions, limitations on human and financial resources, lack of coordination among government agencies, lack of communication between the climate change community and development community, and insufficient knowledge and analytical tools (Warrick 2000; Agrawala 2004; OECD 2005; OECD 2006; Srinivasan 2006a). A thorough assessment of obstacles that take into account country-specific and site-specific considerations is necessary for effective mainstreaming. The preparation of a NAPA type document in all countries, with multi-stakeholder inputs, may help in determining adaptation priorities and suitable means to

integrate such concerns in development planning. Practical demonstrations of promising mainstreaming options, capacity strengthening and streamlining of financial mechanisms are also crucial to making further progress.

Uncertainties regarding future climate change impacts at the national and local levels and the lack of relevant local information necessary for adaptation planning are also major obstacles to the development of effective adaptation actions. For example, in many critical coastal ecosystems in Asia, detailed vulnerability and adaptation assessments have not been completed as most countries do not have detailed topographic maps with sub-meter contours, which are crucial for planning for sea level rise. Also, the detailed down-scaled climate change projections, a prerequisite for adaptation planning, are often unavailable. Increased focus is necessary on data collection, development of enhanced regional and local climate change scenarios, vulnerability mapping, hazard and risk assessment, disaster management and evacuation plans, and databases on good adaptation practices. Developing related scientific tools (e.g. revised building codes, new standards for infrastructure engineering, improved material testing) should also be encouraged. Thus, mainstreaming adaptation concerns into the development agenda in Asia must be pursued based on thorough assessments of current vulnerabilities and opportunities and pitfalls of such integration in each locality.

Mainstreaming adaptation concerns is crucial not only in agriculture and water management but also in sectors such as health, tourism and infrastructure development. A prime example of the immediate need for adaptation is buildings; enforcement of building codes which take into account future impacts of climate change is a completely new area in Asia. Likewise, new transport infrastructure should be made climate proof from the early design phase (box 2.4).

Box 2.4. Adaptation of the Qinghai-Tibet railway to climate change

The Qinghai-Tibet Railway crosses the Tibetan Plateau with about a thousand kilometres of the railway at least 4,000 metres above sea level. Five hundred kilometres of the railway rests on permafrost, with roughly half of it “high temperature permafrost” that is only 1-2ºC below freezing. The railway line would affect the permafrost layer, which will also be impacted by thawing as a result of rising temperatures, thus in turn affecting the stability of the railway line. To reduce these risks, design engineers have put in place a combination of insulation and cooling systems to minimise the amount of heat absorbed by the permafrost (Brown 2005).

Source: IPCC (2007)

The national meteorological services in Asian countries should be strengthened and reoriented to provide policy relevant information regarding adaptation. In addition, legal provisions to mainstream adaptation concerns into management choices could be strengthened. For example, standard environmental impact assessments (EIA) often consider the impacts of the potential project on the environment. In the future, EIAs should also include a section on how current and future impacts of climate change can affect the sustainability of the project and detail measures to overcome these impacts.

The lack of information on the cost-effectiveness of adaptation options and potential synergies with other initiatives are also constraints to mainstreaming adaptation (Srinivasan 2008). All developmental policy measures should undergo an adaptation screen to ensure that they do not enhance vulnerabilities in the long run. For example, policies to promote tourism and the necessary infrastructure in vulnerable areas of coastal zones should consider the projected impacts of climate change in order to avoid mal-adaptation. Likewise, it is important to ensure that development assistance by donors undergoes an adaptation screening to ensure "climate proofing" of externally funded investments.

Donor agencies could facilitate adaptation mainstreaming by screening their project portfolio for potential climate change impacts, and by creating an enabling environment for adaptation mainstreaming through (i) development of operational guidelines; (ii) provision of detailed down-scaled climate projections; (iii) additional support for monitoring and evaluation of mainstreaming approaches; and (iv) enhancing the technical skills for mainstreaming at the sectoral level. The UNFCCC and other international organisations can play a catalytic role in the exchange of experiences, and in facilitating the development of region-wide and sector-wide approaches for mainstreaming. Some progress along these lines is evident already. For example, the Development Assistance Committee of OECD has begun to look at ways to integrate adaptation into EIA and strategic environmental assessments. Similarly, agencies such as the World Bank have begun to use tools (e.g. ADAPT - Assessment and Design for Adaptation to Climate Change: a Prototype Tool) to screen proposed development projects for potential risks posed by climate change.

4.2.3. Harnessing indigenous coping strategies

Asia is a rich reservoir of indigenous knowledge (also referred to as traditional local knowledge), which is unique to local communities and is acquired through local people's experience and observations of their surrounding natural systems (Srinivasan 2004). Since adaptation is often a complex process that requires detailed site-specific considerations, any adaptation measure must effectively utilise or be built on indigenous coping strategies. While not all indigenous practices are necessarily sustainable, successful adaptation typically requires knowledge of local risk factors for extreme climate events, as well as flexible production and income strategies in response to such events (Shaw 2006). Many indigenous coping strategies are known to enhance adaptive capacity (table 2.11) but very few of them have been integrated into national or local adaptation planning in Asia, perhaps due to insufficient recognition of their value and bias against local knowledge. Indeed, many local ways to cope with climate extremes, which were once considered primitive and misguided, are now seen as appropriate and sophisticated. Field surveys in flood-prone and drought-prone areas of Bangladesh revealed that indigenous coping strategies still remain the most reliable and sustainable forms of disaster response (Srinivasan 2004). Effective integration of local coping strategies into adaptation plans, however, requires a thorough assessment of strengths and weaknesses of each strategy, as some are no longer adequate to cope with impacts of climate change.

Realizing the importance of local knowledge and involvement of local communities in successful adaptation, there is a growing interest in international institutions to support community-led initiatives on adaptation or proactive micro-adaptation. For example, in 2003, the UNFCCC initiated a database of local coping strategies for adaptation to disseminate information to a wider audience.[17] The Global Environmental Facility (GEF), through its small grants programme, supports community-oriented adaptation

projects in which local knowledge is duly considered. If other bilateral and multilateral donor agencies can preferentially support collection and integration of local knowledge in adaptation planning, the prospects for improved adaptive capacity will be enhanced.

Table 2.11. Examples of indigenous coping strategies

Location	Indigenous coping strategy
	Coping strategies for floods and heavy rainfall
Manikganj (Bangladesh)	Growing catkin in sandy lands to prevent erosion, and constructing manchans (hanging bamboo platforms inside houses)
Matalom (the Philippines)	Kahun-Kahun (a soil conservation technique to reduce the impact of heavy rainfall)
Mountainous regions of Nepal	Ploughing sloping lands in a sward-like pattern to minimise soil erosion
	Coping strategies for droughts
Kerala (India)	Surangas (man-made caves for water)
Karnataka (India)	Madakas (traditional percolation ponds)
South India	Planting *Sesbania grandiflora* on the edges of long trenches to increase humidity for betel vine gardens

Source: Adapted from Srinivasan (2004)

4.2.4. Broadening the funding base for adaptation

There is a wide gap between the necessary levels of funding for addressing adaptation in developing countries and the funds currently available. Recently, UNDP estimated that the additional costs of adaptation in developing countries would be as high as $86 billion per year by 2015 (UNDP 2008). Likewise, the World Bank estimated that $10-40 billion per year would be necessary to adequately address adaptation needs, while the funds under the current climate regime are less than $200 million. The available amounts are not even adequate for addressing high priority adaptation measures identified by LDCs in their NAPAs. For example, five LDCs (Bangladesh, Bhutan, Cambodia, Samoa and Tuvalu) in the Asia-Pacific region reported that they would require as much as $114 million to cover the costs of priority adaptation measures (table 2.12). Given the wide gap between requirements and supply, existing publicly available funds have to be utilised to finance adaptation projects. In addition to public funds, the role of the private sector (e.g. insurance) will be increasingly important.

IGES reviewed about 30 proposals on adaptation, including those related to adaptation financing. Most proposals are based on ideas of historical responsibility, ability to pay, and the "polluter pays principle." Some proposals seek to create new and specialised funds (Government of Tuvalu 2005; TERI 2005; ICCTF 2005; Müller 2002; Oxfam 2007). The proposal by Tuvalu, for example, identifies various means to diversify and enhance adaptation funds (solidarity fund and insurance fund to be supported by a levy on fossil fuel sales in Annex I countries). TERI's proposal incorporates the convention's guidance to provide new and additional financing besides compensatory financing. Other proposals suggest improving the flexibility of access to (Parry et al. 2005), or enlarging the scope (Bouwer and Aerts 2006) of, adaptation funds. In past negotiations, several developing countries proposed that a levy be imposed on transactions under all three Kyoto mechanisms, while many others opposed an extension of the levy beyond CDM.

Table 2.12. Costs of priority activities of adaptation in selected LDCs in the Asia-Pacific region

Country	Adaptation measure	Cost ($ million)
Bangladesh	Construction of flood shelters, and information and assistance centres to cope with more frequent and intense floods in major floodplains	5.00
	Enhancing the resilience of urban infrastructure and industries to the impacts of climate change	2.00
	Promoting adaptation of coastal crop agriculture to salinity	6.50
	Adaptation of fisheries in areas prone to enhanced flooding in the Northeast and Central Regions through adaptive and diversified fish culture practices	4.50
Bhutan	Landslide management and flood prevention	0.89
	Weather forecasting system to serve farmers	0.42
	Flood protection of downstream industrial and agricultural areas	0.45
	Rainwater harvesting	0.90
Cambodia	Rehabilitation of upper Mekong and provincial waterways to reduce risks caused by floods, improve fishery resources, and supply sufficient water for irrigation and domestic uses	30.00
	Vegetation planning for flood and windstorm protection	4.00
	Development and improvement of community irrigation systems	4.00
	Community mangrove restoration and sustainable use of natural resources	1.00
Samoa	Reforestation, rehabilitation and community forestry fire prevention project	0.42
	Climate early warning system project to implement effective early warnings and emergency response measures to climate and extreme events	4.50
	Coastal infrastructure management plans for highly vulnerable districts	0.45
	Sustainable tourism that takes into account climate change and climate variability	0.25
Tuvalu	Increasing resilience of coastal areas and settlement to climate change	1.90
	Increasing pit-grown pulaka productivity through introduction of a salt-tolerant pulaka species	2.20
	Adaptation to frequent water shortages through increasing household water capacity, water collection accessories, and water conservation techniques	2.70

Source: Adapted from NAPAs submitted to the UNFCCC

Three related groups of proposals focus on funding to reduce climate change risks. Jaeger (2003) proposed creating a fund based on a levy from emissions trading to buy insurance for adaptation costs and damage compensation. Providing insurance was also central to proposals from AOSIS (specifically to small island low-lying nations for the gradual expected sea-level rise), Germanwatch (against extreme weather events), and the International Institute for Applied Systems Analysis (IIASA) (two-tier insurance scheme). While the AOSIS and Germanwatch proposals seek contributions solely from developed countries, the IIASA proposal seeks contributions from both developed and developing countries (Bals et al. 2005). Other risk management schemes such as an insurance pool, catastrophe insurance or micro-insurance (Parry et al. 2005) and risk transfer instruments such as catastrophe bonds (Hamilton 2004), weather derivatives (Figueres 2005) and weather hedges (Linnerooth-Bayer et al. 2003) were also

proposed to finance adaptation efforts in developing countries. Müller and Hepburn (2006) offered a proposal entitled “international air travel adaptation levy” (IATAL) that could attract as much as $4-10 billion per annum. The proposal aims to link the adaptation challenge with a policy for regulating rapidly increasing aviation emissions, and is unique in that it proactively involves the private sector. A modified aviation levy proposal with differentiated burden sharing and fund sharing mechanisms was proposed in recent IGES consultations (Srinivasan 2008).

An assessment of the current financial instruments available to support adaptation in Asia suggests that the amount of resources flowing through such instruments is inadequate. Therefore, options to be examined include (i) enlarging the funding base for adaptation both within and outside the UNFCCC; (ii) involving the private sector (e.g. insurance sector) in facilitating adaptation at the regional, national and local levels; (iii) establishing a region-wide adaptation fund which can be financed, for example, by levying a tax on FDI flowing into the region since it can be seen as outsourcing energy-intensive industrial processes to developing Asia; and (iv) establishing a region-wide insurance facility hosted perhaps at the ADB.

Building synergies of adaptation plans with disaster risk management and MDG achievement plans, developing flexible, customised credit schemes (including microfinance), and providing alternative climate-insensitive income generating activities, can help increase adaptive capacity in Asia. Robust insurance mechanisms, including an “Asian catastrophic risk insurance facility”, may be needed to enhance vulnerability and adaptation assessments and promote pubic-private partnerships in adaptation.

In the short-run, developed countries should play a major role in providing assistance for enhancing regional cooperation in adaptation. For example, Japan can take initiatives in facilitating the development and transfer of adaptation-related technologies, developing new insurance products and a regional insurance scheme, and establishing an innovative adaptation fund in Asia. However, all efforts at national and local levels must aim at making adaptation a self-sustaining mechanism in the long run.

4.3. Harnessing the potential of market mechanisms

The use of market mechanisms for environmental protection has received considerable attention in the UNFCCC and its Kyoto Protocol. The Kyoto Protocol uses three types of market mechanisms to limit GHG emissions – international emissions trading, joint implementation (JI) and CDM. At least five elements are considered essential for providing environmental and economic integrity in such mechanisms: measurement, transparency, accountability, fungibility, and consistency (Petsonk et al. 1998). In developing Asia, the only market mechanism in use is the CDM, which aims at promoting GHG emissions reductions and sustainable development in developing countries, while enabling flows of technology and finance from developed countries in return for emission reduction credits.

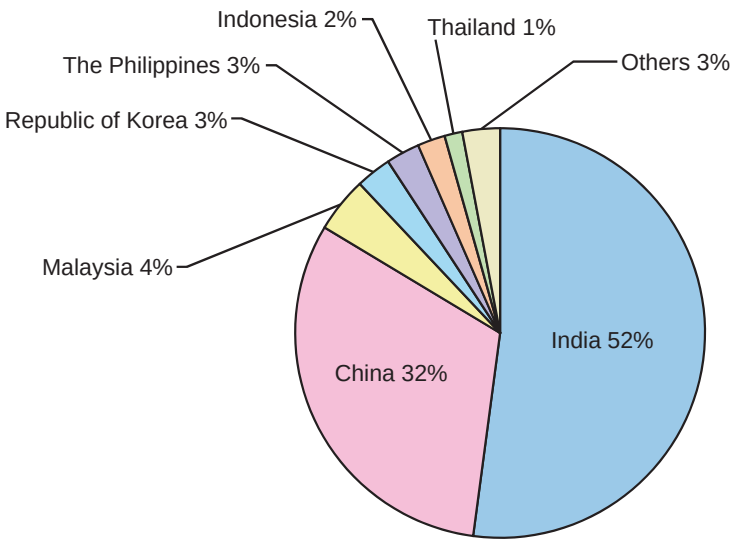
Following the entry into force of the Kyoto Protocol in February 2005, the CDM market has grown rapidly in Asia. The mismatch between the supply and demand of CERs, approval of the decision on unilateral CDM, and the launch of the European Union's (EU) emission trading scheme (ETS) linked with CDM/JI have helped trigger this dramatic growth. Despite such expansion, there are still several barriers preventing the CDM from realizing its full potential in the region.

4.3.1. CDM implementation in Asia

By 1 May 2008, the CDM Executive Board (CDM-EB) registered 1035 CDM projects with an expected delivery of more than 1.27 billion CERs by 2012, of which about 140 million CERs have been issued by host countries. If all the 3,000 projects in the pipeline actually materialise, more than 2.7 billion CERs (tCO_2e) will be issued by 2012 (UNFCCC 2008). Out of 1035 registered CDM projects, 641 were in the Asia-Pacific region, accounting for 62% of the total number of projects and 77% of the total CERs. Within Asia, India and China have 84% of total registered projects and 85% of CERs through 2012 (74% of 111 million CERs issued to date were from projects based in China and India). India has the largest share of registered CDM projects (fig. 2.3), while China has the largest share of CERs (fig. 2.4) (IGES 2008; UNEP-RISO 2008).

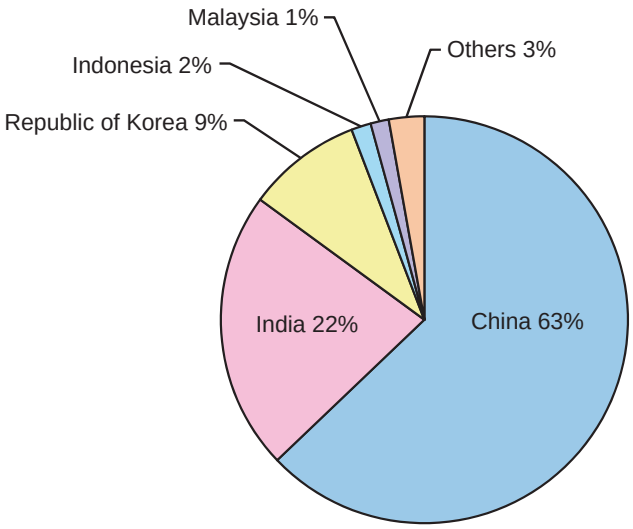
Serious concerns about CDM implementation include (i) the limited attention to environmental integrity (whether CDM emissions reductions are really additional to what would have happened in the business as usual [BAU] scenario); (ii) the uncertainty surrounding post-2012 CER credits; (iii) the ineffectiveness of the CDM-EB; (iv) the slow approval of CDM projects; and (v) the uneven geographical distribution of CDM projects.

Figure 2.3. Distribution of various CDM projects in Asia by country (as of May 2008)



Source: IGES CDM project database (http://www.iges.or.jp/en/cdm/report.html)

Figure 2.4. Distribution of CER volumes through 2012 from CDM projects in Asia by country (as of May 2008)



Source: IGES CDM project database (http://www.iges.or.jp/en/cdm/report.html)

The greographic inequity in CDM is a major concern to many LDCs and SIDS in the region, as most of the CDM projects are in China, India, and the Republic of Korea. Only one project was registered in Bhutan, Cambodia, Fiji, Lao PDR, Pakistan and Papua New Guinea, while there were no registered projects from Maldives, Myanmar, and Singapore even though they have established DNAs. The LDCs with greatest development needs have therefore received the fewest projects.

Cumbersome CDM modalities and procedures and high transaction costs pose major barriers to the development of CDM projects. For example, a CDM project developer needs to justify additionality (how the CDM project reduces GHG emissions below those in a BAU scenario and why the project cannot be implemented without CDM revenue). Also, the methodology to calculate baseline emissions must be approved by the CDM-EB.

Uncertainty about the value of CERs after the first commitment period of the Kyoto Protocol is a concern, especially for private investors. Although most CDM projects have crediting periods that go beyond 2012 and CERs can be accumulated for up to 21 years, the current uncertainty about the post-2012 climate regime has dampened demand for post-2012 CERs (Egenhofer et al. 2005; UNFCCC 2006).

Another criticism of the CDM is that its contribution to promoting sustainable development in developing countries is limited (Lohmann 2006; Olsen 2007). For example, afforestation/reforestation (A/R) CDM projects which could contribute to sustainable development in local areas have not been realised, as only one A/R CDM project has been registered to date. Likewise, projects with large sustainable development benefits provide only a few CERs (and therefore receive less investment funds). For example, while 55% of the CDM projects are based on RE, they only

accounted for 29% of the CERs. EE takes 14% of the CERs for the supply-side EE and only 1% for the demand-side EE. On the other hand, HFC, PFC and N_2O projects were only 2.4% of the total number of projects but contribute nearly 29% of the total volume of CERs by 2012 (UNEP-RISO 2008). The latter projects score much lower on measures of social and environmental development than more sustainable CDM projects such as RE projects (Cosbey et al. 2006). Based on a review of the environmental and development benefits of 10 illustrative CDM projects, Boyd et al. (2007) found that there was no causal relationship between project types and sustainable development outcomes. Also, it can be misleading to assess project performance only through project documentation, as they may conceal local struggles and other development and climate mitigation alternatives. For example, sponge iron projects in India have been criticised for putting pressure on local villages to sell their land and appropriating local water resources for the expansion of company facilities (Lohmann 2008). Studies in China suggest that CDM has had very little impact on key drivers of China's GHG emissions growth, especially in sectors such as coal-fired power generation, transportation and buildings.

4.3.2.Prospects for reforming market mechanisms

(i) Short term

Strengthening human and institutional capacities and improving institutional and operational settings to implement CDM — Many barriers to CDM can be overcome through strengthening institutional and operational settings. An early signal on continuing CDM beyond 2012 is important in the Asia-Pacific region because CDM activities have only recently begun to pick up pace, and many projects in the region have long gestation periods with high capital costs. If CERs continue to have value through an increased demand for credits, it can lead to sustained implementation of CDM projects. Recently, the World Bank decided to launch "Carbon Market Continuity Fund" to provide some assurance to the post-2012 credits.

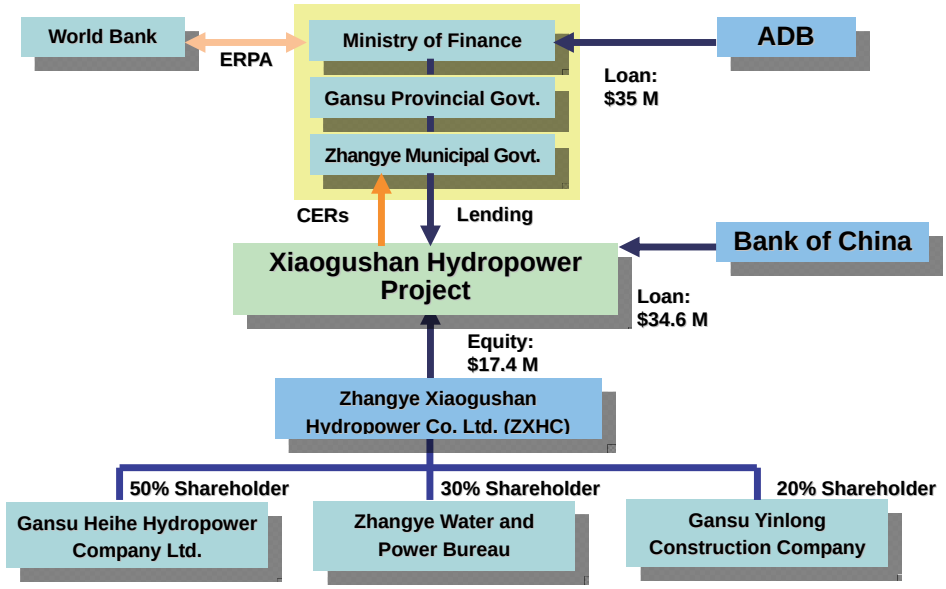
In addition to providing a strong signal that the CDM will continue beyond 2012, complex CDM modalities and procedures as well as high transaction costs of project implementation need to be addressed. In the IGES capacity-building programme, it was found that the frequent updating of rules and procedures was an obstacle to effective CDM project development. Ensuring that the international regime operates on simplified modalities and procedures and national level agencies have sufficient human and institutional capacities will make it easier to take advantage of the CDM in future. In addition, creating databases for baseline calculations by national governments and/or international agencies would reduce transaction costs greatly (Michaelowa 2005).

Using ODA and other multi-source funding approaches to cover CDM risks and underlying project finance, especially in LDCs and middle-income countries, to improve geographic equity — Another major barrier to effective implementation of CDM projects is the lack of underlying finance. To overcome this barrier and enhance the prospects of obtaining up-front payments for project development, synergies between the private sectors of Annex I and non-Annex I countries should be strengthened through bilateral business agreements. In addition, adequate steps should be taken to strengthen capacity and increase awareness of the CDM in both public and private financial institutions of developing countries so that the underlying finance may be secured domestically (Masuda 2005).

Another option to address this financial barrier is the use of ODA for the CDM, although diverting ODA to purchase CERs is not allowed under the current regulation of the CDM (there is a concern that using ODA to purchase CERs will reduce funds allocated to other developmental activities such as education). Providing ODA, especially during the initial stages of CDM implementation, is critical. In this context, Japan's decision in January 2008 to use ODA to implement CDM projects (but not for purchasing CERs) in China is a significant development. ODA can also improve the prospects of bringing investments in LDCs and SIDS, which are not financially attractive to investors. In countries with high risks, ODA coupled with export credit insurance may also be used to mitigate risks. A key requirement is to combine climate change outcomes with sustainable development objectives in project designs.

Multi-source funding can promote CDM projects by sharing risks among several financial institutions so that project owners can receive up-front payments relatively easily (de Gouvello and Coto 2003). Multilateral financial institutions and development agencies can act as catalysts to generate multi-source funding for CDM projects. For example, the Xiaogushan Hydropower Plant Project in China received loans from the Bank of China (39.8% of the total cost) and the ADB (40.2% of the total cost) for implementation, based on an emissions reduction purchase agreement (ERPA) signed with the World Bank (World Bank 2004). The equity contributions of the project owner covered the remaining 20%. Explicit guarantees from the Gansu Provincial Government and the Zhangye Municipal Government also facilitated the loan agreement (fig. 2.5).

Figure 2.5. Multi-source funding structure of the Xiaogushan hydropower project in China



(ii) Medium term

Widening the scope of CDM to include sector-based approaches, including those sectors not yet covered by the Kyoto Protocol (aviation, deforestation, etc.) — The COP/MOP and CDM-EB agreed in 2006 to register programmatic CDM ("project activities under a programme of activities [PoA]") as a CDM project if approved baseline and monitoring methodologies are used to define project boundaries, avoid double-counting and account for leakage. The PoA-type CDM may facilitate implementation of small-scale projects, which are often beneficial to local communities by improving the quality of life in developing countries. However, local/regional/national policies or standards are not yet accepted as CDM. A "sectoral CDM" has been suggested to widen the scope of project-based CDM (Samaniego and Figueres 2002) and several variations have been proposed such as policy-based, intensity-based and cap-based sectoral CDM (Bosi and Ellis 2005). Widening the scope of CDM could considerably increase supplies of CERs while effectively cutting down on transaction costs and offering least-cost mitigation opportunities to Annex I countries. Through sector-based CDM, synergies with sector-based national development plans in Asian countries can also be identified and exploited.

Another potential advantage of a sectoral CDM is that it can increase opportunities for CDM development in LDCs and SIDS and thereby redress the geographical inequity that currently characterises the CDM. Since CDM is a voluntary market-based mechanism, private sector investment activities have tended to gravitate to countries where transaction costs and investment risks are low. For the same reasons, investments have also tended to flow to projects that promise to generate substantial amounts of CERs. Most CDM projects in LDCs and SIDS lack these qualities; that is, they are typically small projects with relatively few CERs and are perceived as having high transaction costs. A sectoral CDM, therefore, can generate more CERs, reduce transaction costs, and provide significant benefits to underrepresented regions.

Broadening the CDM permits inclusion of sectors which are not yet covered by the Kyoto Protocol and related international regimes: i.e. aviation, maritime emissions, deforestation avoidance, etc. For example, GHG emissions from deforestation attracted a considerable amount of attention but deforestation in developing countries is not yet covered in the current CDM. Broadening the CDM to include these additional sectors can facilitate participation in mitigation activities from these key sectors and consequently address sectoral inequities in the CDM. Several schemes to address the issue of "reducing emissions from deforestation and degradation (REDD)," including the creation of a separate market (Ogonowski et al. 2007; Environmental Defense 2007), have been proposed and are discussed in detail in Chapter 4.

Promoting developmental benefits of CDM projects through quantifying and preferentially rewarding such benefits — Although one of the primary objectives of the CDM is to contribute to sustainable development in host countries, the majority of CERs come from projects with significant GHG emission reductions but few development benefits (Boyd et al. 2007). To correct this imbalance, a necessary first step is to strengthen the assessment of how a CDM project contributes to sustainable development. Current screening methodologies are based solely on the host country's assessment criteria and approval processes. More often than not host countries do not place a premium on projects with high development benefits or discount those that might conflict with sustainable development principles. Several proposals have been advanced to rectify this situation. For instance, if CDM-EB required that the host

country's criteria for assessing development benefits be validated by a third party, it could compel project developers to be more receptive to securing developmental co-benefits. However, adding extra burdens to the approval process and high transaction costs already evident in the project-based CDM would have to be avoided.

In addition to third party validation, providing greater incentives to consider developmental co-benefits is crucial. As current rules do not compel project developers to seek out projects with the highest sustainable development benefits, the CDM-EB should create an incentive-based framework that would accommodate sustainable development benefits within the existing CDM. Sustainable development co-benefits from CDM projects ought to be quantified and financially supported separately, for example, by ODA, CSR funding or benevolent funds, so that the total value of the projects with significant sustainable development benefits could out-compete those with high CERs alone (Hiraishi 2005). Quantifying the sustainable development benefits of projects and issuing different types of credits for "sustainable" CERs could attract companies that take CSR seriously. Projects with high CERs should be carefully re-evaluated to capture all the sustainable development benefits or to evaluate secondary impacts of CDM (Kolshus et al. 2001). A voluntary standard such as the "CDM Gold Standard" can help in realising sustainable development benefits of CDM.

Self-assessment by project developers using various tools, such as an additionality tool for sustainable development, or an economic internal rate of return with qualitative indicators that capture non-monetary quantitative indicators (Motta et al. 2002) may also be helpful. Another way to ensure that developmental co-benefits are realised is for the COP/MOP and CDM-EB to impose a form of taxation on projects with low sustainable development benefits and then allocate the collected revenue to projects with high sustainable development benefits. Application of a differentiated levy to various projects, depending on their contribution to sustainable development, would help to promote projects with high sustainable development benefits (Muller 2007). Establishing a global point system and ensuring that all projects have to reach a minimum number of points for sustainable development benefits to be accepted by the CDM-EB has also been suggested. A scheme under which certain types of projects in key regions or sectors could gain double or triple CERs while others generating few sustainable development benefits would be awarded half or a third of the number of CERs currently awarded has also been suggested. However, an international agreement on policy-based adjustments to CERs or intentional distortion of the emerging carbon market is not easy to achieve.

(iii) Medium to long term:

Involving developing Asia in schemes to promote low carbon economies — A more conducive domestic policy environment is needed to harness the potential of market mechanisms and FDI to promote a low carbon economy. Domestic developmental, energy and related policies should include provisions to support such market mechanisms. Initiatives to develop local and national allowance-based mechanisms (i.e. local and national ETS) in the Asia-Pacific region would also be beneficial in furthering this agenda. More concretely, the establishment of an Asia-based ETS would ease the process of integrating local, national, and eventually international ETS. In this light, the development of domestic CDM projects such as those being promoted by the Republic of Korea alongside the development of domestic ETS is encouraging as such experience will facilitate carbon trading in the region.

Current estimates of CDM project development suggest that as much as 2.7 $GtCO_2e$ emissions may be reduced by 2012, if all projects in the pipeline are implemented successfully. Although the amount is substantial, it is still far too small to make a significant reduction in the GHG emission trajectories of developing countries. For example, annual fossil fuel based emissions from developing countries are expected to double from the current 10 to 20 $GtCO_2e$ in 2030. Therefore, other types of market mechanisms are needed to complement the CDM. Project-based approaches are not always applicable to many sectors such as transportation and households. To facilitate participation from those sectors, different incentive and disincentive mechanisms must be utilised (e.g. international carbon tax system, promotion of venture capital funds, or payment for ecosystem services). New special funds from multilateral financial institutions, such as the World Bank, will also help to realise the full potential of market mechanisms. Experience gained through operating the Prototype Carbon Fund, Community Development Carbon Fund, Biocarbon Fund, and others needs to be documented and built on. The launch of the World Bank's Carbon Market Continuity Fund (to ensure the value of post-2012 CERs) and Carbon Partnership Facility should stimulate fuller utilization of market mechanisms for climate protection.

There has been a dramatic expansion of voluntary carbon markets and the trend is likely to continue in the future (box 2.5). Expansion of these markets is due to the heightened awareness of individuals and companies of climate change and the consequent willingness to offset GHG emissions from their activities through the procurement of voluntary carbon credits. Voluntary carbon offsets may be used to transfer resources that will allow communities to leverage benefits locally. If the voluntary market is to continue to grow, however, minimum institutional arrangements should be put in place to enhance its credibility. Environmental education or other awareness raising measures will also help the market's development.

The Chicago Climate Exchange (CCX) held its first auction of CERs in September 2007. The auction was for 163,784 CERs issued by the UNFCCC to a wind energy farm in western India The clearing price was $22.11 per tCO_2e, which was $1.00-$3.00 less than the CER futures contract price in Europe. The sale was a clear indication that the CCX is expanding to include more options for buyers than its voluntary emissions reduction (VER) dominated market. Likewise, some airline companies have begun to launch carbon offset schemes linked to CDM. For example, British Airways launched a scheme in January 2008, allowing customers to offset GHG emissions from their air travel by funding clean energy projects developed under CDM.

Several ideas may be considered to improve the cost-effectiveness and the environmental integrity of market mechanisms in Asia. For example, CDM could be abolished after 2012 to be replaced by another mechanism, if it is proved that the CDM did not lead to net global emission reductions. Likewise, selected sectors or countries may be retired from CDM (CDM sunset) to promote CDM in other sectors and countries, which have not benefited from CDM to date. Premium emission budgets could ensure full access to the carbon market in return for voluntary commitments from developing countries (Environmental Defense 2007). In this scheme, any reduction in emissions below current levels would be tradable, and reductions not sold during the premium budget period can be banked for the future. Another variant—value-added CDM on demand and supply sides—was also suggested. For value-added CDM on the demand side, an entity in an Annex I country has to retire 10 CERs for every 100 CERs bought from developing countries. Similar value-added ratios worked well under the US Clean Air Act. Value-added CDM on the supply side enables major developing

Box 2.5. Development of voluntary carbon markets

Recently the voluntary carbon market has grown dramatically, although it is still a small fraction of the size of the regulated markets such as CDM and JI. In 2007, a total volume of 65 $MtCO_2e$ with a value of $331 million transacted in the voluntary carbon market, which represented a tripling of transactions in 2006. Asia's share of projects in the voluntary market increased from 22% in 2006 to 39% in 2007. The price for credits showed a huge variation, ranging from $1.80 per tCO_2e to $300 per tCO_2e (Hamilton et al. 2008).

The buyers of voluntary market credits are typically individuals that wish to offset lifestyle-related GHG emissions (residential energy use, commuting, travel), consumer-oriented companies that wish to offset operational-related GHG emissions, and high emitting companies that wish to voluntarily offset GHG emission that they cannot easily reduce through changes in their production processes (World Bank 2007). For companies, there are numerous drivers behind their involvement in the voluntary market, but CSR and familiarity with the market in anticipation of it being incorporated in the future climate regime appear to be the most important.

The voluntary market also has some unique features that distinguish it from the CDM. Chief among these is that the voluntary market covers projects from underrepresented sectors. A recent survey, for instance, found that forestry projects accounted for 36% and RE projects account for 33% of total projects. The predominance of forestry credits is derived from not only the regulation of the compliance market (i.e. rules of CDM and EU-ETS) but also perceived sustainable development benefits of these projects, which many voluntary buyers find attractive (Hamilton et al. 2007).

While these are encouraging signs, the credibility of the voluntary carbon market must be enhanced if it is to have more than a modest impact. To do so, the markets would need to introduce uniform standards of voluntary credits and verification from independent third parties that funds were actually used for their intended purposes. The current lack of a universally acceptable voluntary standard for emission reduction seems to be a significant impediment to the voluntary market's further expansion (World Bank 2007). Several promising standards have already been proposed, such as the Gold Standard by 51 NGOs/ charitable organizations and the Voluntary Carbon Standard by the International Emission Trading Association (IETA).

economies to apply the value-added ratio to their own CERs, and withhold a portion of CERs from the market. Putting quantitative limits on CER imports by Annex I countries was also suggested as a means to force Annex I countries to realise emission reductions within their own borders.

4.4. Implementing policies with multiple climate and developmental benefits, and measures to realise a low carbon society in the future

4.4.1. Developmental co-benefits in Asia

There is a heightened interest in making GHG mitigation strategies compatible with national sustainable development priorities. Policies that can concurrently mitigate global and local pollutants are sought. Rather than exclusively targeting the abatement of GHGs, integrated policy measures promise to deliver "co-benefits" (implied in Nordhaus 1991; estimated in Ayres and Walter 1991; explained in Krupnick et al. 2000). Co-benefits are the locally desirable and additional sustainable development benefits (e.g. improved air and water quality, enhanced energy security, reduced land use impacts, reduced congestion, improved traffic safety, increased income to rural communities, protection and preservation of biodiversity) that would accompany climate actions in various sectors such as transportation, agriculture, forestry, industry and infrastructure.[18]

Some co-benefit studies have shown that the benefits of climate actions can reach more than 2% of GDP in cities such as Beijing (He 2003).[19] Such co-benefits can offset the costs of even aggressive climate measures, and do so by a wide margin. Unfortunately, co-benefit studies in Asia have been limited to analytical inputs for a handful of policy decisions (IGES 2007). To promote the linkage between sustainable development co-benefits and climate change actions, the following measures should be considered.

(i) Raising awareness of developmental co-benefits

In the short term, policymakers in Asia should become more cognizant of the linkages between sustainable development and GHG mitigation, especially in Asia's rapidly growing (e.g. energy, transportation, commercial buildings) and climate-sensitive (e.g. water, agriculture, land use/land use change/forestry) sectors. Underlying the lack of awareness is the widely held misperception that mitigating GHGs is incompatible with sustaining development. This misperception needs to be changed soon.

Fortunately, the misperception should be easy to correct in developing Asia. Numerous integrated sustainable development policies and measures already exist in the region. Many of these integrated policies deliver non-health co-benefits. That is, rather than simply improving air quality and public health, they also make other contributions to local and national development. For instance, China has introduced a total emissions control plan that is intended to mitigate sulphur dioxide, lessen the impacts of acid rain, and boost crop yields; the total control plan, if implemented effectively, will also reduce carbon emissions (Aunan et al. 2007). The Philippines Clean Air Act could reduce traffic congestion and commuting times, in addition to mitigating GHGs (Subida et al. 2004). Co-benefits can come from a wide range of measures, including but not limited to (i) EE, RE and energy conservation policies; (ii) land use and community forestry practices; and (iii) sustainable transportation and fuel efficiency initiatives.

Policymakers must not only become aware of co-benefits but also realise that measures to mitigate GHGs lie at the core of many of the developmental challenges confronting the region. This conceptual shift will require both a heightened appreciation of co-benefits and a broadening of the concept. Because most studies rely on methods

that estimate health-related co-benefits (focusing on the link between improved local air quality and various health endpoints), non-health endpoints such as improved energy security and technology transfer have been underemphasised in co-benefit research. New techniques for estimating sustainable developmental benefits need to be developed. Policymakers need to be encouraged to consider the full range of benefits (and costs) that flow from climate actions.

Expanding the concept of co-benefits will not only raise awareness, but also help to situate co-benefits in a wider range of policy debates and lead to a greater consideration of climate benefits in sustainable development planning. Mainstreaming co-benefits into sustainable development planning would also reduce the risks of climate plans being "orphaned," or relegated to a single ministry with insufficient leverage.

(ii) Building institutions to recognise and reward co-benefits

In the medium term, national and international institutions are needed to scale-up co-benefits and overcome barriers to implementing integrated policies. Limited administrative capacity, inter-agency coordination problems, and opposition from vested interests—the same barriers that undermine the implementation of regulatory initiatives in much of the developing world—may also frustrate the realization of co-benefits (Janicke and Weidner 1997; Desai 1998; Pearce 2000).

Some effort to overcome these barriers might be taken at the national level. As domestic policymakers become more familiar with developmental co-benefits, they may consider constructing databases of integrated policies, such as the one being developed by the World Resources Institute (WRI 2008), and devising nationally-suitable metrics to assess the sustainable developmental contribution of these policies. However, much of the impetus for these international efforts should come from a post-2012 climate regime that recognises and rewards co-benefits. In building such a regime, climate negotiators should review the operational features of bottom-up post-2012 regime proposals such as the SD-PAMs (table 2.13) that would enable developing countries to pledge integrated policies (Winkler et al. 2002; Baumert and Winkler 2005; South Africa 2006). Climate negotiators should consider building a standardised set of tools and procedures to estimate the value of co-benefits into the post-2012 regime (such as the IISD developmental dividend, the CDM Gold Standard, or the UNEP Risø Centre COSI tool) (Cosbey et al. 2006; CDM Gold Standard 2007; Olsen 2007). Consideration of these tools and procedures should take into account the tension between using rapid assessment techniques to scope the development benefits of integrated policies against more rigorous methods for measuring these benefits. A possible resolution to this tension would be allowing national policymakers to conduct a preliminary evaluation of developmental benefits with less rigorous scoping methods and then delegating authority to a certifying body within the UNFCCC to use more rigorous evaluation techniques if initially scoped estimated benefits prove controversial.

Table 2.13. Step-wise implementation of SD-PAMs in an international climate framework

1	Country outlines future development objectives.
2	Identification of PAMs to achieve development objectives more sustainably. PAMS may be new policies or policies that are not fully implemented.
3	Mobilise investment and implement SD-PAMs.
4	Recording SD-PAMs in a registry (e.g. maintained by the UNFCCC secretariat).
5	Setting up a national monitoring system to track the implementation of SD-PAMs.
6	Review of SD-PAMs in SD units, either as part of a NC or a specific review.
7	Quantifying the changes in GHG emissions from individual PAMs.
8	Identifying PAMs with synergies or conflicts between sustainable development benefits and GHG mitigation.
9	Summarizing the net impact of SD-PAMs on development and GHG emissions.

Once co-benefits are reliably measured, they should be rewarded. Policymakers and climate negotiators should consider incentives that are most likely to help overcome the barriers to achieving developmental benefits. Three kinds of incentives are likely to prove most attractive: (i) finance to support the implementation of pledged policies (through a sectoral or policy-based CDM); (ii) access to low carbon technologies to enhance the effectiveness of pledged policies (both within and outside the UNFCCC); and (iii) capacity building to better assess, develop, and implement pledged policies (with possible support from ODA or GEF). Arguably more important than the type of incentive is whether access to finance, technology, or capacity building should be pegged to the quantity of the co-benefits or the quantity of GHG reduced from a policy or some combination of both. A resolution to this sticking point is to borrow an approach from China's current CDM programme that taxes CERs from projects with low developmental benefits and then supports other development-oriented projects. Along similar lines, levies from projects with low developmental benefits can be collected at the international level and allocated to countries that implement policies or projects with high developmental but low carbon benefits. Policies that fail to deliver any climate benefits would have to seek funding or support from domestic governments or from multilateral financial institutions.

While undertaking these changes, climate negotiators should also prepare for the increased monitoring and enforcement costs in the post-2012 climate regime. These costs are likely to stem from the difficulties of establishing baselines, determining leakage and double counting, and comparing ex-ante and ex-post evaluation of development benefits. As with a sectoral or policy CDM, there will also have to be appropriate actions to ensure that the influx of CERs does not lead to a dramatic drop in CER pricing. With this end in mind, these new arrangements should be piloted and phased in gradually, beginning with voluntary pledging and preliminary measurement and rewarding of co-benefits. Due to the significant untapped gains from these policies, developing countries in Asia should be particularly interested in participating in the pilot phase. Both the arrangements that recognise co-benefits and the structures that reward co-benefits should be adjusted at predetermined future times before a mandatory programme is established.

(iii) Integration across MEAs

In the long term, efforts must be intensified to identify and strengthen linkages between the co-benefits arrangements in the climate regime and other MEAs such as the CBD and the UNCCD. This institutional integration could also increase funding for policies aimed at co-benefits and facilitate the harmonisation of methods for measuring the multi-dimensional impacts of climate policies. Integration with MEAs might also prove useful for considering the co-benefits of adaptation policies, which will become increasingly relevant as the adverse impacts of climate change become more apparent in Asia.

The ultimate goal, then, would be to work towards a more and more expansive institutional framework that can systematically but simply account for the co-benefits (and co-costs) of mitigation and adaptation actions. The impetus for this framework should begin with a growing awareness of co-benefits and expansion of the co-benefit concept. Subsequently, international (and possibly domestic) arrangements and structures that recognise and reward countries for their co-benefits can be gradually scaled up. Integration across multiple regimes should demonstrate that policies that are good for the global commons are also good for local development.

4.4.2. Low carbon economy

Establishing a low carbon society (LCS) is urgent in Asia where GHG emissions are increasing rapidly due to high economic growth and increasing demand for energy. Although traditionally Asian societies adopted many low-carbon pathways of development including frugal lifestyles, current trends and projections suggest future development patterns with a large carbon footprint. It is practically impossible for developing Asia to follow the same historic growth patterns as the US, Europe and Japan, and thus there is a need to find different growth models to establish a LCS. In IGES consultations on the post-2012 climate regime, several stakeholders stressed that the design of the future regime should aim to change energy-intensive lifestyles and consumption patterns, and consider a new set of carbon standards to promote such a transition in all countries.

The core of a low-carbon economy is EE and a clean energy structure. The LCS 2050 project of the National Institute of Environmental Studies (NIES) in Japan and other similar projects suggest that the reduction of global GHG emissions by 20% by 2030 and 50-60% by 2050 or even 80% by 2100 is possible provided rapid transformation of social, industrial and economic systems takes place in the medium to long term. For example, a 70% reduction of CO_2 emissions by 2050 (compared to 1990) is feasible in Japan if a 40-45% reduction in energy demand is combined with a decarbonization of energy supply. Reductions in energy demand of 20-40% in industry (through structural changes and introduction of energy conservation technologies), 80% in passenger transport (through appropriate land use and EE improvement), 60-70% in freight transport (through controls on the distribution system and improved EE of cars), 50% in the residential sector (through high thermal insulation housing) and 40% in the commercial sector are plausible. The expected cost of introducing the enabling technologies amounts to only 1% of GDP in 2050 in Japan (NIES 2007)[20]. The same study found that the introduction of ETS and a carbon tax would not be enough to achieve a LCS in Japan.[21, 22]

It is important to identify which policies and measures need to be realigned to achieve a LCS in Asia. Some national models for a low carbon economy (e.g. Norway, Iceland)

are possible where hydropower or geothermal power is a major source of electricity. Iceland, for instance, intends to become the world's first hydrogen economy by 2050. To visualise similar low carbon futures in the Asian context, national energy strategies need to be based on a thorough reassessment of alternative energy potential through a comprehensive inventory of natural resource endowments. Most Asian countries, however, have not yet mapped the full potential for wind, solar, or geothermal energy sources and have only made limited efforts to exploit such sources. In this light, the recently announced "Cool Earth Promotion" initiative by the Government of Japan, which calls for the development and dissemination of 21 specific innovative technologies by around 2030, and a global goal of improving EE by 30% by 2020, can contribute greatly to the achievement of low carbon economy in Asia.

In Europe, EE gains in transport, industry and building sectors, decarbonisation of power generation through increased deployment of renewable sources, natural gas, and coal with CO_2 capture and storage, and increased use of renewable sources of energy including biofuels for transport, are some of the measures identified to move towards a low carbon pathway. Similar policies and measures need to be examined for their potential deployment in developing Asia depending on national circumstances. Reducing global emissions by 50-60% by 2050 at acceptable costs will require innovation in science and technology to make clean energy technologies more efficient and affordable. As deploying technologies such as solar, wind, biofuels, hydrogen and carbon capture and storage will be most crucial in Asia, technology development partnerships should be formed through the infusion of public funds. Stern (2007) recommended doubling the aggregate amount of public funds devoted to energy R&D to reach about $20 billion per year.

Strategic regional cooperation, through effective investments, policies and measures to improve EE and promote RE, will play a key role in establishing a LCS in Asia. To encourage a shift in the direction of EE and RE sources, greater attention should be directed to bilateral and multilateral development assistance. The role of developed countries such as Japan and other G8 economies and multilateral financial institutions such as the World Bank is crucial to accelerating the transition to a low carbon economy. Leveraging such investments with private resources is also essential.

Developing Asia receives substantial bilateral assistance for energy, with 14 Asian countries among the top 20 recipients of bilateral development assistance for energy. Japan, which has provided a large portion of annual energy assistance of about $6-7 billion for the past 7 years, is well placed to provide leadership by mainstreaming EE and RE projects in its development assistance portfolios. Likewise, ADB could double annual investments in its Energy Efficiency Initiative from the current level of $1 billion. A recent proposal by Japan, the USA and the EU to create a new body to promote energy conservation measures within the International Energy Agency (IEA), and Japan's announcement to invest about $30 billion over the next 5 years in R&D in the energy and environment sectors will also be useful.

Addressing climate change in the next 25 years will require significant changes in the patterns of investment and financial flows. Assuming emissions reduction by industrialised countries will be on the order of 60-80% of their 1990 emissions by mid-century, half of which are anticipated to be met through investment in developing countries, emission reduction purchases of up to $100 billion per year can be estimated (UNFCCC 2007). The infrastructure component of current ODA amounts to only 0.2%

of total investment, reaching 22% if FDI is included (UNFCCC 2007). Current ODA levels for infrastructure will not be enough to develop the infrastructure necessary for a LCS. Therefore private sector funds will be crucial in the long-term. IEA estimates that as much as $20 trillion would be required for global energy investment by 2030, of which $10 trillion is expected to flow to China, India and Brazil.

Only low carbon supply options are compatible with a carbon-constrained world. Several solutions to create a LCS are within Asia's reach. Policymakers and politicians will need to show leadership by moderating the growth of GHG emissions in the near term and putting in place a comprehensive plan of action for changing the emissions trajectory by 2012.

5. Conclusions

The science and economics of climate change have advanced considerably since the establishment of the IPCC in 1988. Likewise, the global discussions on climate change have moved forward significantly since the adoption of the UNFCCC in 1992. However, progress in aligning climate actions with sustainable developmental strategies has been slow and inadequate at the global level and particularly in Asia. It is now widely understood that climate policy alone will not solve the climate change problem. Climate outcomes are influenced not only by climate-specific policies but also by the mix of development choices made and the development paths along which these policies move forward (IPCC 2007). Therefore, the most promising route to stabilizing emissions from the region will involve formulating and implementing climate-friendly developmental policies.

As climate change is set to reverse decades of social and economic development across Asia, there is no other region that would benefit more from the alignment of climate and development actions. The additional costs incurred in such alignment, if any, must be viewed as an insurance policy against the potentially severe consequences of unchecked GHG emissions in the region. The time for action is now and countries in Asia need to make the right choices for sustainable development—particularly development that enhances the adaptive capacity of Asian populations and development with minimal growth in GHG emissions. The choices range from more effective participation in the future climate regime to developing a decarbonised society based on a new energy paradigm.

Beyond the four priorities discussed above to realise the vision of a low-carbon climate-resilient Asia, two additional characteristics should be evident in Asia’s future climate policies. First, climate policies should retain the flexibility needed to accommodate the continually evolving nature of climate change. Second, policies should be firm enough to withstand opposition from vested industrial interests. In this connection, it is important to mobilise constituencies that are significantly sensitive to climate change (e.g. forestry, agriculture, fisheries, water) to offset the interests of other industries. Striking a balance between flexibility and firmness—crafting a resilient climate policy—will be a challenge, but it can be addressed with strong political will and concerted action at multiple levels. It will require additional research on new mechanisms that enable the switch from dirty to sustainable development, and on ways to realise a sustainable development paradigm that fully integrates climate concerns. Perhaps more consideration should be given to

enhancing the role of the financial and investment agencies to favour climate-friendly development. Further research on climate change insurance (especially the assessment and actual implementation of insurance products in developing Asia), and low carbon technologies and technology policies relevant to natural resource endowments in Asia is also necessary. Enhancement of research capacity for integrated assessment modelling of impacts and for determining the costs of climate action and inaction at the national and local levels is also crucial.

While the current development patterns in Asia have thus far emulated unsustainable patterns in developed countries, the region does not have to (and cannot) continue along this same trajectory. Since much of Asia's energy and material infrastructure will be built in the near future, regional policymakers should pursue an alternative low carbon developmental path. In China's building sector, to cite an area where such potential exists, approximately half of the building stock will be constructed over the next 15 years. When estimates like these are projected across multiple sectors and countries the implication is clear: not only will it be imprudent for Asia to follow the same development path as industrialised countries, but there are opportunities for leapfrogging to a lower carbon developmental trajectory if an appropriate mix of policies is adopted and implemented.

A step toward capitalising on this opportunity would be the establishment of medium and long-term developmental goals and targets which integrate climate change goals and targets for the next 20 to 50 years. Recent events seem to point in this direction. Japan, for instance, proposed a global target of halving GHG emissions by the year 2050. China released its National Climate Change Action Plan, which reiterates previously made pledges to improve energy intensity, expand the use of RE, and increase forest coverage, although it does not commit to specific long term emission targets. India plans to release a similar national plan in 2008. There are growing indications that countries in Asia are prepared to take a proactive stance in global climate negotiations. Asia is poised to take the lead in shaping a new world developmental order that duly reflects the challenges presented by climate change.

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Endnotes – Chapter 2

[1] The proportion of Asians who live in urban areas has increased from 30% in 1990 to 38% today, and is projected to rise to 50% by 2030.
[2] Large scale expansion of household electricity access is underway in many countries, most notably in India, the Philippines, Bangladesh and Sri Lanka. In 2005, India, which accounts for nearly one third of the 1.6 billion people worldwide without electricity, is reported to have connected 4 million households. Rural electricity access in Vietnam is reported to have increased from 51% in 1996 to 88% in 2004. Overall energy demand for the Asia and Pacific region is expected to more than double from 1997 to 2020. All these changes are accompanied by increased GHG emissions.
[3] More than 70% of Asia's energy comes from fossil fuels, the majority of which is coal-based.
[4] As rising temperatures cause glaciers to melt, the accumulation of water places strains on moraines (ice dams) and increases the likelihood that they will be breached. Glacial lake outburst floods have increased in frequency in the Himalayas in the latter half of the 20th century. See Germanwatch, *Glacial Lake Outburst Floods in Nepal and Switzerland: Glacial Lake Outburst Floods*, 2004, http://www.germanwatch.org/download/klak/fb-gl-e.pdf.
[5] Wetlands International estimates that Southeast Asia's peat lands store 42,000 million tonnes of carbon.
[6] For low income countries, natural disasters can cost an average of 5% of GDP.
[7] Sea levels are projected to rise from 3 to 16 cm by 2030, and from 7 to 50 cm by 2070. The estimates do not account for potential contributions from melt of the ice sheets of West Antarctica or Greenland, which could contribute to sea-level rise of approximately 5 and 7 metres, and intensified storm surges.
[8] These figures capture costs that are not captured in the Stern model mean level estimates, such as (i) disproportionate impacts on poor and vulnerable communities; (ii) unpredictable and extreme non-linear events (weather and natural resource crises); and (iii) continued emission increases that raise temperatures (and heighten the risks of mass migration).
[9] The data for this category—"estimates that do not reflect the full range of costs"—is only reported for India, Southeast Asia, and Africa. To arrive at estimates for only India and Southeast Asia, the proportion of the people from India and Southeast Asia from the full range of costs category (100/145=0.68) is multiplied by the reported "not reflecting the full range of costs" figure for India, Southeast Asia, and Africa (35 million). 35 million x 0.68=24 million.
[10] These estimates reflect what would occur if there are amplifying feedbacks in the climate system.
[11] The data for this category—"estimates that do not reflect the full range of costs"—is only reported for India, Southeast Asia, and Africa. To arrive at estimates for only India and Southeast Asia, the proportion of the people from India and Southeast Asia from the full range of costs category (150/220=0.68) is multiplied by the reported "not reflecting the full range of costs" figure for India, Southeast Asia, and Africa (50 million). 50 million x 0.68=34 million.
[12] "No regret" options are steps to reduce GHGs that would pay for themselves even without a climate change policy (Pew Centre). "Win-win" measures are options that are advantageous or satisfactory to all parties involved (Webster).
[13] The plan includes targets for wind (30 GW), solar power PV (1.8 GW), biomass power (30 GW) and small hydro (80 GW).
[14] Decisions adopted by the Nineteenth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer (Advance, untitled edition). 2007.
http://ozone.unep.org/Meeting_Documents/mop/19mop/MOP_19_ReportE.pdf
[15] This shortcoming is also partly related to the lack of emphasis on the role of private sector in coping with the impacts of climate change. In contrast, the role of the private sector in mitigation was more evident.
[16] http://ocwr.ouce.ox.ac.uk/research/wmpg/cvi
[17] http://maindb.unfccc.int/public/adaptation/ The database on local coping strategies at the UNFCCC is intended to facilitate the transfer of long-standing coping strategies/mechanisms, knowledge and experience from communities that have had to adapt to specific hazards or climatic conditions to communities that may just be starting to experience such conditions as a result of climate change.
[18] Ellis offers a more complete classification scheme, noting that co-benefits can be direct and indirect; can be company-specific, local, regional, national, and global; and they can flow to project developers or local governments. (Ellis 2007).
[19] Similar figures are cited from other studies in Asia. A study using data from Shanghai shows that health loss arising from air pollution was equal to 1.6% of GDP in 2000 (Kan et al. 2004).
[20] NIES "Japan Low Carbon Society" scenario team. 2007. Japan Scenarios towards Low-Carbon Society (LCS)-Feasibility study for 70% CO_2 emission reduction by 2050 below 1990 level. February 2007. http://2050.nies.go.jp/interimreport/20070215_report_e.pdf
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Part II