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ADB-ADBI Study on Climate Change and Green Asia

POLICIES AND PRACTICES FOR LOW-CARBON GREEN GROWTH IN ASIA

Highlights

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Acronyms

ADB	Asian Development Bank
ADBI	Asian Development Bank Institute
APP	Asia-Pacific Partnership on Clean Development and Climate
ASEAN	Association of Southeast Asian Nations
CAREC	Central Asia Regional Economic Cooperation
CCS	carbon capture and storage
CDM	Clean Development Mechanism
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CP3	Climate Public Private Partnership
DFID	The Department For International Development
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
FDI	foreign direct investment
FIT	feed-in tariff
GMS	Greater Mekong Subregion
GRT	generation rights trading
Gt	billion metric tons
IEA	International Energy Agency
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IPR	intellectual property rights
MDGs	Millennium Development Goals
MRV	measurement, reporting and verification
Mt	million metric tons
ODA	official development assistance
OECD	Organization for Economic Co-operation and Development
PAT	perform, achieve and trade
PRC	People's Republic of China
R&D	research and development
RECs	renewable energy certificates
REDD	Reducing emissions from deforestation and degradation
RPS	renewable portfolio standards
SAARC	South Asian Association for Regional Cooperation
SMEs	small and medium enterprises
TRIPS	trade-related aspects of intellectual property rights
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change

1 Introduction: Why Low-Carbon Green Growth for Asia

Asia is at a crossroads. The pursuit of growth has been for several decades and remains today the single most important policy goal of emerging Asian countries. With higher economic growth rates, emerging Asia is increasingly moving towards becoming a middle income region. This fast-paced economic growth has been accompanied by high rates of material and energy consumption. Resource extraction[1] for economic use rose from 9 billion tons in 1985 to 13 billion tons of resources in 1995, and further leapt to almost 18 billion tons in 2005. The growth of resource use in Asia has been much faster than the global average. This increasing share of resources extraction, pollution and carbon dioxide emissions have been characteristics of the ongoing industrialization process of Asia. Despite all the achievements and short-term prosperity, policymakers within and outside the region agree that, in the long run, this type of development, without due regard to social inclusiveness and the environment, is not sustainable. But there also remains, as a neglected challenge, in spite of past economic growth and success, the fact of 675 million people living in Asia who still do not have access to clean fuels for cooking and heating, and millions of people who do not have access to electricity.

How close are the emerging economies of Asia to turning their aspirations of low-carbon green growth into a reality? What national and sectoral experiences currently exist? What policies, institutional and financial factors currently accelerate or inhibit a shift towards resource-efficient green growth? What is the potential for technology diffusion, financing and regional cooperation to become drivers for future economic growth? This book aims to answer these questions, reviewing the low-carbon and green policy initiatives taken by Asian countries at a national, sectoral and local level and assessing the achievements made while identifying gaps and examining the new opportunities for low-carbon green growth. Building on this thorough analysis, the book also presents key conclusions and recommendations for policymakers in the region.

This book is based on the recognition that low-carbon green growth is an imperative, not a luxury, for developing Asia. Heavily dependent on imported resources and energy, the emerging economies of Asia are already embarking on the application of a new sustainable development paradigm that brings competitiveness to its industries and serves growing green technology markets. Asia's current policy experiences and aspirations for tackling climate change through multi-sectoral, multi-level approaches demonstrate that there are benefits in the short term as well as the medium and long term. Capacity limitations critically

1 In general, four major types of resources are considered (i) materials such as .steel, iron ore; (ii) biomass from agriculture, forestry, fishery, and biomass products; (iii) Fossil energy carriers (such as coal, oil, gas, peat), used for energetic and non-energetic purposes; and (iv) minerals -industrial and construction minerals and mineral products such as glass or natural fertilizers.

restrict the degree to which countries can take advantage of these opportunities, however. The task for Asia and the goal of this study is to spread and disseminate the actions of some Asian countries to other developing nations, while widening and deepening actions in the leading economies, by learning and sharing their experiences and lessons. Contributions are required not just from environmental policy, but also from finance, industry, trade, science, technology, governance and other policy areas.

The book focuses on the emerging economies of the People's Republic of China (PRC), India, Indonesia, Thailand, Viet Nam and Singapore, with Japan, the Republic of Korea and Australia as reference cases (Table 1). This book analyses low-carbon green growth strategies in the broader development context of Asia, and focuses on climate change mitigation rather than adaptation, pollution control or the theory of policymaking. Readers are encouraged to refer also to the recent publication "Green Growth, Resources and Resilience: Environmental Sustainability in Asia and the Pacific" for its focuses on resource efficiency.

Table 1: Economic, Social and Emissions Indicators for Developing Asia in Context

	Population (billions)	**% Population <$2 a day**	**GDP** (trillion)	**Cumulative CO_2 Emissions (1895–2008)** (Mt CO_2e)	**CO_2 emissions** (metric tons per capita, 2007–2011)	**Carbon growth rate from between 1990 to 2010** (%)
People's Rep. of China	1.39	36	10.10	113,144	5.3	65.0
India	1.17	75	4.20	30,362	1.5	60.4
Indonesia	0.24	51	1.03	7,35	1.7	63.2
Thailand	0.07	27	0.59	4,175	4.2	66.5
Viet Nam	0.09	38	0.28	1,761	1.5	83.2
Japan	0.13	0	4.33	46,866	9.5	9.4
Australia	0.02	0	0.87	13,456	18.6	28.0
Rep. of Korea	0.05	0	1.42	10,836	10.5	52.1
World	6.86	–	76.30	1,465,852	4.8	30.7

Source: World Bank (2011), IEA 2011, CIA 2011.

Notes: Gross domestic product (GDP) is adjusted for purchasing power parity and measured in international dollars (see World Bank 2011 for further details). All data are current unless other-wise specified. GDP growth projections originate from the International Monetary Fund and are adapted from IEA (2011). '% population <$2 a day' indicates the percentage of a country's population estimated to live off $2 dollars a day, adjusted for purchasing power parity.

1.1 Low-Carbon Green Growth is Imperative

Low-carbon green growth is a pattern of development that decouples economic growth from carbon emissions, pollution and resource use, and promotes growth through the creation of new environment friendly products, industries and business models that also improve people's quality of life. Thus, low-carbon green growth entails (i) using less energy, improving the efficiency with which resources are

used and moving to low-carbon energy sources (ii) protecting and promoting the sustainable use of natural resources such as forests and peat lands (iii) designing and disseminating low-carbon technologies and business models to reinvigorate local economies and (iv) implementing policies and incentives which discourage carbon intensive practices.

Global climate change and the growing rate of emissions are among the most daunting aspects of the crisis precipitated by the traditional development model. Scientists warn us that climate change, if emissions are allowed to grow unchecked, could become catastrophic in nature, and even at lower levels will threaten economic growth, if countries around the world, including emerging Asia, do not change their carbon-intensive developmental course. Developed countries, comprising only 20% of the global population, developed during a period of high fossil fuel and resource consumption. Now the rest of the world also seeks to improve economically. However, if the other 80% of the world population – most of whom are living in Asia - modernizes in the same way as the developed countries did, the costs will become insurmountable for all countries. Moreover, the poor populations of emerging Asia are also likely to suffer disproportionately from the adverse impacts of climate change.

There is a scientific consensus that to limit the rise in global average surface temperature to 2˚Celsius, which climate scientists believe marks the limit of safety, beyond which climate change becomes catastrophic and irreversible, then global carbon emissions must peak around the year 2020, followed by dramatic declines in global emissions of 2% per year. In short, there is simply not enough room within that target for all emerging economies to continue to grow in the old model of development.

1.2 Low-Carbon Green Growth is Feasible

Addressing climate change, poverty, the depletion of resources and energy security concerns will be a central developmental challenge for emerging Asia. Among them, climate policy is the most important environmental policy area, and so it is vital to ask to what extent climate policies could help to reduce energy use, poverty and resource use as well as increase productivity – or, in other words, to what extent could emerging Asia's other developmental policies contribute to the avoidance of dangerous climate change? The amount of CO_2 a country emits into the atmosphere depends on a wide range of factors, including the size of its economy, the level of industrialization, and the efficiency of its energy use, as well as population, lifestyle choices and land use changes. As a consequence of rapid and carbon intensive growth, the Asian region has been fast becoming a major source of greenhouse gas emissions.

The transition to a low-carbon economy is benefitting emerging Asia in at least four ways:

- Many low-carbon interventions have important co-benefits for Asia at different levels, including the enhanced energy security associated with

energy efficiency (on both the supply and demand side) and renewable energy projects; the human health benefits from interventions that reduce air pollutants, such as those from transport; and the environmental benefits that can be achieved through forestry and agricultural management, waste reduction programs and employment programs.

- Numerous "low hanging – no-regret" low-carbon interventions, which have positive economic rates of return and short pay back time and should be undertaken irrespective of climate change considerations, can contribute substantially to the economic development of emerging Asian countries.
- Asian countries that pursue low-carbon development, including the transfer of financial resources through the carbon market and new public programs that support the reduction of emissions are likely to reap strategic and competitive advantage at the regional and international levels.
- Because the emerging countries of Asia are likely to suffer disproportionately from the impacts of climate change (drought, increased severity of tropical storms, sea level rise, etc). Asia has a strong interest in becoming a leading participant in global efforts on both emissions reduction and adaptation.

1.3 Low-Carbon Green Growth is Attractive

Low-carbon green growth is a unique opportunity to invest in change. Many analysts believe that the sooner emerging Asian countries take advantage of low-carbon green growth, the better it will be for their long-term development prospects, economic restructuring and their quest to find new drivers of growth. Even though the transition to a low-carbon green growth paradigm is a long term process, the following years are crucial for Asia to seize the economic, social and environmental opportunities, gain competitive advantage and show global leadership through regional cooperation.

As emerging Asia positions itself to take advantage of low-carbon green growth opportunities, some of the key gains that can be expected are:

- Low-carbon green growth will become more important as countries seek to take a pro-poor, pro-employment economic development path based on innovation.
- Emerging Asia will have real social gains in the low-carbon green growth process by involving local communities to promote equity and fairness, along with improved air quality and other eco-system services.
- Emerging Asia will become a leader in key green technologies and business models, and an important destination for the commercialization of key low-carbon technologies, green products and services.
- Emerging Asia will adopt stringent and wide-reaching resource efficiency standards, penetrating all sectors of the economy to bring international competitiveness to its industries.

- Emerging Asia will have made real gains in energy security and resource efficiency, by creating an enabling policy architecture, both domestic and international.
- Emerging Asia will be able to sweep away the short-term developmental thinking that has plagued the past several decades and replace it with paths delivering development that flourishes within ecological limits.

2 Tackling Climate Change and Accelerating Low-Carbon Green Growth – the Asian Renaissance and the Scale of the Challenge

Recent estimates suggest that Asia accounts for 27% of the world's energy-related emissions and this proportion is likely to increase to 40% by 2030. Asia's urban population is expected to double by 2050, from the current 1.6 billion people living in urban centers. This urbanization will be accompanied by a sharp increase in energy use and demand for individual ownership of vehicles and a continued reliance on fossil fuel and energy intensive industries. The announcement in 2007 that the PRC surpassed the United States (US) as the world's biggest carbon emitter is part of a general picture that the region has become and will continue to be a major source of emissions.

Decoupling emissions from economic growth requires a fundamental and wide-ranging response encompassing the public and private sector, targets and regulations as well as deep investment. This is the challenge that confronts emerging Asian economies today, especially PRC, India, and countries within ASEAN. However, there is reason for optimism. These economies have successfully made the transition from least developed to middle income, showing that such a transition is possible under the right circumstances and the correct policies. Within Asia, experiences suggest that it is possible to make development efforts that facilitate growth and poverty eradication, which are also environmentally sustainable. Such a development path needs to be increasingly based on harnessing the co-benefits to tackling climate change.

2.1 Climate Change and Development: The Policy Nexus

Climate change, green growth and poverty are related. Climate change will have severe negative impacts that will exacerbate poverty and hinder development; but development will reduce poverty and increase the region's adaptive capacity. At the same time, development if carried on in a high carbon fashion will lead to increased carbon emissions that will eventually cause climate change and so exacerbate the ill effects of poverty, in a vicious circle. But low-carbon green growth provides an alternative – the potential for a virtuous circle creating increasing access to energy among the poor, generating new green jobs and boosting the economy, while reducing the greenhouse gas emissions that lead to climate change.

Poverty reduction remains the foremost goal in emerging Asian countries. Policy development and international negotiations on carbon emissions cannot be isolated from the larger and more pressing issue of poverty. The process towards buy-in from emerging economies thus depends on how much it helps them in their development efforts. As such, the Millennium Development Goals

(MDGs) provide a simple, politically acceptable and sufficiently quantitative definition of development. The MDGs have been adopted by countries around the world and are applied in their respective development strategies. The reduction of poverty and attainment of MDG goals requires access to productive resources.

Climate-friendly modern energy can widen access to energy, which is gravely restricted among the poor in many emerging Asian economies. Used as an alternative to traditional fuels, it can also provide green jobs and increase community participation in low-carbon green growth.

2.2 Evolution and Convergence in Asian Perceptions

Recognition of the developmental benefits of reduced emissions started in the 1990s, notably after the risks related to climate change were highlighted in the reports of the Intergovernmental Panel on Climate Change (IPCC). The Kyoto Protocol, adopted in 1997 under the UN Framework Convention on Climate Change (UNFCCC), aims at stabilizing global emissions of greenhouse gas emissions and has been strategically important in establishing an institutional architecture for international cooperation on the mitigation of emissions. In recognition of the costs of the technology that is needed to cut greenhouse gas emissions, a system of carbon trading was instituted under the protocol, called the clean development mechanism (CDM), by which developed countries can meet their carbon reduction targets by funding schemes to cut emissions in developing countries. Wider international cooperation on cutting greenhouse gases would be difficult to conceive, had the protocol and CDM not been in place. Developing Asian countries have a wide variety of national developmental circumstances and this is reflected in the initiatives they are undertaking. Prior to the 2009 climate summit in Copenhagen, many of them held a strong view that each individual country had the right to emit as much as carbon as they wanted. During the Copenhagen negotiations, the emerging economies of Asia committed to reduce their emissions substantially through nationally appropriate, non-binding targets, which are subject to measurement, reporting and verification (MRV).

This was taken forward further at the UNFCCC talks in Durban in 2011, at which Asian governments pushed for cost-effective low-carbon solutions in the power, transport, waste and forestry sectors.

Many initiatives also evolved outside the UN system, such as the Asia-Pacific Partnership on Clean Development and Climate (APP), which is also effective in assisting Asia's efforts to move towards low-carbon green growth. As a response to the global financial crisis, in 2008 the Republic of Korea implemented green growth as the foundation for its five-year plan and allocated 2% of GDP with quantitative objectives for green growth. Japan through its Hatayoma initiative is pushing for an additional 30% energy efficiency gains, starting from its position of already being one of the most energy efficient economies in the world.

2.3 Factors Favoring and Impeding Low-Carbon Green Growth in Asia

Technology

Achieving ambitious deep cuts in emissions and accelerating green growth will require the development and diffusion of technological innovations. However, low-carbon development challenges cannot be met by just applying carbon efficient technologies in niche markets and leaving others unchanged. The development and deployment of beneficial technologies across all sectors will be needed. Key carbon mitigation technologies and practices projected to be commercialized before 2030 include carbon capture and storage, advanced nuclear power, new forms of renewable energy, second generation biofuels, advanced electric and hybrid vehicles. In recent literature, many studies have identified these technologies[2] as key to emissions mitigation strategies. Other studies suggest that it is economically feasible to halt, and possibly reverse, the growth in emissions with currently available technologies in a cost-effective way. This has already been happening in some Asian countries. However, there is a huge gap between the current state of those technologies and what they are expected to deliver. Furthermore, technology innovation should be understood in its broadest sense, encompassing any technology that cuts emissions, preserves the environment, and increases resource efficiency. Emerging Asia has good reason to implement ideas from scratch as many of its factories, infrastructures and buildings are yet to be built, and the market potential for the deployment of innovative technological systems is high. Moreover, the region has the chance to position itself as a front-runner in low-carbon green innovation, to become the most energy and resource efficient region in the world and, in so doing, strengthen its global competitive position. If implemented in the right way, innovation for low-carbon technologies and green services will become a key driver of growth, competitiveness and employment for emerging Asia.

The wrong policy choices can easily lead to a misguided preference, for instance by subsidizing the use of inefficient technologies or by postponing action to later years in the hope that new technologies will be freely transferred – but this would lock emerging Asia into a high carbon future. To foster the development and deployment of currently available technologies, the green innovation machine must be turned on.

2 The 17 technologies distinguished as low-carbon by the International Energy Agency (IEA) are: carbon capture and storage (CCS); nuclear power plants; onshore and offshore wind energy; biomass integrated gasification combined cycle; photovoltaic systems; concentrating solar power; coal integrated gasification combined cycle; coal ultra supercritical steam cycle; energy efficiency in buildings and appliances; heat pumps; solar space and water heating; energy efficiency in transport; second generation bio-fuels; electric and plug-in vehicles; hydrogen fuel cell vehicles; fuel transformation; industrial motor systems.

Finance

Financing the efforts of developing countries to combat climate change is seen as one of the fundamental building blocks of emission reductions (Table 2). In Copenhagen, industrialized countries pledged to commit $30 billion for fast start finance over three years 2010–2012, and by 2020 to mobilize $100 billion of financing annually. Substantial progress is being made on building the institutions to deliver this, such as the Green Climate Fund.

Table 2: Cost of Achieving 450 ppm CO_2e by 2050

	Gt/ year	Gt/ year	Gt/ year	Gt/ year	Gt/ year	Gt/ year	Cum. Invest-ment ($bn)	Cum. Invest-ment ($bn)	Cum. Inv. in Low-Carbon ($bn)	Incr. Inv. (as % of GDP)	Incr. Inv. (as % of GDP)
	1990	2007	2020 (ref)	2020 (450 ppm)	2030 (ref)	2030 (450 ppm)	2010–2020	2020–2030	2010–2030	2020	2030
World	20.9	28.8	34.5	30.7	40.2	26.4	2,400	8,100	6,600	0.5	1.1
PRC	2.2	6.1	9.6	8.4	11.6	7.1	400	1,700	1,500	0.8	1.5
US	4.8	5.7	5.5	4.7	5.5	3.2	520	1,500	1,100	0.5	1.0
EU	4.0	3.9	3.6	3.1	3.5	2.3	500	1,100	1,300	0.3	0.6
Russian Federation	2.2	1.6	1.7	1.6	1.9	1.3	18	180	220	0.3	1.0
India	0.6	1.3	2.2	1.9	3.4	2.2	100	500	550	0.9	1.4
OCs	3.5	5.0	6.7	6.1	9.1	6.4	400	1,500	1,450	0.6	1.2

Source: World Economic Outlook 2009

Note: Gt: billions of tons; emissions are energy-related; ref.; reference/BAU; * Renewables (incl. hydro, wind), nuclear and CCS; OCs: Other (developing) countries. Including India but excluding the PRC, Brazil, South Africa, and the Middle East.

At the national level, financing could be through public sources (by raising revenues from the auctioning of emission allowances, carbon taxes, removing fossil fuel subsidies, financial transaction taxes, transportation taxes, direct budget contributions), market-based instruments (such as the purchase of carbon offsets), or through international transfer (multi-lateral and bilateral). The argument for tax reform, including a shift in the burden of taxation from economic goods (e.g., incomes) to public bads, (e.g., emissions), has been broadly accepted, but progress is yet to be made. An important aspect behind such tax-shifting programs implemented in several European countries is the principle of 'revenue neutrality', meaning that the increase in tax revenues generated by eco-taxes is offset by the reduction of other taxes or charges. Changing the tax structure in Asia to achieve these financing needs is also feasible. The UN advisory group emphasized the importance of a carbon price in the range of $20–$25 per ton of CO_2 equivalent in 2020 as a key element of reaching the target of $100 billion per year.

A number of market-based approaches are also possible, including economy wide cap-and-trade systems, carbon taxes and energy efficiency targets. Each

approach creates a different cost of carbon within the economy, either explicitly through the allowance price under a cap-and-trade system or implicitly through the incremental cost of policy requirements. Stronger use of economic instruments such as carbon taxes, cap and trade systems etc, at both regional and national level, could create the market dynamics that would bring about more radical technological shifts and a further increase in tax revenues, so carbon taxes or cap and trade systems can bring double dividends. Low-carbon investments in Asia could also lead to substantial job creation, and the reduction of labor taxes enabled by eco-taxes could enhance this increased employment. Well-designed eco-tax policies and green labor policies can contribute to realizing the double dividend of emission reduction and economic growth. Bilateral and multilateral official development assistance (ODA) will also be important in supporting national/regional level financing mechanisms for low-carbon development.

Financing low-carbon development through capital markets is also feasible for Asia, and could achieve the targets without significant loss of economic growth and public spending. The prospects of involving the private sector and capital markets depend on a multitude of factors. The CDM has provided valuable experience in mobilizing capital for investments in low emission technologies in developing countries. However, it is unlikely to be the whole answer. As commercial investments are driven by risk and return, the level and directions of investments are determined by both long term financial viability and the degree of regulatory certainty. At present, an absence of positive incentives and weak regulatory frameworks limit the flow of private capital from sources such as pension funds to low-carbon green options. Judging by the success of infrastructure funds, tax incentives to climate change related bonds could also feasible. A sound institutional and regulatory framework including a predictable long-term price on emissions would be an important driver guiding capital market formation and overcoming premium costs.

Capacity Building

Institutional capacity-building in emerging Asia is a prerequisite for technology deployment and the mobilization of resources for implementation and the monitoring, reporting and verification of mitigation actions. There is much progress as well as serious shortcomings in the decision-making regimes at the local, national and regional levels. Low-carbon green growth is a crosscutting issue and hence the rules and institutions for decision-making are influenced by vested interests, with different interests influencing how decisions are made. Effective change in governance demands action at different levels. At the local level, public hearings and social audits have started to bring the voices of marginalized groups to the forefront. Implementation failures also occur because decisions are being made in sectoral compartments, with environmental, social and economic dimensions addressed by separate, competing structures. Better MRV systems, communication and coordination of decision-making are all needed.

3 Transformation Strategies and Policy Actions

In the past, low-carbon development was considered an unaffordable luxury for emerging Asia. New evidence from current policy actions shows that the goals of economic growth and emission reduction can be realized simultaneously, and can also be mutually reinforcing.

3.1 Voluntary Pledges and Emission Reduction Targets

Most countries in developing Asia have in recent years begun to mainstream climate change considerations in their planning processes. This clearly reflects the willingness of these countries to play a role in responding to climate change issues. Most of the countries under study have articulated targets to reduce greenhouse gases, the bulk of which come from energy production and consumption. Table 3 summarizes these objectives across four major indicators: emissions, renewable energy, energy efficiency, and deforestation.

In the lead-up to the UNFCCC Copenhagen conference in 2009, the PRC, for the first time, articulated a specific target for reducing carbon emissions. Subsequently, the 12th Five Year Plan revealed a further series of relevant targets to 2015. Additionally, the government aims to reduce emissions of nitrous oxide (a greenhouse gas) by 10%, and install extra capacity of non-fossil fuel power generation (i.e. wind, 70 GW; solar, 15 GW; hydropower, 120 GW; nuclear, 40 GW), among other quantitative targets.

The Indian government, prior to its voluntary Copenhagen pledge of reducing emissions intensity by 20–25% of 2005 levels by 2020, announced its National Action Plan on Climate Change in 2008, with eight goals covering both mitigation and adaptation. The target for an increase in solar power generation is seen as a key focus area to help India move towards becoming a global leader in solar energy deployment, and the extension of access to electricity. Targets relating to this objective include: 2 GW of off-grid solar plants, and 20 million solar lighting systems to be created and distributed in rural areas, saving about 1 billion liters of kerosene every year.

Indonesia, apart from its National Action Plan Addressing Climate Change, has included climate change in national development planning and in its mid-term development plan (RJPM 2010–2014). Indonesia has voluntarily pledged to reduce its emissions by 26% compared with business-as-usual by 2020, and by up to 41% with international support. At present, land-use and land-use change (particularly forestry and peatland) comprise 85% of national carbon emissions. The government plans to achieve 87% of its emissions reductions for both the higher and lower targets in these sectors. However, energy-based emissions are the largest source of emissions growth, and are projected to reach parity with land-based emissions by 2020. Accordingly, the government has enforced energy-

Table 3: Climate Change Mitigation Targets for Major Asian Economies

	Emissions	Renewable Energy Targets	Energy Efficiency	Deforestation
People's Republic of China	40% to 45% ↓ emissions intensity (2005→2020) 17% ↓ emissions intensity (2010→2015)	11.4% by 2015 15% by 2020 up from 8.3% in 2010	16% ↓energy intensity (2010→2015)	↑ forest cover by 40 million ha by 2020 from 2005 level ↑ forest cover to 21.7% by 2015, from 20.36% in 2010
India	20% to 25% ↓ emissions intensity (2005→2020)	15% by 2020 up from ~ 4% (2010) 20,000 MW solar by 2020	10,000 MW energy savings by 2020	↑ forest cover by 20 million ha by 2020 from 2010 level
Indonesia	26% to 41% ↓ emissions below BAU	15% by 2025 (incl. nuclear)	1% average annual ↓energy intensity (2005→2025) ↓elasticity of electricity/GDP to <1 (2025)	Forestry as net carbon sink by 2030
Thailand	30% ↓ energy emissions below BAU	20% by 2022	8% ↓energy intensity (2005→2015), 15% ↓ (2005→2020) 25% ↓ (2005→2030)	Forest cover to be 40% of total land mass (target introduced in 1991, 2010 level is 37%, up from 25% in 1998)
Viet Nam	–	5.6% by 2020 9.4% by 2030 up from 3% (2010)	↓elasticity of electricity/GDP from 2 (2010) to 1.5 (2015), to 1 (2020)	↑ forest cover to 16.2 million ha in 2020 from 14.3 million ha (2010)
Japan	Conditional 25% ↓emissions below 2000 levels	16.0 TWh by 2014	30% ↓energy intensity (2006→2030)	–
Australia	5% to 25% ↓ emissions below 2000 levels	20% by 2020, up from 8% in 2007	–	Planned offset scheme as part of domestic carbon market
Republic of Korea	30% ↓ emissions below BAU in 2030	6.08% by 2020, up from 2.7% in 2009	–	–

Sources: UNFCCC (2011), Howes and Dobes (2011), Chotichanathanwewong and Thongplew (2011), Mathur (2011), Patunru (2011), Toan (2011), and Zhu (2011).

Notes: All emissions targets by 2020 unless stated otherwise. BAU refers to business-as-usual. Emissions intensity refers to the volume of carbon emissions produced per unit of gross domestic product (GDP). Energy intensity refers to the volume of energy consumed per unit of GDP. The absence of specific targets for particular issues does not indicate an absence of policy, rather the absence of a stated national target. For example, the Korean government is implementing a large number of policy actions relating to energy efficiency, but does not have a specific national target.

specific targets and formulated the goal of tripling geothermal energy generation to 4 GW by 2015, and up to 9 GW by 2025.

As the energy requirements of Thailand's industrializing economy have grown, the government has instituted ambitious energy efficiency and renewable energy targets. For its economy-wide energy efficiency targets, 44% of the savings are intended to be found in the transport sector, followed by industry (37%), and buildings (17%). For renewable energy, 3.7 GW of the targeted 5.6 GW of renewable energy is assigned to biomass, and then, in descending order, wind (0.8

GW), solar (0.5 GW), hydropower (0.32 GW), and methane from municipal waste (0.16 GW).

Viet Nam's government estimates that, under current policies, energy demand will grow four-fold and coal consumption will double between 2010 and 2030, with the country becoming a net energy importer by 2015. Consequently, the government has passed several laws relating to energy efficiency and conservation, in addition to specific environmental laws and a National Target Plan to Respond to Climate Change, which sets national ministries, provinces, sectors and cities with the task of developing concerted plans to reduce carbon emissions.

The Republic of Korea put forth its 4th Comprehensive National Action Plan for Climate Change (2008-2012), the 5-Year National Action Plan for Green Growth in July 2009 and the Basic Law on Low-Carbon and Green Growth in January 2010. Singapore put forward its National Climate Change Strategy in March 2008 and the implementation of the Sustainable Singapore Blueprint started in April.

3.2 Sector-wide Policy Actions on Climate Change Mitigation

Many Asian countries have taken steps to cut carbon emissions through technology and fiscal policies. There are several examples of focused interventions across all countries in the transport, buildings, and industry and waste sectors. Table 4 provides a comparison of the current application of various instruments within each of the study countries.

Empirical evidence shows that in most countries in developing Asia, development plans and policies that were not directly aimed at tackling climate change, but at reducing energy consumption and emissions of pollutants, have been formulated and implemented at various levels and across sectors over the last couple of decades, and these have led to co-benefits in reduced greenhouse gas emissions as well providing electricity to the poor. All countries have fairly ambitious plans to reduce energy intensity and the share of fossil fuels in the energy mix.

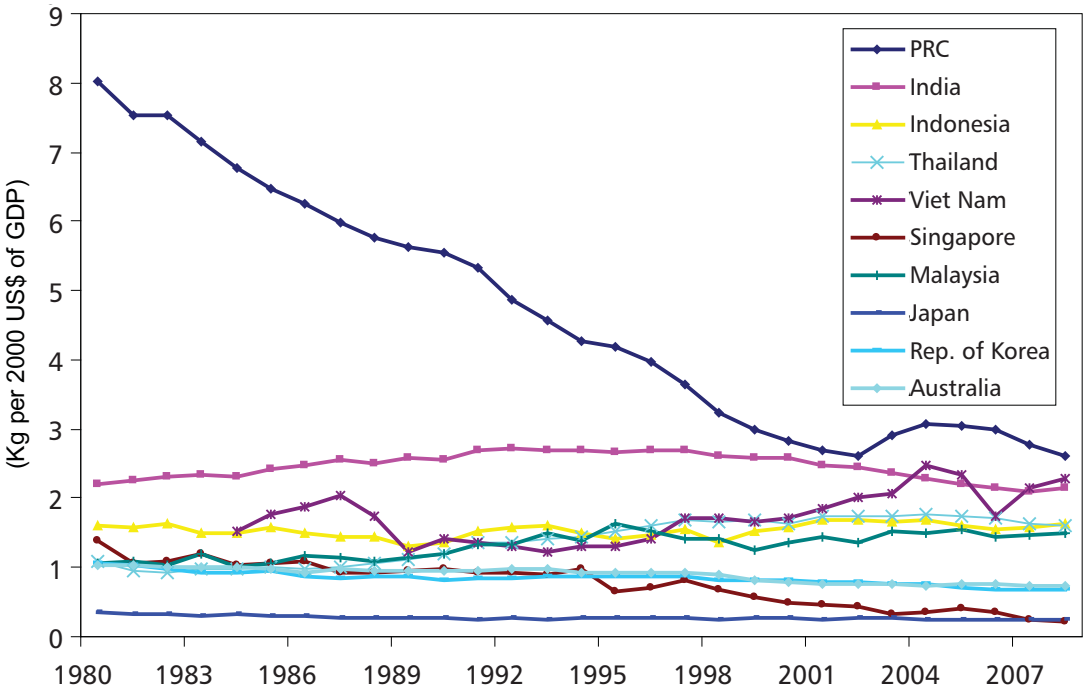
The PRC's renewable energy law is managed by the state council, and promotes the establishment of a renewable energy market for wind, solar, hydro, biomass and geo-thermal energies. New industries are promoted, with banks offering preferential loans with interest subsidies to energy efficiency projects. The reduced carbon intensity can be vividly seen in Figure 1. Today, PRC leads the world in renewable energy investment and in 2010 accounted for half of all global manufacturing of solar modules and wind turbines, with the majority of its solar technology production made for export. Elsewhere, India now ranks 10th globally in clean energy investment, and Indonesia had the 4th largest growth in this area from 2005–2010. Whether it is to boost export or to meet expanding domestic demand, growth in the renewable energy sector is an important stimulus for domestic manufacturing, and economic growth in general. India's mandatory energy efficiency trading scheme of Perform, Achieve and Trade (PAT), covering eight sectors, responsible for 54% of India's industrial energy consumption is replicable in other countries. Capital subsidies, sales incentives,

Table 4: A Summary of Low-Carbon Green Growth Policies and Measures Practiced or Proposed by Emerging Economies in Asia

Sectors	Policies and Measures	People's Rep. of China	India	Japan	Australia	Singapore	Republic of Korea	Indonesia	Thailand	Viet Nam
Energy supply	Advanced fossil generation technologies	■	■	■	■	■	■			
	Transition/distribution grid improvements	■	■					■		■
	Retiring old, inefficient plants	■								
	Feed-in tariff	■	■	■	■	■	■	■	■	
	Renewable portfolio standards	■	■	■	■					
	Subsidies, grants, rebates	■	■	■	■	■	■			
	Investment excise and other tax credits	■	■	■		■	■	■		
	Public investment and loans	■	■	■	■	■	■	■	■	
Energy Demand	Efficiency labels	■	■	■	■	■	■	■	■	■
	Sales tax, energy tax, VAT reduction	■	■		■	■	■	■	■	■
Transport	Mass transit goals	■	■	■	■	■	■			
	Control of individual vehicle ownership					■				
	Vehicle fuel efficiency goals	■	■	■		■				■
	Vehicle Emission Standards	■	■	■	■	■	■	■	■	■
	Bio fuel standards	■	■			■	■	■	■	
Agriculture	Fertilizer management	■	■	■	■		■	■		
	Crop carbon sequestration	■	■	■	■		■			
	Methane mitigation	■	■	■	■		■	■		
	Reduction of open-field burning	■	■	■				■	■	
	Afforestation/Reforestation programs	■	■	■		■	■	■	■	
	REDD							■		■
R&D	Clean / energy efficiency programs	■	■	■	■	■	■		■	
	Carbon sink programs	■	■	■	■	■	■	■	■	
Financing	Climate Funds			■	■			■		
Capacity Building	Public awareness campaigns	■	■	■	■	■	■	■	■	■
	Institutional capacity	■	■	■	■	■	■			
	Human resources development	■	■	■	■	■	■	■	■	■
City Level Measures	Demand side energy	■	■	■	■	■	■	■	■	■
	Net metering			■	■				■	
	Sustainable transport systems	■	■	■	■	■	■	■	■	
	Compact cities	■	■	■		■		■	■	■
	Low carbon life style	■	■	■	■	■	■	■		
	Shift of energy intensive industries	■	■	■	■	■	■	■		
	Use of MBI, such as C&T	■		■	■					

Source: Adapted from REN 2011; USAID 2008, and Country Background Papers from the ADBI Climate Change and Green Asia Study.

Figure 1: Carbon Intensity of Selected Asian Countries



Source: World Bank Indicator. http://data.worldbank.org/indicator

the reimbursement of fees for solar thermal projects and automatic approval for foreign direct investments are part of its rural clean energy development program.

As a large country with huge tracts of carbon-absorbing forests, Indonesia is making efforts to cut carbon emissions by 26% from the business-as-usual level by 2020, something which also created a lot of employment opportunities for isolated regions. Reducing emissions from deforestation and degradation (REDD) is the name given to a proposed international system by which the preservation of forests will be funded by carbon trading. However, the system has not yet been completed, and its scope has not been defined. Nevertheless, and without an internationally binding obligation, Indonesia and the Philippines are undertaking proactive actions in the forest sector. Forest-based mitigation policies are being achieved in three ways: the maintenance of existing forest; the restoration of lost carbon sinks from degraded or cleared forest, rectifying the negative impact the sector has had in terms of emissions in recent years; and through the creation of new forest areas, thus increasing the amount of forest to act as sinks. Malaysia, too, has implemented policies to shift the economy structurally away from polluting energy-intensive industries. Thailand is the first country among the emerging economies to develop carbon labels, which help its economy move forward in a low-carbon fashion, without retarding economic growth.

Taking advantage of late-comer advantage, countries like Viet Nam are looking at a number of areas with scope for emission reductions (including

public transport, green buildings, the adoption of energy-saving equipment and switching from coal to natural gas and smart power plants). In order to strike a balance between short-term economic needs and the long-term environmental imperative, the emerging Asian economies have begun to put in place policy and regulatory frameworks in order to better design financial and regulatory incentives and build institutional capabilities for low-carbon green growth in the long term. Japan, the Republic of Korea and Singapore's success in following green sectoral policies owes much to their planning capabilities, capacities that have evolved under public-private partnerships, which were able to take a long term perspective. Those policy experiences can be scaled up and replicated.

The governments of emerging Asia have introduced many different forms of regulation and standards relevant to greenhouse gas mitigation. Examples include: ethanol blending in fuel; emissions and fuel economy standards for cars; minimum efficiency standards and the compulsory labeling of energy appliances; the compulsory closure of small inefficient fossil fuel power plants; and many others.

Efforts have also been made to improve and align governance issues at the domestic level, to include nongovernmental organizations and private enterprises to play a role in energy conservation decision making, to undertake project evaluation, and to support the implementation of government policies and initiatives. Governments have also extended budgetary allocations to support energy savings and demonstration projects. Countries like the PRC and India, despite having large energy gaps, have gradually been eliminating out-dated production capacities as part of their energy efficiency efforts. Increasingly, efforts are being made to improve the level of waste utilization and to reduce waste generation, as well as to enhance the recycling of waste.

Pricing and taxation policies are increasingly being aligned to assist energy conservation efforts. Recognizing that this could put the poorer sections of society and small and medium enterprises at a disadvantage, there are examples of focused initiatives such as cash transfer programs to support these groups. The Tech-up scheme in India, directed at helping small and medium enterprises to move to more efficient technology through capital subsidies, and efforts made to provide targeted subsidies are examples of such support.

3.3 Key Enabling Policy Instruments

The types of policy instrument and measures applied differ across economies and sectors (Table 5). Generally, "demand-pull" measures have been used to create and enhance the demand for alternative technologies. These include instruments such as feed-in tariffs, renewable energy certificates, standards and regulations, etc. "Supply-push" measures are used to correct market failures and help reduce the costs of producing a technology - for instance, investment subsidies and tax incentives, and public finance for research and development (R&D).

Feed-in Tariffs

Feed-in tariffs are a commonly used policy instrument that ensures renewable energy generators receive favorable terms. Although the exact arrangements vary from country to country, generally they share three standard characteristics: guaranteed access to the electricity grid; long-term contracts; and the power generated being purchased by grid companies at higher prices than power from fossil-fuel sources, reflecting the relatively higher generation costs of renewables. This instrument has played an important role in the rapid development of the wind industry of the PRC.

Green Certificates/Renewable Energy Portfolio and Other Market-based Mechanisms

Renewable energy certificates (RECs) create a market mechanism for utility companies to meet mandated targets for renewable generation. Renewable energy operators are issued with credits proportional to the amount of electricity they produce, and these credits can then be purchased and/or traded by utilities in fulfillment of their portfolio obligations. This system provides incentives for renewable energy operators to compete with each other in lowering their costs. However, when multiple forms of energy are covered by the same scheme, the lowest-cost type of technology is generally favored, often wind power. In 2011, India was the first of the developing Asian countries to launch a REC scheme, providing a means for states and utilities to meet previously set targets for renewable energy. The implementation of RECs in India accompanies a similar scheme directed at energy efficiency, namely the PAT mechanism, whereby India's largest energy users are set benchmark efficiency levels, with trade occurring between participants who exceed their targets and those who fail to meet them. The PAT instrument echoes a voluntary mechanism developed earlier in the PRC, known as Generation Rights Trading (GRT), in which coal-based electricity operators are assigned tradable quotas and the efficiency of electricity production is increased. In 2007, it is estimated that the use of GRT across 23 Chinese provinces involved a total transaction quantity of 54TWh, saving the equivalent of 6.2 million tonnes of coal.

Rules, Regulations and Standards

There are numerous prominent examples of regulatory instruments in the study countries. In the PRC, the Energy Saving Power Dispatch mechanism prioritizes dispatch to the energy grid by different generators based on their efficiency and the emissions each produces. Priority is given to non-adjustable sources of renewable energy (such as solar and wind), then adjustable renewable sources (such as hydropower), nuclear, and so on, with coal and oil lowest in the ranking. In India, government regulations have been effective in the conversion of Delhi's three-wheeler taxis to natural gas, among other policies to reduce urban air pollution.

Table 5: Public Policy Mechanisms for Supporting Carbon Innovations

Stage of Technology Development	Early Research	Demonstration and Commercialization	Market Update
Key Policy Challenges	• Increase the volume of early-stage research • Improve the flow of funding to promising research • Transfer academic research into commercial environment • Don't write off promising technologies too early	• Identify scalable, lab-proven technologies • Provide soft credit where it is required to achieve target returns • Establish dear performance standards • Don't try to pick winners, but cull losers aggressively • Develop a replicable blueprint for large-volume roll-out • Provide support to dose cost gap with mature technologies • Ensure availability of credit despite market and policy risk • Ensure economic system can absorb new technologies and remain stable • Support/create lead customers	• Ensure energy diversity, if necessary providing long-term support for higher-cost technologies • Protect public budgets • Avoid locking in uncompetitive market structures • Shift emphasis to "polluter pays" rather than maintaining subsidies forever
Enabling Policies Regulation		• National/State/local Procurement targets • Feed-in Tariffs • Reverse Auctions/Requests for Contract • Renewable Portfolio Standards (RPS)/Green Certificates/PET • Renewable Fuel Standards	• Top runner Requirements • Utility Regulation
Finance Mechanisms for Innovation	• Incubators • National Laboratories • Prizes • National/State-Funded Venture capital • National/State-Run Venture Capital • R&D Grants	• Project Grants	• Technology Transfer Funds • National/State/Local Infrastructure Funds
Credit Mechanisms		• Venture Loan Guarantees • Green Bonds • Loan Guarantees • Debt Funds	• Export Trade Credit • Microfinance • Sovereign/Policy Risk Insurance • National/State/Local ESCO Funds
Tax-based Policies	• Capital Gains Tax Waivers • R&D Tax Credits	• Innovation clusters • Accelerated Depreciation • Investment Tax Credits • Production Tax Credits	• Carbon Tax
Carbon Market Mechanisms		• Monitoring, reporting, and verification (MRV)	• Domestic Carbon Cap and Trade • Project-Based Carbon Credits • National and Multilateral Carbon Funds

Tax Incentives and Credit Lending for the Deployment of Low-Carbon Technology

A variety of subsidies and incentives are used to reduce the costs of investing in technology demonstration and deployment. Examples include: reduced taxes on inputs, tax holidays, accelerated depreciation, matched investment funding and import duty exemptions. Governments are also offering concessional loans to reduce upfront costs, or loan guarantees to reduce financiers' risks. For example, Thailand's Revolving Fund provides capital to banks that is made available to borrowers at concessional rates, with the repayments from existing borrowers financing new projects. Subsidies and incentives are also commonly used to create market demand, such as government rebates to purchasers of energy-efficiency devices or domestic solar panels, and low-interest 'green' loans on retrofitting projects to encourage buyers. These government interventions, in partnership with private financial institutions, have brought the effective price down for users of low-carbon products. This in turn, by increasing the potential market, can assist the achievement of economies of scale by producers and place further downward pressure on prices, in a virtuous circle that further stimulates demand for low-carbon goods and services.

Public Finance for Research, Development, and Deployment

The 'public good' characteristics of low-carbon R&D represent an attractive use of public finance. Various instruments serve this purpose, such as: specialized national research institutes, direct government grants to companies, matched investment funding, student scholarships and tax subsidies, among many others. All of the study countries have some form of R&D funding, with most of it in PRC and India. Aside from developing new technology, research and capacity-building efforts are also undertaken by various governments at the sectoral level.

Carbon Pricing

Well-designed and well-supported carbon pricing is the most effective policy approach to incorporating the social costs of greenhouse gas emissions into industrial and household decision-making. Carbon pricing also provides a signal for innovators to develop new low-carbon green technologies. There are two main types of carbon pricing: carbon taxes, and emissions trading systems. A carbon tax fixes the increase in prices, but without determining what the final reduction in emissions will be. An emissions trading system involves the setting of an economy-wide level of emissions, with permits to produce emissions allocated or sold to industry such that aggregate emissions do not exceed the set level. These are often known as cap-and-trade systems because they require a cap on emissions with companies awarded quotas of emissions that they may trade with one another. At present, experience with carbon pricing, whether through a carbon tax or trading schemes, is fairly limited among the study countries, although proposals for carbon price instruments do exist, mostly in the form of levies on electricity or fossil fuels.

Progress is being made most notably in the PRC, where pilot schemes are being set up, including in the nation's most industrialized region, Guangdong province, and in Beijing. The city of Tokyo in Japan has also introduced a cap-and-trade system for the building sector, on a pilot basis.

Targeted Planning by Local Governments

Many local governments also have planning targets and policy processes. One example is the system of provincial targets set by PRC's central government for environmental and energy efficiency. Promotion for senior government officials within the bureaucracy has long been dependent upon the achievement of centrally determined targets. Until the 11th Five Year Plan (2006–2010), such targets almost exclusively focused on macroeconomic figures, such as GDP growth. However, today promotion requires the achievement of environmental targets, thus building strong incentives for provincial officials to set and meet targets or follow through on central government initiatives. At the international level, for all of the study countries, targets are a means by which actions and progress can be judged externally, even if they are voluntary.

Regional planning, through which urban and rural planners develop land-use, forest-use and traffic/transport programs, offers powerful instruments to reduce the carbon footprints of the rapidly urbanizing and industrializing areas of Asia. Housing construction, road networks and the spatial structure of an urban area 'lock in' carbon footprints for the indefinite future. For example, cities such as Yokohama in Japan, Tianjin in PRC and Ho Chi Minh in Viet Nam are planned as compact communities, so that less energy is required for moving residents from their homes to workplaces, less for conveying water, and less for removing city wastes or converting them into energy or other material forms. The use of specific instruments such as taxes to promote the development of compact low-carbon cities required community ownership of the planning process, to ensure widespread support for the idea and ensure that a compact community can be a liveable community as well.

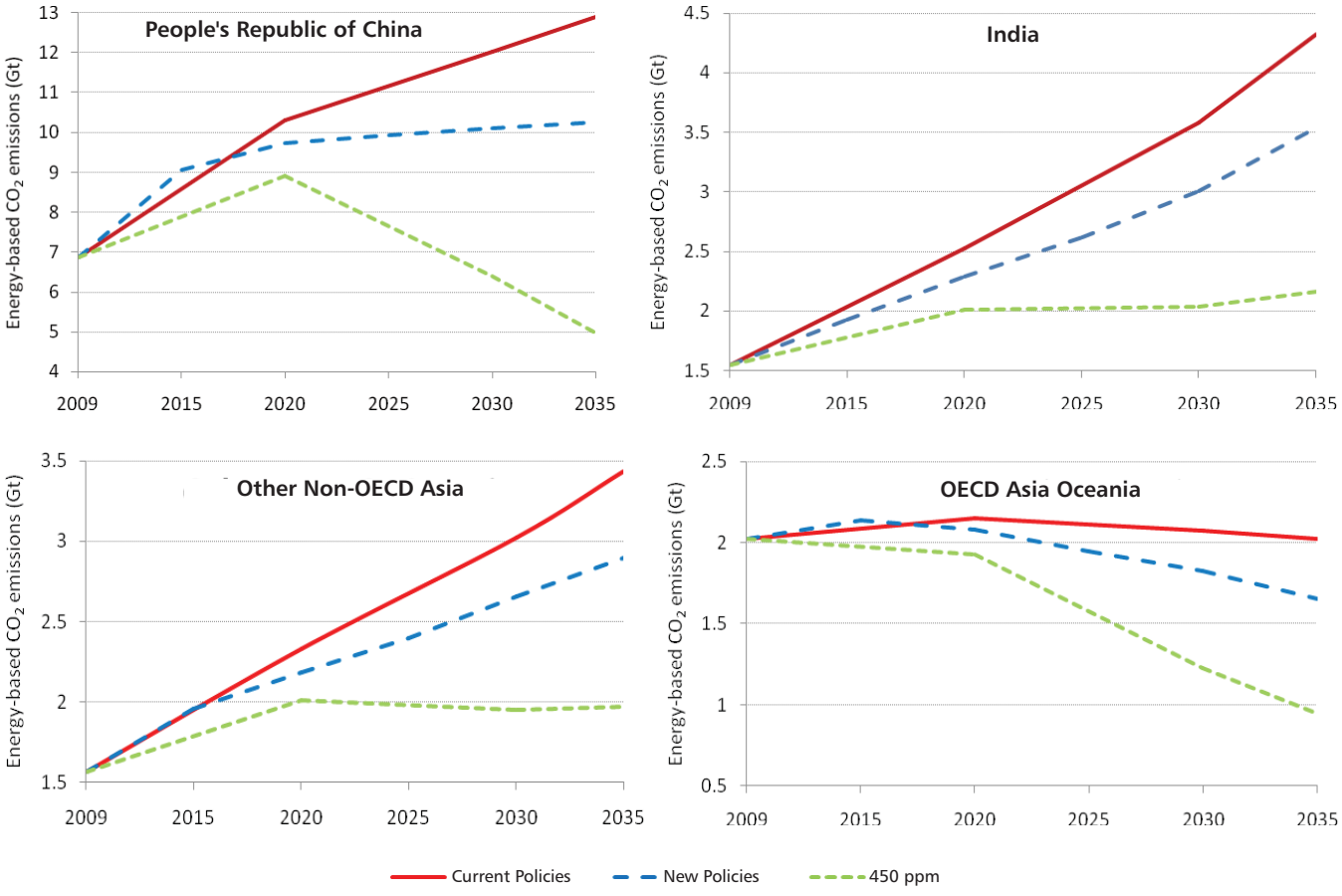
In the transport sector, while the investment needs are huge, scaling up public investment is seen as the first step (and is expected to further stimulate private investment) to address the mobility needs of economically weaker groups.

Transformation Approaches and Gaps

Much is already being done by developing Asia on its own, mostly by harvesting low-hanging fruits. The challenge is to speed up and enhance the transition to a low-carbon path for economic development (Figure 2). Numerous studies have shown that the aggregate effect of the Copenhagen pledges by all countries will not be sufficient to avoid breaching what has become the international standard for dangerous climate change: 2°Celsius of warming or an atmospheric greenhouse gas concentration of 450 ppm CO_2-equivalent.

While domestic actions motivated by concerns other than climate change may also be helpful to encourage higher levels of efficiency and the use of clean

Figure 2: Emissions Profiles Across Asia



(After Howes and Wyroll, 2011)

and renewable fuels and technologies, the scale and timing of changes needs to change significantly. For instance, a study of India indicates that a 450 ppm climate scenario is likely to call for large and transformational changes, such as retiring newly set-up coal-fired power stations before the end of their economic life-times, while simultaneously needing huge increases in renewable power generation capacity to meet increasing demand across the economy.

Although significant efforts are already being made across developing Asia, these are concentrated in a few areas and there is a need to spread the efficiency benefits more deeply and more widely across different user groups and across regions, including the hard-to-reach small and medium enterprises (SMEs) sector.

3.4 Addressing the Gaps and Accelerating Transformation

The need for co-operation in moving Asia to a low-carbon green development path is clear. But given the difference between what developing Asia is capable of achieving on its own versus the levels of transformation that are likely to be

required from a climate perspective, it is crucial that developed countries step in to bridge the gap. Moreover, there is considerable scope for enhanced and rapid learning with regional cooperation and knowledge-sharing mechanisms.

Much Larger and Transformational Financial Support is Needed from Developed Countries

While Asia's developing countries clearly see the need to progress much faster to low-carbon green growth, they are also faced with other priorities towards which funds need to be channeled, and budgetary allocations are largely directed at the social sector from which spending should not be diverted. Enhancing and accelerating the transition towards lower carbon pathways would require large investments and developed countries need to play a key role in providing the additional finance. The additional investment needs for renewable energy, for example, are significant, though necessary to prevent lock-in to current high carbon technologies. In the case of India, estimates indicate that the additional investment needs for the power sector alone are of the order of $13 trillion during 2011–2051 (TERI, 2010). Viet Nam's national energy development strategy indicates lack of access to financial resources for renewable energy as a major barrier. The allocation of ODA and loans from bilateral financial agreements for investing in the exploration and deployment of renewable energy is perceived to be an important priority.

Leveraging Private Finance

It is estimated that the region will require over $6 trillion for new energy infrastructure by 2030. Private sector financing makes up the bulk of funding for low-carbon development at the global level. Some of the difficulties in pursuing low-carbon development and technological advancement in the developing countries in Asia include high upfront capital costs, the limited availability of long-term financing, regulatory uncertainty, and technological risks: for example, commercial banks financing clean energy projects in developing countries have relatively high transaction costs and lending premiums, and demand additional security and/or collateral requirements from project sponsors.

This discourages private sector investments because it imposes additional costs on business. In the absence of an efficient financial market, new approaches to low-carbon development financing such as sharing risks and costs based on performance and other similar incentive schemes are necessary to mitigate investment risks and to foster the infant industry and market at a faster pace. It is therefore important to accelerate capacity development activities to create an enabling policy and regulatory environment in developing countries to attract private investments. At the same time, there is an urgent need to deploy innovative financing mechanisms related to debt products (including mezzanine products such as convertible debt) and guarantee products to: (i) buy down or otherwise reduce margins, base interest, guarantee fees or other financing fees and costs

and expenses; (ii) provide "first loss" protection; (iii) provide performance-based or other incentive financing; and (iv) support feed-in tariffs and other revenue streams. To facilitate this, development partners can collaborate to scale up the deployment of existing financial instruments such as guarantees, risk transfer products, and concessional loans focusing on leveraging private financing.

There are some good examples of private sector investments supported by ADB's private sector operations:

- **Cleantech:** Venture capital funds - 2 funds, $40 millon; these provide early stage support in the form of equity and knowledge advisory services to venture capital funds that will invest in nascent companies with climate mitigation and adaptation technology.
- **India Solar Guarantee Facility:** $150 millon guarantees and $10 millon UK grant. ADB will issue partial credit guarantees up to an aggregate $150 million to international and local banks lending to early entrant solar power project developers in India. The guarantees cover non-payment risk of up to 50% of the loan, which finance small solar projects from 2MW to 25MW. The UK government is providing a $10 millon grant to buy down the guarantee fees, reducing the overall financing costs for the projects. ADB is providing parallel technical assistance and training to banks on technology risks and technical due diligence to further leverage commercial debt into the sector.
- **Thailand Solar PV output:** the country's first large-scale photovoltaic farm, for which a $2 millon grant from ADB's Clean Energy funds finances contingencies; reduces project costs and debt servicing
- **Bangladesh Industrial Energy Efficiency:** $30 millon credit line plus technical assistance to domestic private banks support the introduction of energy-saving technologies in the brick kiln and other targeted industries.
- **Climate Public Private Partnership (CP3):** this is an innovative investment vehicle that intends to catalyze large amounts from institutional investors (including large pension funds and sovereign wealth funds) into a $1 billion climate specific fund. These funds will be catalyzed by ADB and the UK's The Department For International Development (DFID) (about $200 millon combined) as the anchor investors. By crowding in 'patient capital' from pension funds, sovereign wealth funds and other institutions, the fund can take a longer term investment horizon which is needed for mitigation and adaptation investments. .

Much Greater Sharing of Knowledge and Experience is Required across the Region

There is a need for platforms to share learning and experiences across developed as well as developing countries. There are many similarities across developing countries in terms of the requirements, the challenges and the possible solutions. Sharing of knowledge with regard to the adoption and adaptation of

new technologies, as well as new ways of handling difficult reform processes and minimizing mitigation costs, could bring about rapid scale-ups of successful models across the region.

Technology Transfer Needs to be Supported with Adequate and Appropriate Capacity-Building in Developing Countries

Technology transfer is critical to the proliferation of renewable energy in developing Asia. However, this process is not one of simply transferring technology blueprints from developed countries. Achieving the widespread dissemination of renewable energy technology requires the development of a local manufacturing base and the associated supply chains; systems for maintenance and marketing; a labor force that can build, use, and maintain the technology; and, in many cases, the adaptation of technology to local conditions. Without the capacity to absorb and use transferred knowledge, the returns on technology transfer are likely to be limited. Domestic and international policy intervention must therefore have a central role in building this capacity. Also, much more research, development, and demonstration spending is required globally, including in developing Asia.

4 Transformation Lessons—Going Green as a Development Strategy

4.1 Co-benefits of Low-Carbon Green Growth

The transformation required if a low-carbon green Asia is to be achieved entails many challenges to economic policy-makers. But it also opens up many opportunities to build more innovative, more sustainable, more resilient and more socially inclusive economies. This potential means that 'going green' can strongly boost countries' economic development, if policies are well-designed.

Just as cutting greenhouse gases can generate 'co-benefits' from reduced local pollution, there are potential co-benefits for economic growth and well-being from tackling a broad range of environmental problems – if the right tools and incentives are put in place.

4.2 Social Inclusion and Equity

Action on climate change that hinders development or excludes significant groups from its benefits cannot build the global coalition on which effective, efficient and equitable action against climate change depends. But if climate-change policies encourage social inclusion, they can benefit development more broadly than simply by reducing climate-change risks. This is crucial for emerging Asia given that a majority of the world's poor live in the continent and the level of GDP per capita of many Asian nations leaves them a long way below the global average. First, reductions in inequality tend to encourage economic growth – as usually measured – in the long run. Second, reducing social exclusion and poverty are worthy ends in themselves. Third, empowering the poor will help the most vulnerable to develop the capacity to adapt to the consequences of the levels of climate change that are now unavoidable given past carbon emissions.

There are many ways through which vulnerable communities can be strengthened while maintaining high economic growth rates and reducing greenhouse gas emissions. For example, promoting low-carbon energy sources that are not dependent on costly infrastructure such as national electricity grids can be a cost-effective way of expanding access to energy to poorer and more marginal social groups. Close to 2 billion people in the developing world, many of them in Asia, use traditional biomass fuels as their primary source of energy. Enabling access to cleaner and affordable cooking energy is key to reducing women's drudgery and indoor air pollution. Women's responsibilities as stewards of natural and household resources position them well to contribute to effective adaptation to changing environmental problems, so it is important to empower women in developing countries, engaging them actively in decision-making about climate-change policies.

Large populations within developing countries depend on climate-sensitive sectors such as agriculture, forestry and animal husbandry. The natural resources that underpin these sectors, such as soil, water, grazing land, biodiversity and forests, are subject to continued degradation as a result of the changing climate and their exploitation for short-term benefits. There are several measures, such as low-till agriculture, afforestation and community forest management that can simultaneously reduce resource degradation, sustain the livelihoods of the rural poor, reduce emissions and increase the absorption of carbon dioxide by forests.

The development of renewable energy is a key route to green growth. If properly planned, biofuels development could provide income to poor farmers and rural communities around the world. Developing countries with tropical climates have an advantage in growing energy-rich biomass. Second-generation technologies could enable an expansion of the range of feedstock used, to include grasses and trees that can thrive in less fertile, more drought-prone regions. But biofuels provide a good example of where the wrong policies can have harmful side effects. Rapid bioenergy expansion can cause upward pressure on food prices, so that staple crops become less affordable for the poor, and harm soil quality and fertility, exhaust water resources, and damage biodiversity and natural ecosystems. It is possible to mitigate these adverse impacts through innovation, increased investment in technologies for biofuel conversion and crop productivity improvements.

The transition to low-carbon green growth could also lead to health benefits, especially from improvements in local air quality and lower emissions of particulate matter, sulfur and nitrogen pollutants. In rural areas of developing countries, programs to introduce low-emission stoves could avert millions of premature deaths and reduce greenhouse gas emissions. Similarly, reducing reliance on carbon-based electricity generation would provide health benefits. Another important health benefit would follow from improving transport systems, cutting emissions by reducing the use of petrol-based motor vehicles and improving low-carbon public transport.

Greater social inclusion and equity from climate change mitigation could be achieved by:

- Overcoming knowledge gaps
- Promoting collective action by local communities, including those currently largely disenfranchised in the policy formation process
- Building local skills and infrastructure
- Encouraging collaboration between the public sector, businesses, the academic community, media and members of the public to enhance efforts to achieve green growth with fairness
- Developing synergies across national, state and local level action plans
- Promoting research and demonstration projects to local communities

4.3 Green Jobs

The transition to a more sustainable low-carbon economy requires the growth of industry sectors producing environmentally sound products, providing the opportunity to create new jobs and offer new skills to workers. Green growth requires that more labor is devoted to low-carbon activities, particularly in the near to medium term while the capital stock embodying environmentally destructive technologies is replaced. Electricity generation from renewable energy and energy efficiency improvements are more labor intensive than a fossil-fuel-based electricity supply. Low-carbon land use and forest management can also be more labor-intensive.

Several studies of the employment effects of specific mitigation measures in Asian countries have illustrated the scope for more green job creation. Renewable energy is the sector in which the opportunities are perhaps the most obvious in Asia, but carbon mitigation strategies can create employment through agriculture and forestry activities, too. In India, for example, opportunities have been identified in renewable energy (especially solar), green transport and public works in water and forest management.

Overall, it appears that the scope for gross green job creation in Asia is substantial – probably on average at least of the order of 1% or 2% of the labor force, enough to make a dent in unemployment rates but not likely to transform the overall balance of labor demand and supply. It is larger in many poorer Asian countries, first because of the greater need to improve the environment and adopt more sustainable production patterns and, second, because of the scope for increasing employment in forestry and agriculture, which are relatively more important in these countries and often ignored in projections of green jobs in industrial countries.

The opportunities for net job creation from the transition to green growth differ across the region, depending on how labor markets work in individual countries. In this respect, some countries in Asia face the paradox that the opportunities are limited because their labor markets are already reasonably efficient in delivering low and relatively stable unemployment. Several countries, for example, have shown remarkable resilience in the face of the recent global economic slowdown and have high rates of labor market participation. However, several Asian labor markets, particularly in poorer economies, suffer disadvantages. First, the labor force is growing very rapidly in several, particularly India, Indonesia and the Philippines among the larger economies, and they are finding it difficult to generate enough new jobs. Second, the rates of underemployment and vulnerable employment – such as own-account workers and unpaid family workers – are high in several of these countries, so that vulnerable employment is high by world standards. Together with the relatively high share of agriculture and traditional activities in these economies, this suggests that more workers could move from low-productivity sectors to others, including environmental services and climate-change mitigation that have higher private and social returns. However, not all

jobs created by the transition to green growth are likely to have high productivity; part of the benefit is likely to be the creation of low-productivity jobs for those who would otherwise have no paid employment at all. Green growth will only generate substantial labor market benefits if it is combined with policies to increase aggregate labor demand in line with labor supply and to tackle poverty and social exclusion.

But in all countries, gross green job creation risks being held back by weaknesses in education and training. Already, skills shortages are reported to be obstructing green growth strategies. They arise from long-standing failings in education and training and reflect problems such as the lack of incentives for employers to invest in developing the transferable skills of their workforces, and from the lack of access for the disadvantaged to time and finance for training, and the inflexibility of relative pay rates.

If countries are to achieve major labor market benefits from the creation of green jobs, active labor market policies will be required. Otherwise, induced structural change may lead to higher unemployment and a loss of human capital. In many countries, public employment schemes are likely to be part of the solution. However, these require public finance and should be designed to encourage longer-lasting job creation.

4.4 Expansion of Demand in Traditional and Service Sectors

Increased innovation and the removal of barriers to the efficient functioning of labor markets can increase the supply capacity of economies as well as tackling environmental problems. But that has to be matched with increased demand if resources are not to remain idle and involuntary unemployment is not to rise. Given the extent of unemployment and vulnerable employment in many poorer Asian countries and the prospect of large labor force increases for some of them, this is important for wellbeing and growth. In the longer term, nations can also benefit from developing a comparative advantage in producing green goods and services, for which world demand is increasing rapidly. If labor markets are working effectively, this may not increase employment but will raise real incomes by improving countries' terms of trade. This is why well-designed macroeconomic policies in the short run and industrial policies in the longer term can generate growth that is faster and greener at the same time.

Macroeconomic policies must stimulate demand while ensuring that debt-financed spending supports economic activities with high social returns, including environmental benefits. That means increasing spending on green projects now, given the degree of economic slack that still persists in several Asian nations, and being ready to respond to unexpected downturns by reducing the backlog of green investment projects. But countercyclical spending plans need to take account of the debt-servicing capacity and fiscal management capabilities of governments.

Controversy remains about the danger of industrial policy distorting incentives for potential investors and entrepreneurs and thus misallocating capital across economies. Cost-effective industrial policy focuses on correcting market and policy

failures that are inhibiting growth in new sectors by ensuring that, for example, appropriate knowledge and infrastructure are available, risks are borne by those who can best manage them and businesses are confident that policies are going to be stable and predictable.

Several Asian countries, such as the PRC and the Republic of Korea, have used short-term macroeconomic policies and longer-term industrial policies sensibly to stimulate increases in employment and real incomes while speeding the transition to greener, more sustainable growth. The Korean fiscal stimulus from 2008 did not stand alone but as an early step along the road to fulfill the 'Low-Carbon Green Growth' vision and strategy, announced that year, designed to transform the Korean economy from 2009 to 2050. Already, the PRC has shown it is possible for Asian countries to exploit a comparative advantage in manufacturing to gain world leadership in clean technologies. But the experience has not been uniform. Some of the lower-income countries in Asia find it more difficult to adjust spending in timely fashion and also have yet to evolve effective longer-term industrial policies.

It is too early to judge the success of the ambitious longer-term plans put forward by some countries, but the emphasis on drawing on existing comparative advantages in manufacturing gives grounds for optimism. It is always difficult to anticipate how countries' comparative advantages will evolve, so picking winners worthy of government support can be perilous. Also, it is impossible for all nations around the world to increase net exports in all growth sectors. Instead, policy-makers should concentrate on market and policy failures, such as those affecting innovation and labor markets that could impede the growth of green sectors. Environmental pricing, the provision of information about market opportunities, the design of regulation in important sectors such as energy and construction and the building of the long-term credibility of green growth policies are among the other ways of building a strong supportive framework. Given the novelty of some green activities and the need for some large individual projects, particularly in energy, policy-makers need to take account of market imperfections in the provision of finance and ensure that banking and risk-sharing arrangements are appropriate. As one of the biggest risks involved is political risk – changes in regulatory regimes, the international policy context and governments' commitment to green policies – some risk-sharing by the public sector, for example through public-sector investment institutions and international development banks, is likely to be desirable.

4.5 Eco-Innovations

The transition to low-carbon green growth requires more innovation, particularly in the energy sector but also in the construction sector; transport; product and process design; urban planning; and agricultural practices and land management. New technologies and processes need to be developed that are less dependent on fossil fuels, existing technologies need to be made more resource- (and particularly energy-) efficient, and new products must be introduced that depend less on resource inputs for their value to the consumer.

However, innovation is inhibited by several market failures that slow the transition to green growth. For example, there are spill-overs from new ideas; the social returns to R&D investment are often much greater than the private ones. There are also externalities from the adoption of technologies, due to network effects, learning-by-using and learning-by-doing. These can lead to the locking-in of well-established technologies, which benefit from the experience organizations have had with them and the embodiment of existing techniques in the capital stock in place. A switch to new technologies may be desirable in a particular sector, but individual companies will not have sufficient incentive to change unless confident that other companies will, too. So policy-makers have to set credible incentives over an extended period.

Many Asian economies have relied heavily on the accumulation of capital and the reallocation of workers from less to more productive sectors to fuel their past economic growth. The scope for them to continue along these lines will diminish as populations age, saving rates decline and the movement of people out of rural agriculture into urban industry and services slows. The transition to green growth can facilitate a broader transition to greater reliance on innovation as a source of sustainable economic growth.

The pattern and pace of innovation in Asia have been mixed. In some cases, notably Japan, R&D effort has been relatively high for many years. Korean and Chinese spending has increased rapidly since the end of the last century. Indian R&D spending has also been increasing significantly. Yet most R&D still takes place in high-income countries – around 70% of the world total. They spend around 2.5% of their GDP on R&D – more than double the rate of middle-income economies as a whole. This dominance is also the case for environmental innovations, for example in pollution abatement technologies. Technologies that have wider global suitability are nearly all from developed economies. But Asian countries could increase their innovatory activities greatly, adapting ideas, products and services developed elsewhere to local circumstances, which may be very different to those in the countries undertaking the original research because of differences in income per head, natural endowments, institutions and social values. Many Asian countries, for example, have abundant supplies of unskilled labor but are less well endowed with raw materials and energy resources.

In order for nations to stimulate green innovation in particular and innovation in general, thus promoting sustainable growth across the whole economy, they need to have effectively functioning national innovation systems, comprising government policies and institutions involving government and the private sector. If governments can make national innovation systems fit for their environmental objectives, they are also more likely to be fit for purpose across the board. A sustained effort to redirect such systems will be necessary, because economies of scale and the higher returns to new ideas in larger, well-established industries tend to establish path dependence for innovatory activities. This may require support for infant green sectors, subsidies (preferably time-limited) for the deployment of novel green technologies, and environmental pricing.

Some countries in Asia, including Japan, the Republic of Korea, the PRC and Singapore, already have well developed national innovation systems. But there is currently a large gulf between the richer and poorer countries in Asia in this respect. Also, small and medium-sized enterprises need to be given better access to channels of technology transfer.

Innovation in many Asian countries will necessarily rely to a large extent on adapting the outputs of basic R&D in high-income countries, so that the intellectual property rights (IPR) governing the international spread of innovation are important.

4.6 Energy Security

There are two aspects to energy security: first, the objective of ensuring that all who need energy services have access to them, which is important to ensure social inclusion and to fight poverty; and, second, the objective of maintaining an uninterrupted supply of energy. That requires a robust energy infrastructure, access to a variety of primary energy sources and the diversification of energy imports to reduce geopolitical risks. Both aspects are important for Asia. As far as energy access across the population is concerned, about 60% of the 1.6 billion people around the world who do not have access to electricity live in Asia. The electrification rate is only 20% in Cambodia and Lao PDR and even lower, at 11%, in Myanmar. There is a heavy reliance on traditional biofuels. Imported energy has become more important in the energy mix of most Asian countries and reliance on fossil fuels is greater than the global average. Import dependence looks set to rise unless there is a step change in the exploitation of domestic energy resources. One response of governments in the region has been to stimulate the production of renewables but, so far, these have not made a major impact on countries' energy mixes.

This is another area where there are potential synergies between the pursuit of environmental objectives and other important development goals. For example, reducing dependence on traditional biomass can bring down airborne particulate emissions. Asia has extensive renewable energy resources that could be further developed to do this while at the same time extending access to energy and reducing dependence on foreign imports.

A recent major study by the ADB (2009) identified a number of useful energy security policy initiatives:

(1) Reducing price distortions in energy markets, particularly by removing subsidies to fossil fuels (while introducing more targeted support for poor households).
(2) Scaling up successful pilot projects and local initiatives in renewable energy supply.
(3) Improving the regulation of public-sector energy supply to improve its cost effectiveness, including by increasing private-sector involvement and competition.
(4) Improving regional collaboration on renewable energy R&D and the adaptation of energy technologies to Asian circumstances.

(5) Using modern technology such as 'smart' grids to leapfrog older technologies, making it easier for energy demand to respond to prices and for renewable energy to be used effectively.
(6) Offering incentives to the private sector to invest in renewable energy and energy efficiency.
(7) Helping energy efficiency projects benefit from the CDM.

4.7 Fostering the Sources of Low-Carbon Green Growth

Low-carbon green growth is a pro-poor, pro-environment, pro-job development strategy for emerging Asia. Harnessing the full potential of green growth requires the use of policies across a wide range of areas to correct existing market and policy failures, particularly those arising from environmental externalities and inadequate incentives for innovation. Well-designed policies can improve the properly measured productivity of economies, stimulating growth rather than holding it back, and reducing the risk of environmental catastrophes.

Action is required in four broad areas. First, the costs imposed by producers on others for which they do not currently have to pay should be internalized. Hence energy subsidies need to be unwound and carbon pricing introduced. That can improve energy efficiency and generate tax revenues to fund other national objectives. Second, locally appropriate innovation in production technologies, and products and management methods, needs to be stimulated. That requires sector-specific initiatives and more regional cooperation. Third, incentives for efficiency, particularly in the use of natural resources and the services provided by the natural environment, need to be improved. The focus must be on what is appropriate for nations in the longer term, given the long lives of many investments, particularly in the energy sector. Policy-makers need to discourage private investors from locking in inefficient technologies when they invest by offering clear signals about the potentially high returns from the transition to green growth. Fourth, the social dimension of growth needs to be integrated with the macroeconomic dimension. Enhancing communities' capacities for collective action should improve economic, social and environmental outcomes.

In all four areas, there are 'no regrets' strategies available where the resource costs of action are relatively small, the likely benefits significant and the risks avoided are substantial. But there are obstacles that must be overcome, including the analytical challenge of designing efficient policies and the political challenge of improving governance and overcoming those entrenched economic interests benefiting from the status quo. The danger is that such obstacles will lead to delay. The message is clear – emerging Asia needs to take action now to be a low-carbon leader in the future.

5 Regional Cooperation for Seizing the Opportunities

Effective regional and international co-operation are central to improving green growth and creating low-carbon societies. Regional cooperation can be a 'win-win' situation for the concerned countries in distributing their pooled resources fruitfully towards regional development without hurting national development. Emerging Asia is well-positioned to harness the opportunities of low-carbon green growth through regional cooperation. Despite the differences in governance structure and inequalities across countries in terms of GDP, and physical and human infrastructure, the emerging Asian economies also show similarities in terms of emissions growth, developmental challenges and lifestyle choices.

5.1 Market-Based Approaches

Trade in Low-Carbon Technologies and Services

In addition to domestic technology policies, an important issue for emerging Asia is access to low-carbon technologies available elsewhere. Liberalization of trade and reduced tariff rates for low-carbon green products and services would accelerate technology transfer. Higher tariffs on environmental technologies are a major barrier to the wider use of such technologies.

Those observations suggest that emerging Asian countries will need to upgrade their export profile towards the manufacturing of greener products for the region's rapidly expanding consumer products sector. New opportunities, all of which generate jobs and confer competitive advantage, include: (i) the production and export of solar and wind technology (ii) trade in ethanol fuel and technology and flex-fuel vehicles technology (iii) new high-tech energy industries and the green services sector, with opportunities in export and expertise. In the context of global emissions reductions, an outstanding and significant issue is the prospect of an extensive transfer of intellectual property. If patent protection limits the ability of domestic manufacturers in Asia to adapt externally developed technologies, their dissemination is likely to be lower. To help overcome this obstacle, emerging economies could be involved in international collaborative partnerships from the R&D stage (Table 6). Achieving extensive technology and financial transfer from advanced economies will also require new arrangements and, perhaps, willingness on the part of developed countries to forgo some commercial interests of their own industries.

The integration of regional markets has also been seen as a prerequisite for reducing emissions in a cost-effective way, and will continue to be a key factor if countries are to benefit from new private flows of finance through mechanisms such as the CDM, and new export opportunities for environmental goods and services. However, emerging climate-change regimes are likely to result in shifts in comparative advantage, and new export opportunities and risks, to which

emerging Asia will need to adapt. For example, mandatory emissions targets could create incentives for relatively 'dirty' industries to move to the developing Asian countries that do not have emissions caps. However, border tax adjustments are also being considered by some developed countries to prevent this carbon leakage, which could have consequences for access to other export markets.

Emerging Asia would benefit greatly from the knowledge created by the experience of emissions reduction activities in advanced economies such as Japan, the Republic of Korea and Singapore. Shifting away from the traditional growth paradigm, which is heavily dependent on fossil fuels, requires both strong political support from the top and the institutionalization of green growth programs.

Regional cooperation extends beyond developed countries. Despite the variability in their economic structure and societies, the major economies of developing Asia share two important characteristics: high rates of growth and the need to alter their development trajectories. Achieving the latter transformation given the former trend will throw up many policy challenges. The exchange of knowledge about how to overcome these many policy challenges will be mutually beneficial, particularly with regards to least-cost technology innovation and adoption, difficult reform processes, and the minimization of mitigation costs. The coordination of national policies may reduce the prospect of intra-regional carbon leakage. If and when national carbon prices arise, regional links could reduce mitigation costs by exploiting areas of comparative advantage in reducing emissions, such as deforestation in Indonesia, agriculture in Viet Nam, or the efficiency of coal-fired power plants in India.

Developing Regional Carbon Markets

Financing is one major obstacle for the implementation of low-carbon green growth policies. Most of Asia's emerging economies do not have the public resources to fund a comprehensive approach to low-carbon green growth, so private sector participation is critical. However, many low-carbon projects have a long payback time. Governments can play a catalytic role by setting up low-carbon funds and changing tax policies and subsidies to cushion private investment risks.

It is in the developed world's interests for developing Asia to cut emissions. From the perspective of equity and historical responsibility, it is necessitous for developed countries to show leadership and share responsibility in financing the significant gap between the up-front benefits and costs of mitigation, technology transfer and capacity-building. Domestic motivations, such as energy security, employment generation, and improved local environmental conditions, involve substantial benefits over time, but may not be enough to drive the major additional transformations required. Substantial additional investments in, for example, renewable energy need to occur soon to avoid a situation where more fossil fuel power generation capacity is built now, thereby building an energy infrastructure that locks in high future emissions. Developing countries will need the financial assistance they have been promised by the developed world because they also

Table 6: Public Policy Choices for Promoting Low-Carbon Technologies through Regional Economic Cooperation

Type of Economy Based on Carbon-Intensiveness	Trade in Low-Carbon Goods and Services	Foreign Direct Investment (FDI)	Trade in Knowledge (Licensing)	International Property Rights (IPR)	Low-Carbon Industrial Policies
Domestic Policies					
Low-carbon intensive - Bangladesh, Lao PDR, Cambodia, Sri Lanka, Nepal	Liberal access	Non-discriminatory investment promotion	Improve information flows about public domain and mature technologies	Basic protection and minimum standards only	Basic education; improve infrastructure; reduce entry barriers
Low medium-carbon intensive - Indonesia, Thailand, Viet Nam	Liberal access	Non-discriminatory investment promotion	Improve information; limited incentives for licensing	Wider scope of IPR protection; employ flexibilities	R&D support policies; improve infrastructure; reduce entry barriers
High-carbon intensive - People's Rep. of China and India	Liberal access	Upstream supplier support programs	Improve information; limited incentives for licensing	Apply full TRIPS	R&D support policies; improve infrastructure; reduce entry barriers
Developed-Country Policies Towards Emerging Asia					
Low-carbon intensive - Bangladesh, Lao PDR, Cambodia, Sri Lanka, Nepal	Subsidize public-good-type imports; free trade	Incentives for outward flows exceeding those for FDI	Subsidize transfer of public domain and mature technologies	Forbearance in disputes; differential pricing for exports of IPR products; competition policy assistance	Support for general low-carbon technology policies; public and public-private research facilities
Low medium-carbon intensive - Indonesia, Thailand, Viet Nam	Free trade; no controls	Incentives equal to those granted for own disadvantaged regions	Assistance in establishing joint venture partnerships; matching grants	Differential pricing of public-good type IPR protected goods; competition policy assistance	Support for general low-carbon technology policies; fiscal incentives for R&D performed in developing countries
High-carbon intensive - People's Rep. of China and India	Free trade; no controls	Incentives equal to those granted for own disadvantaged regions	Assistance in establishment of joint venture partnerships; matching	Differential pricing of public-good type IPR protected goods; competition policy assistance	Support for general low-carbon technology policies; fiscal incentives for R&D

have a range of other developmental priorities to consider, including spending on healthcare and education. As arrangements for the UNFCCC Green Climate Fund progress in a risky global economic environment, it is pivotal that developed countries fulfill their climate finance commitments; the major economies of developing Asia cannot be expected to carry the full burden of their mitigation costs alone, but can leverage current actions to get additional international finance.

5.2 Non-Market – Policy Networking and Capacity Building

Managing the transition to low-carbon green growth demands substantial institutional capacity and synergy. Not only do systems need to be put in place to design and manage the mechanism over time, government bureaucracy needs to

monitor emissions, ensure compliance through credible enforcement and monitor the economic and social impact of policies. Creating the necessary additional institutions is hard enough - doing so in developing countries where institutional capacity may already be lacking will be even harder still. A large body of skilled professionals in planning agencies with ample resources and deepened knowledge of proven policy practice will be required.

Moreover, there is poor coordination of policies on technology transfer, trade and investment. Technical standards are not harmonized, business associations advocating renewable energy are weak and there is consumer skepticism about low-carbon technologies. There is also little information on the effectiveness of various incentives and tax mechanisms. Access to funding from banks or financial institutions is poor because of a lack of strong MRV systems.

None of these conditions or requirements is likely to come about easily; improved governance is a much sought after, yet difficult to attain, objective in many developing economies. Fortunately, however, developing Asia is gaining increasing experience within the domain of climate-change mitigation – the Perform, Achieve, and Trade Mechanism in India, generation rights trading and the pilot emissions trading schemes in the PRC, or the various fossil fuel taxes in all countries – and the lessons learned and extra capacity created will facilitate future institutional reform. A regional effort for sector or economy-wide institutional strengthening is needed. Countries need to establish regional level low-carbon innovation centers and invest in training programs to expand their capabilities to implement policies and regulations.

5.3 Low-Carbon Agenda in Sub-regional Cooperation Programs

There is a growing need, at the sub-regional level in the Asia and Pacific region, to integrate climate change considerations and the low-carbon agenda in organizations such as the Greater Mekong Subregion (GMS), Association of Southeast Asian Nations (ASEAN), Central Asia Regional Economic Cooperation (CAREC), and South Asian Association for Regional Cooperation (SAARC). Sub-regional groups are expected to address specific issues (e.g., clean energy trade in the GMS). For example, through a long term dialogue, GMS countries agreed to enter in to power trade agreements to help each other meet energy needs. In the case of Thailand and Lao PDR, they signed an agreement to trade up to 18,000 MW of electricity under which several regional power trade investments (such as Nam Theun II Hydroelectric Project and Theun Hinboun Hydropower Project) were successfully implemented. The benefits of such collaboration are twofold: (i) to displace Thailand's coal-fired power plants with clean energy electricity from Lao PDR; (ii) to coordinate the different demand peak times of neighboring countries to meet each others' energy needs without having to add new generation capacity.

6 Conclusions and Recommendations

The analysis throughout this book makes a strong case that developing Asia must be at the center of the global agenda on low-carbon and green growth. Asia has much at stake in the global fight against climate change; the region is the world's most populous, has had high economic growth and a rising share of global greenhouse gas emissions, and parts of Asia are among the most vulnerable places in the world to looming climate risks. Nowhere on the planet are economies, material consumption, poverty and emissions growing faster than in developing Asia.

Developing Asia has indeed been moving ahead actively in the journey to low-carbon green growth. This is notwithstanding the political issues that some Asian governments have had with the global framework for tackling climate change under the United Nations. Increasingly, the region's policymakers and stakeholders see the new economic opportunities that low-carbon green growth offers for inclusive, pro-poor and sustainable growth. This is evident from the great weight that energy efficiency and renewable energy receive in policy discussions in Asia, and from the many initiatives that Asian countries have started to introduce and implement in recent years. It is certainly the case that recent policy announcements and targets have already transformed emissions trajectories and developing Asia is making a major contribution to collective global efforts. Asia's shift towards low-carbon growth can be accelerated through targets and sectoral interventions as illustrated in the Table 7.

Table 7: National Level Sector Specific Recommendations for Accelerating Low-Carbon Green Growth

National Level Recommendations
Energy
Seek cost-effective, market-based solutions for the uptake of existing technologies • Invest in reducing the cost of existing low-carbon energy efficient technologies such as solar, wind, bio-energy etc Continue to focus on lowering the energy intensity and improving the carbon productivity by changing the energy mix to augment the decoupling. • Gradually remove energy sector fuel subsidies and introduce true energy pricing through mechanisms such as feed-in tariff (FIT) and renewable portfolio standards (RPS) • Progressively amend laws in order to scale up renewable energy in a competitive market dominated by fossil fuels.

Table 7: National Level Sector Specific Recommendations for Accelerating Low-Carbon Green Growth *(continued)*

Energy Efficiency
Using a combination of regulations and market-based policy instruments improve energy efficiency • Launch top-runner programs for industrial technologies and electrical appliances • Expand carbon reduction labelling programs for high impact sectors • Develop a focused and well packaged regulatory system for SMEs that integrate efficiency standards and targets by assisting with compliance mechanisms, including providing funds and matching grants with goals • Develop sectoral guidelines and training to achieve energy efficiency standards
Transport
Develop new regulations, policies and financing mechanisms to alter current fleet growth patterns • Introduce new performance-based targets and incentive systems, such as tax exemption for low-carbon vehicles for the transport sector • Progressively improve the fuel efficiency and pollution standards for passenger cars and light duty vehicles • Introduce retail sales of bio-fuels such as ethanol in urban and rural markets • Develop a consistent framework for integrating externalities such as local air pollution and use that to promote efficient and seamless multi-modal transport systems
Agriculture & Forestry
Identify and implement the immediate actions needed to restore carbon sink • Introduce new market-based incentives for restoring degraded forests and providing rural employment • Inspection capacity to be doubled and penalties increasing the penalty for illegal logging tightened • Scale up pilot schemes for carbon sequestrations and input (water and fertilizer) saving technologies • Extend awareness of market-based instruments to isolated communities/poor farmers
Urban Sector Measures
Scale up coordinated policies for land use planning, urban infrastructure and finance • Change regulations and standards that leading to the inefficient use of energy and materials, as well as barriers to mobility • Roll out market-based mechanisms such as carbon pricing and cap-and-trade to encourage the efficient use of public resources • Encourage and provide advice on low-carbon life style choices and mentoring programs for neighborhoods • Pilot new performance- based indicators for local officials of mega cities

Industry & Trade
Create competitive markets focused on high value added, low-carbon products and services • Integrate low-carbon targets and objectives into central and state level industrial policy • Link industrial promotion incentives and private sector innovations to carbon performance • Reduce the tariff rate for low-carbon environmental goods and services and strengthen intellectual property regimes • Provide information and training on existing and emerging technologies, management practices and related green business opportunities available internationally
Fiscal
Identify and implement immediate actions needed to introduce market-based instruments • Introduce budgetary reforms with gradual increase in energy taxes or carbon pricing. • Introduce performance based tax incentive systems for achieving sectoral emission targets • Explore innovative financing instruments and accelerate R&D support for future industries through climate change agenda • Improve efficiency, transparency and accountability in the financial sector, by including rating programs and MRV systems linked to credit lines

This book has focused on the importance of a broad approach to addressing climate change mitigation that extends across all sectors of the economy and that involves all levels of government. While it is too early to judge the efficacy of many of the policies that have been set out, a focused assessment of policy actions is critical to distill lessons for timely feedback and to speed up further actions for effective responses. What emerges from the cross-country review is that isolated or sector-focused policies will not be sufficient for the major switch to a low-carbon, environmentally sustainable trajectory. Much more synergy has to be developed among sectoral actions to meet economy wide targets and avoid excessive lock-in effects.

The findings of the study can be summarized as follows.

1. Current patterns of economic growth in Asia are unsustainable and have to change. The problem is urgent – infrastructure built now and in the next five years risks locking in a long-term future of high emissions, if it is built along the high carbon lines of the past.
2. The window of opportunity for low-carbon development in Asia is narrowing. Countries in Asia must take immediate action to get on a path which embraces economic growth, social inclusion and environmentally sustainable development.
3. Low-carbon growth is not just about climate change mitigation. It also makes tremendous sense to sustainable development planning, as it steers nations away from dependence on the highly volatile fossil fuel market, while green infrastructure development opens vast new business opportunities.

4. The actions taken so far have been impressive, but the effort to implement low-carbon green growth must be strengthened and the low-carbon development agenda needs to expand to cover all sectors beyond energy.
5. Clearly set long-term targets and plans, systematically designed policy interventions, and coordinated implementation will be needed to provide the proper business signals that are key to effective action.
6. Asia's ambitious low-carbon green development agenda will be achieved by harnessing the full range of available policy instruments that correct market failures.
7. Innovation at the economy-wide level holds the key for developing Asia to decouple future economic growth from high carbon emissions and high rates of resource use.
8. Leveraging and catalyzing low-carbon financing, especially through private capital, requires special attention. Developing countries need to create an appropriate policy and legal environment to attract more private sector participation.
9. There is significant opportunity for developing Asia in regional cooperation to advance the low-carbon green growth agenda.
10. The journey ahead towards low-carbon green growth remains challenging. There is a need for continued effort to review and assess the progress made and to review and provide guidance in implementing further action. With the rich diversity of country experiences comes the opportunity for continued sharing of policy insights and good practice on the ground. All this calls for an institutionalized mechanism at a regional level.

Recommendations for Near-Term Collective Actions

High priority actions have already been proven in some parts of Asia and could be scaled up at regional level in the coming years. The following key recommendations can form the basis of an effective push to low-carbon green growth for the region.

1. A regional partnership program on renewable energy, setting targets and using existing initiatives including feed-in tariffs and renewable energy portfolio standards.
2. An effective capacity development program at a regional or sub-regional level to help create an enabling policy and legal environment to attract private sector participation. International development institutions should use risk-mitigating products (e.g., political risk guarantees, credit risk guarantees, etc) to encourage private sector investment in low-carbon infrastructure development.
3. A set of regionally accepted minimum efficiency standards should be developed and applied to a limited but critical range of energy-intensive industrial and consumer goods, and buildings, whether they are existing buildings being refurbished or new buildings being constructed. As part of this, governments

should develop energy efficiency labeling for electrical appliances, consumer products, and industrial manufacturing processes, building on work currently under way.

4. Implement proper land use planning in both urban and rural areas and encourage investment in low-carbon infrastructure including transport. Develop MRV (measuring, reporting and verification) standards for low-carbon infrastructure projects for ultimate adoption by all countries.
5. Promote a regional public – private portfolio of several large-scale integrated smart city and smart grid demonstration projects across different regulatory regimes.
6. Establish a network of regional low-carbon innovation centers modeled on the Consultative Group on International Agricultural Research, to help developing countries accelerate the uptake of low-carbon technology. Regional development institutions such as ADB should be engaged in recording the progress made in comparison with other regions, and helping countries learn from each other.
7. Create a free-trade zone within Asia for high-impact green and low-carbon technologies and services.
8. Create a regional carbon market. This will require the setting up of a regional public - private policy dialogue and framework to prepare the ground for the introduction of market-based mechanisms and develop a transparent institution and structured rules for such a market.
9. Encourage the phasing out of pervasive fossil fuel subsidies, using a regionally coordinated approach. This should be done as a prelude to introducing fiscal reforms that encompass a range of pricing and taxation instruments, including taxes on fossil fuels and other resources.
10. Set up a regional platform to encourage REDD+ (reduced emissions from deforestation and degradation) projects and push for reforms to the rules governing the UN's CDM. This platform should be hosted by key forest nations of the region and involve the international community, regional financial institutions, civil society and the private sector.

Bibliography

Asian Development Bank (ADB). 2011. *Asian Development Outlook*.

———. 2009. *Improving Energy Security and Reducing Carbon Intensity in Asia and the Pacific.*

Asian Development Bank (ADB), United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and United Nations Environment Programme (UNEP). 2010. *Green Growth, Resources, and Resilience.* Bangkok, Thailand. http://www.unescap.org/esd/environment/flagpubs/GGRAP/

Asian Development Bank Institute (ADBI). 2012. *ASEAN 2030 Toward a Borderless Economic Community* (draft highlights). Tokyo, Japan.

Central Intelligence Agency (CIA). 2011. "The World Factbook" online, https://www.cia.gov/library/publications/the-world-factbook/.

Chtotichanathawewong, Qwanruedee and Natapol Thongplew. 2011. "Development Trajectories, Emission Profile and Policy Actions: Thailand." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Dellink, R., G. Briner and C. Clapp. 2010. "Costs, Revenues, and Effectiveness of the Copenhagen Accord Emission Pledges for 2020." *OECD Environment Working Papers No. 22*. OECD Publishing, http://dx.doi.org/10.1787/5km975plmzg6-en

Dervis K. and A. Jones (2009). *Climate Change Policy: Recommendations to Reach Consensus*. Brookings Bulm Rountable.

Global Access Partners. 2009. "Low Carbon Economy: Business Opportunities for Australia." Report by the Low Carbon Economy Task Force, Global Access Partners.

Frankel, J.A. 2009. "An Elaborated Global Climate Policy Architecture: Specific Formulas and Emission Targets for All Countries in All Decades." NBER Working Paper Series, Working Paper No. 14876. National Bureau of Economic Research, http://www.nber.org/papers/w14876.

Howes, S. and L. Dobes. 2011. *Climate Change and Fiscal Policy: A Report for APEC*. World Bank: Office of the Chief Economist, East Asia and Pacific Region.

Howes, Stephen and Paul Wyroll. 2011. "Climate Change Mitigation and Green Growth in Developing Asia." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

International Energy Agency (IEA). 2010. *World Energy Outlook 2010*. Paris, France. International Energy Agency.

———. 2011. *World Energy Outlook 2011*. Paris, France: International Energy Agency.

International Labour Organization (ILO). 2009. *World of Work Report: The Global Jobs Crisis and Beyond*.

Intergovernmental Panel on Climate Change (IPCC). 2000. "Special Report on Emission Scenarios." *A Special Report on Intergovernmental Panel on Climate Change Working Group III*. Cambridge University Press. Cambridge.

Kainuma, Mikiko. 2011. "Development Trajectories, Emission Profile and Policy Actions: Japan." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Kalirajan, Kaliappa. 2011. "Regional Cooperation: Trade and Investment." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Kang, Sang In. 2011. "Development Trajectories, Emission Profile and Policy Actions: Republic of Korea." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Kawai, M. and J.W. Lee. 2010. "Rebalancing for Sustainable Growth: Asia's Post Crisis Challenge." Highlights of a Joint Study of the Asian Development Bank and the Asian Development Bank Institute.

Kim, Jootae. 2011. "Public Finance." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Kohli, Harinder, Ashok Sharma and Anil Sood (editors). 2011. *Asia 2050: Realizing the Asian Century*. Sage Ltd.

Mathur, Ritu. 2011. "Development Trajectories, Emission Profile and Policy Actions: India." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Martinot, Eric and Li Junfeng. 2007. "Powering [People's Republic of] China's Development: Role of Energy." Word Watch Institute. http://www.worldwatch.org/files/pdf/Powering%20China%27s%20Development.pdf

Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Current State and Trends*. Island Press, Washington DC.

Mohanty, Brahmanand. 2011. "Life Style Choices." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Nordhaus, W. D. 2010. "Economic Aspects of Global Warming in a Post-Copenhagen Environment." Proceedings of the National Academy of Sciences 107(26): 11721-11726.

Organisation for Economic Co-operation and Development (OECD). 2009. "Financing Climate Change Action, Supporting Technology Transfer and Development: Key Messages and Recommendation" from recent OECD work.

Patunru, Arianto. 2011. "Development Trajectories, Emission Profile and Policy Actions: Indonesia." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Ramanathan, Krishnamurthy. 2011. "Eco-Innovation and International Technology Transfer." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Sachs, Jeffrey and Shiv Someshwar. 2011. "Green Growth and Equity: Some Considerations." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Salim, Emil. 2011. "Pro-growth, Pro-poor, Pro-Job, Pro-environment." Key note speech at the Asian Development Bank and Asian Development Bank Institute workshop on Climate Change and Green Asia.

Schipper, Lee, Herbert Fabian, and James Leather. 2009. "Transport and Carbon Dioxide Emissions: Forecasts, Option Analysis and Evaluation," *ADB Sustainable Development Working Paper Series*. http://cistup.iisc.ernet.in/UrbanMobility8thMarch2012/TransportCO2emmissionsADB.PDF

Shrestha, M., S. Pradhan and M. Liyanagek. 2008. *Effects of Carbon Tax on Green House Gas Mitigation in Thailand*.

Stern, Nicholas. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge: Cambridge University Press.

Sivanappan, Kumar. 2011. "Co-Benefit Technologies and National Innovation Systems." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Stiglitz, Joseph. 2010. *Freefall: America, Free Markets, and the Sinking of the World Economy*.

Sudo, Tomonori. 2011. "Climate Finance and International Financial Institutes." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Toan, Pham. 2011. "Development Trajectories, Emission Profile and Policy Actions: Viet Nam." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), Asian Development Bank (ADB) and United Nations Development Programme (UNDP). 2010. *Asia Pacific Millennium Development Goals (MDGs) Report*.

———. 2012. *Green Growth, Resources and Resilience: Environmental Sustainability in Asia and the Pacific*. United Nations and Asian Development Bank publication.

UNEP (United Nations Environment Program). 2010. "The Emissions Gap Report." http://www.unep.org/publications/ebooks/emissionsgapreport/.

United Nations (UN). 2009. *World Economic Situation and Prospects*. United Nations, New York.

United Nations (UN). 2009. *Report of the UN Secretary-General's High Level Advisory Group on Climate Financing*. November, 2009

Ward, Murray. 2008. *The Role of Sectoral No-Lose Targets in Scaling up Finance for Climate Change Mitigation in Developing Countries*. Wellington.

World Bank. 2009. *Global Economic Prospects 2009. Commodities at the Crossroads*. The World Bank. Washington DC.

World Bank. 2009. *Low Carbon Growth; Country Studies Program. Mitigating Climate Change through Development*. The World Bank. Washington DC.

World Bank. 2009. "Options for Low Carbon Development." Synopsis of a study by the World Bank for Government of India. The World Bank. Washington DC.

World Bank 2011, "World Development Indicators DataBank," http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2.

Wyes, Heirich and Michael Lewandowski, 2011. "Narrowing the Gaps through Regional Cooperation Institutions and Governance Systems." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Zhu, Yuezhong. 2011. "Development Trajectories, Emission Profile and Policy Actions: People's Republic of China." Background paper prepared for the Asian Development Bank Institute Climate Change and Green Asia Flagship Study.

Appendix

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International Advisory Committee	Position and Organization
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Policies and Practices for Low-Carbon Green Growth in Asia

Asia is at a crossroads. As the world's most populous region, with high economic growth, a rising share of global greenhouse gas emissions, and the most vulnerability to climate risks, Asia must be at the center in the global fight against climate change. Simply stated, Asia's current resource- and emission-intensive growth pattern is not sustainable, with further gains in human well-being constrained by the environmental carrying capacity. This study recognizes low-carbon green growth as an imperative—not an option—for developing Asia.

The region has taken on board the message that it must change, and it is starting to move toward low-carbon green growth. Many emerging economies have started the shift toward a new sustainable development paradigm that brings competitiveness to its industries and serves growing green technology markets.

The goal of this study is to share with developing nations the experiences of advanced Asian economies and the lessons they have learned, while widening and deepening actions in both. The study reviews and assesses the low-carbon and green policies and practices taken by Asian countries while identifying gaps and examining the new opportunities for low-carbon green growth.

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