Alex Bowen, Ruth Kattumuri

Transition lessons: going green as a development strategy

Book section

Chapter 4
Transition Lessons: Going Green as a Development Strategy

Chapter 4
Transition Lessons: Going Green as a Development Strategy

4.1	Opportunities in Green Growth	123
4.2	Social Inclusion and Equity	125
4.2.1	Why Promoting Social Inclusion is Vital for Green Growth	125
4.2.2	Dealing with the Cost of Going Green	134
4.2.3	Policy Implications	135
4.3	Green Jobs	127
4.3.1	Opportunities and Challenges in Labor Markets	137
4.3.2	Policy Implications	150
4.4	Expansion of Demand	151
4.4.1	Promoting Growth by Increasing Demand	151
4.4.2	The Asian Experience	152
4.4.3	Policy Implications	155
4.5	Innovation	157
4.5.1	Why Innovation Matters	157
4.5.2	The Asian Experience	158
4.6	Energy Security	162
4.6.1	The Two Dimensions of Energy Security	162
4.6.2	The Asian Experience	163
4.6.3	Policy Implications	169
4.7	Towards a New Policy Approach	169

4.1
Opportunities in Green Growth

The transformation required if a low-carbon world is to be achieved entails many challenges to economic policy makers in Asia, as the previous chapters make clear, but it also opens up many opportunities to build more innovative, more sustainable, more resilient, and more socially inclusive economies. This potential means "going green" can propel economic development, if policies are well designed. This chapter reviews some of the major opportunities for enhancing development in key areas of social and economic policy. First, it considers the scope for low-carbon green growth to promote social inclusion and equity, which is of central importance if poverty is to be sharply reduced and development is to benefit all sectors of society. Then the chapter focuses on the possibilities for creating jobs and expanding aggregate demand. Job creation and full utilization of economies' resources are important in underpinning economic growth and providing opportunities to all sections of the population to share in its benefits. Neglecting low-carbon green growth risks missed opportunities for all economies. This chapter discusses the contribution that green growth policies could make to stimulate innovation across the whole economy, which is key to ensuring that growth continues in the long term. Finally, it draws attention to the potential role of low-carbon policies in improving energy security, from the perspectives of both energy-poor families and governments concerned to guarantee continuous access to energy supplies.

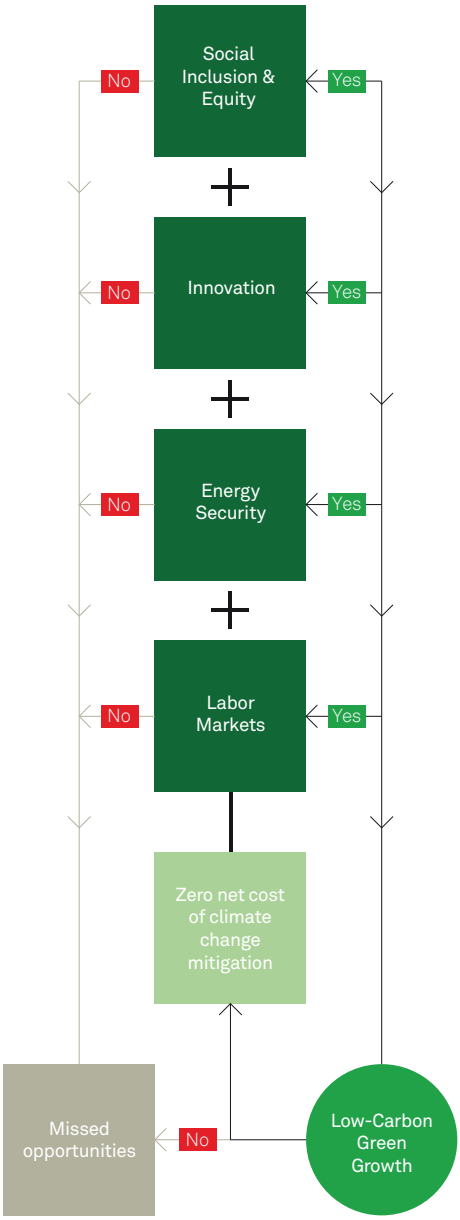
The framework for a low-carbon green growth development strategy is in Figure 4.1, which highlights how new growth implies action on social inclusion and equity, innovation, energy security and labor markets; without such action, there will be missed opportunities. The chapter elucidates this framework and provides examples of successes, identifies obstacles to be overcome, and discusses the implications for the design of policies.

Some low-carbon green growth opportunities are already being seized but the efforts began only in the past 5 years and progress varies across countries. There is much scope for policy makers to learn from each other, identify best practice, and adapt their strategies for growth and development to exploit synergies to halt human-induced climate change and enable more resilient and socially inclusive economies and societies. Without such adaptation, the prospects for poverty alleviation and a continuing convergence with living standards in developed countries will dim.

The transition to green growth requires nations to tackle environmental problems, especially human-induced climate change, which are threatening people's well-being and inhibiting the scope for sustained economic growth—particularly in some of the poorest countries, because of their vulnerability to climate change. Many of these environmental problems involve "externalities"—situations where those damaging the environment by their activities do not have to face the consequences of their actions, unless policy makers intervene. These externalities require policy interventions.

Figure 4.1

Low-Carbon Green Growth Development Strategy



Source: ADB–ADBI study team.

Designing cost-effective policy interventions is not easy, even where the direct resource costs are low. In particular, policy makers have to identify market and policy failures and overcome opposition from groups with vested interests in the status quo. However, if policy makers take this challenge seriously, they can produce significant benefits, not only in the form of improved environmental outcomes but also in greater social inclusivity and fairness, higher economic growth, and better energy security. Just as climate change mitigation can generate so-called co-benefits from reduced local pollution, there are co-benefits for economic growth and well-being from tackling a broad range of environmental problems with the right tools and incentives. The key message is that a comprehensive set of policy instruments needs to be used if development prospects are to be enhanced and Asia's ambitious emission reduction and renewable energy targets are to be achieved. If countries grasp this opportunity, growth can be stronger, more sustainable, and more equitable.

4.2
Social Inclusion and Equity

4.2.1
Why Promoting Social Inclusion is Vital for Green Growth

Action on climate change that hinders development, discourages the inclusion of significant groups in economic and social activity, or is widely regarded as unfair can never build the global coalition on which effective, efficient, and equitable action depends (Stern, Kattumuri, and Rydge 2012). One issue of great importance to developing countries is to ensure a strategy whereby existing resources are used sustainably and in accordance with the needs of the local populace (Sathaye, Shukla, and Ravindranath 2006).

However, if climate change policies have regard for social inclusion, they can benefit development more broadly than just by reducing climate change risks. First, reductions in inequality tend to encourage conventionally measured economic growth, as argued by Duflo and Banerjee (2003) and illustrated by Wan, Lu, and Chen (2006) in the case of the People's Republic of China (PRC). Second, promoting social inclusion and reducing poverty are widely regarded as an integral part of development strategies and worthy ends in themselves. Third, empowering the poor will help the most vulnerable to develop the capacity to adapt to climate change that is now unavoidable.

Based on a case study in Bangladesh, Ayers and Huq (2008a) argue that combining mitigation and adaptation can contribute to the sustainable development goals of climate change. Goklany (2007) identifies that climate change could exacerbate existing climate-sensitive hurdles to sustainable development (hunger, malaria, water shortage, coastal flooding, and threats to biodiversity) faced by many developing countries.

Unmanaged climate change risks irretrievably damaging prospects for development and greater inclusion. About 1.29 billion people, 22% of the developing world's population, live on less than $1.25 a day (World Bank 2012d). A similar number have no access to electricity, while 3 billion lack adequate sanitation and 1 billion have no clean drinking water. For many of these marginalized communities, the daily struggle for survival will be made more difficult by the environmental shocks from climate change (Casillas and Kammen 2012). Even with a temperature rise of 1.0°C–2.5°C, the Intergovernmental Panel on Climate Change (IPCC 2007a) predicts serious effects, including reduced crop yields in tropical areas leading to increased hunger, the spread of climate-sensitive diseases such as malaria, and an increased risk of extinction of 20%–30% of all plant and animal species. Countries in Asia are among the most vulnerable to extreme weather (Table 4.1). Much adaptation to climate change will have to be undertaken at grassroots level, because climate change impacts across localities will be varied. Empowering vulnerable groups will enable them to mitigate their risks to climate change. Ensuring that climate change mitigation is socially inclusive thus promotes both mitigation and adaptation.

Table 4.1

Economies Most Vulnerable to Weather Impacts to 2015 (per 100,000 Population)

Economy	2008 Rank	2015 Rank	2008	2015 Climate only	2015 Climate & income	2015 Climate income, urbanization, & regulation
PRC	3	1	6,772	25,072	19,933	17,720
Djibouti	1	2	13,709	14,281	14,167	14,331
India	7	3	2,599	11,704	9,531	9,153
Kenya	2	4	6,807	7,752	7,620	7,617
Somalia	8	5	2,382	4,011	3,807	5,482
Mozambique	4	6	4,576	5,133	5,028	5,269
Philippines	10	7	2,134	5,161	4,607	5,102
Bangladesh	19	8	823	5,487	4,611	4,844
Sri Lanka	6	9	3,458	4,304	4,072	4,558
Ethiopia	5	10	3,791	4,892	4,747	4,540
Viet Nam	11	11	1,904	4,696	4,121	3,834
Bolivia	20	12	638	1,508	1,362	3,573
Hong Kong, China	17	13	1,251	3,877	3,147	2,413
Cuba	9	14	2,190	2,221	2,213	2,227
Madagascar	14	15	1,314	2,203	2,076	2,122
Honduras	18	16	1,237	2,303	2,148	2,104
Thailand	16	17	1,271	1,996	1,813	1,863
Zambia	12	18	1,718	1,877	1,847	1,853
Colombia	15	19	1,299	2,026	1,892	1,781
Zimbabwe	13	20	1,692	1,714	1,709	1,721

Source: Wheeler (2011).

Basu (2006; 2008) and Flipo and Schneider (2008) argue that the present triple threat of environmental, social, and economic crises offers the perfect opportunity to promote low-carbon green growth and the creation of opportunities leading to socially inclusive and equitable development.

Thus, there is a demand for a new development paradigm in which social transitions and sustainability go hand in hand with green growth initiatives. A low-carbon development path that is inclusive, equitable, and sustainable has the potential to create immense opportunities, empower communities, and protect the vulnerable.

There are many ways through which vulnerable communities can be strengthened while maintaining economic growth rates and mitigating greenhouse gas (GHG) emissions, including:

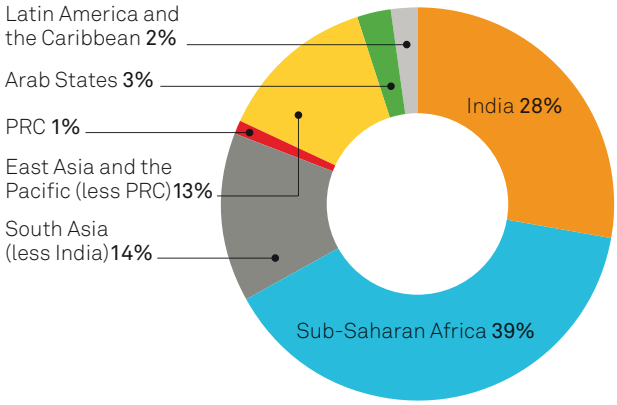
- Generating livelihoods and employment for the poor
- Empowering local institutions
- Generating environmental services
- Conserving natural resources
- Reducing vulnerability to climate risks.

These activities can be managed so that the poor are integrated into the green growth development path. Interventions ought to be cost-effective, leading to tangible economic benefits (such as increases in crop yield or water availability) and environmental benefits (such as reducing emissions or promoting biodiversity conservation).

Climate change exacerbates existing inequalities including wealth, access to energy, health, education, access to information, and access to resources (Masika 2002). Hence, low-carbon policies that are designed to promote social inclusion can have a doubly beneficial impact.

Figure 4.2

Distribution of Population without Electricity, 2008

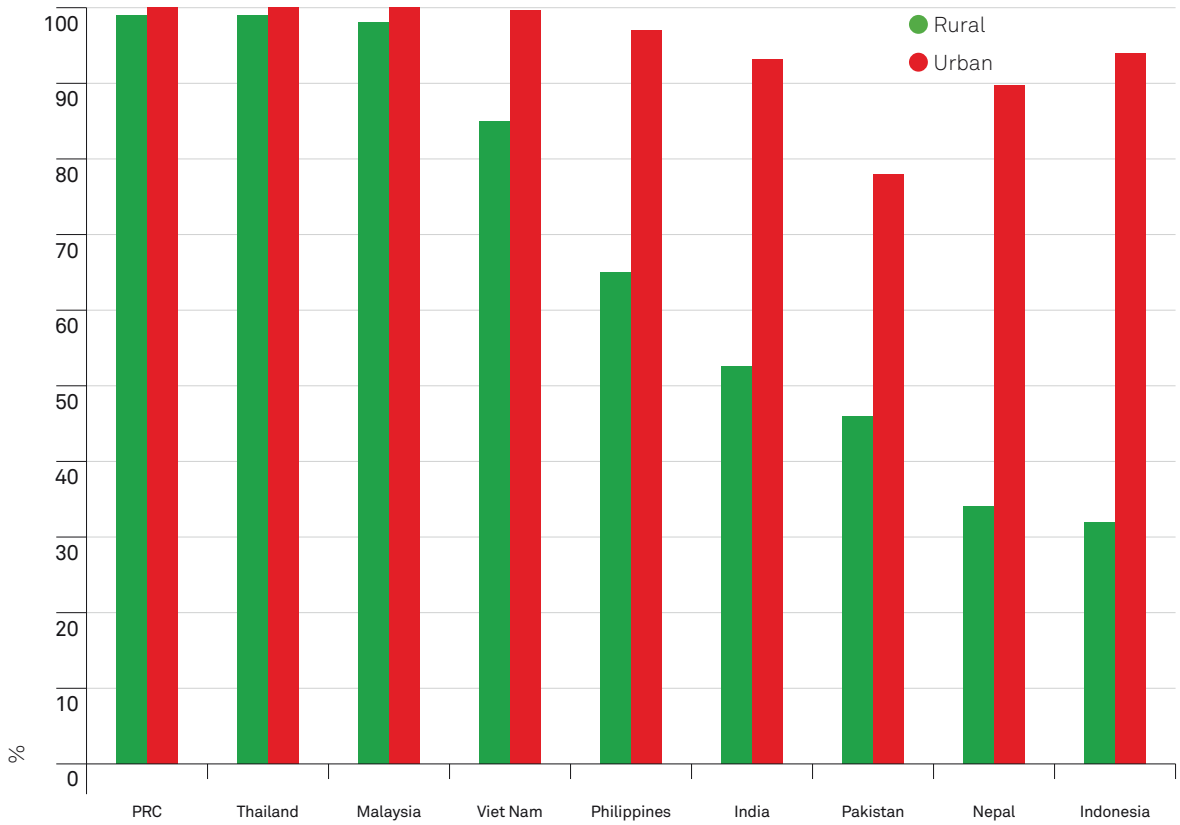


Sources: Derived from World Health Organization (WHO) and United Nations Development Programme (UNDP) 2009; ADB–ADBI study team.

About 28% of Indians and 14% in other South Asian countries lack access to electricity (Figure 4.2). Access to electricity is lowest in Bangladesh among the Asian countries for which data was available. Access to electricity is considerably lower in rural than in urban areas among the 10 Asian countries considered except in the PRC, Malaysia, and Thailand (Figure 4.3). Urban–rural inequality in access to electricity is severe in Bangladesh (76% of the urban population has access compared with 28% rural); India (93% of the urban population has access to electricity versus 53% rural); Indonesia (94% of the urban population has access compared with 32% rural); and Nepal (90% urban versus 34% rural).

Figure 4.3

Proportion of Rural and Urban Population with Electricity in Asia



Source: Derived from data in WHO and UNDP (2009); ADB–ADBI study team.

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 energy access to the poor and marginalized groups.

Small communities in India have pioneered a wide range of innovative and "home-grown" technologies, activities, and approaches. The following are a few examples (UNDP-GEF 2003):

1. Smokeless stoves
2. Solar energy for drying herbs and pumping water
3. Biogas technology
4. Micro-hydropower plants that depend on sustainable watershed management
5. Developing the capacities of energy micro-enterprises
6. Improving decentralized power policy and legislation
7. Commercializing rural solar electrification; and inventing more efficient and nonpolluting brick kilns.

Box 4.1

Grameen Shakti, Bangladesh – Community Participation using a Market-Based Approach

In Bangladesh, it is impossible economically and logistically to reach the millions of off-grid rural people with electricity through conventional means. Grameen Shakti, set up in 1996 as a not-for-profit company, developed an integrated program—using markets and social networks—to popularize renewable energy technologies in the form of solar home systems to millions of rural villagers. This offers an excellent example of an inclusive strategy for low-carbon development.

Grameen Shakti has been very successful in promoting renewable energy technologies in Bangladesh because it has developed a unique approach involving soft credit for consumers, adaptive technology to reduce costs, the maximization of income generation, and effective after-sales service. Grameen Shakti had installed 100,000 Solar Home Systems by June 2007. Bangladesh now has one of the fastest-growing photovoltaic programs in the world.

Grameen Shakti has emphasized collective community participation and motivation. It has employed local youth as technicians, trained users on home-based troubleshooting, and provided scholarships for its clients' children. It has focused on ensuring the participation of women, training women from user families in repair and maintenance, and employing local women as technicians. Grameen Shakti has promoted the benefits of renewable energy to rural women through demonstrations and house-to-house contacts.

Source: Barua (2007).

The Asian experience: Women's Empowerment

Differential access to social and physical goods or resources is one of the key dimensions of gender inequality. A United Nations (UN) report on gender equality and climate change established that the links among energy supplies, gender roles, and climate change are strongest in countries with low availability of basic electricity and modern fuels, as well as high dependence on biomass for cooking, heating, and lighting (UN Women Watch 2009). Around 2 billion people in the developing world, many of them in Asia, use traditional biomass as their primary source of energy. The UN report showed that access to cleaner and affordable cooking energy reduces women's drudgery, the time they spend gathering fuel, and the health impacts of indoor air pollution. Furthermore, women's responsibilities in households and communities, as stewards of natural and household resources, position them well to contribute to livelihoods adapted to new climate change policies and changing environmental realities. Thus, it is very important to empower women in developing countries and engage them in decision making on climate change policies. Women should be given greater involvement so that dependence on biomass can be reduced, energy supplies can be decarbonized and managed more effectively, and communities can be raised out of extreme poverty (UN Women Watch 2009). Box 4.1 exemplifies such an approach in Bangladesh.

The Asian Experience: Sustaining Livelihoods Dependent on Natural Resources

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 changing climate and economic exploitation for short-run benefits. Several measures such as low-till agriculture, afforestation, and community forest management reduce resource degradation, sustain the livelihoods of the rural poor (including those without their own land), reduce GHG emissions from agriculture, and increase carbon sequestration by forests.

The poor are often highly dependent for their livelihoods on common property natural resources, such as fallow fields, forests, fishing grounds, pastureland, and wetlands. These are a source of food, fodder, building materials, fuel, and medicinal plants. The poorer the household, the more important the contribution from common property resources. Common property natural resources contribute to rural equity (Organisation for Economic Co-operation and Development [OECD] 2009b).

Depletion of natural resources resulting from global environmental change has led to faltering livelihoods for some communities. Forest improvement options should therefore be properly designed and implemented, taking into consideration the many livelihoods that depend on these resources. They should be designed to provide substantial co-benefits in terms of employment and income generation opportunities, biodiversity and watershed conservation, and provision of timber and fiber. Box 4.2 depicts such an effect in India.

Box 4.2

Himachal Pradesh Mid-Himalayan Watershed Development Project, India

The project is an integrated multi-sectoral watershed development project, being implemented in the Mid Hills and High Hill zone of Himachal Pradesh. The state of Himachal Pradesh is largely agrarian and people's livelihoods depend on rain-fed crops, horticulture, and livestock. Nine out of 10 households are rural, and most live in small settlements, often in remote valleys. The rural population is heavily dependent on forests and community land for fuelwood, fodder, and food. Their heavy dependence on natural resources has degraded the forests around them, reducing their contribution as carbon sinks. According to a government estimate, more than 15% of the natural water resources have dried up.

The project has three components: (i) institutional strengthening – building the capacity of communities and local governments to effectively manage watershed development in a participatory, transparent, and demand-driven manner; (ii) watershed development and management, including the financing of soil and water conservation, non-arable land treatments, crop and livestock production, and rural infrastructure; and (iii) enhancing mountain livelihoods – the promotion of value-added agriculture and income-generating activities. Through this project, sustainable agricultural practices are being adopted. Water harvesting structures, supported by communities, are helping to harness water that earlier flowed by unused, and irrigation channels are carrying this water to faraway fields. This has changed the way people farm. With water reaching their farmlands, the villagers are no longer dependent on traditional crops such as maize and wheat. They have begun to grow cash crops, such as vegetables. As incomes improve, families are beginning to spend more on livestock and better farming tools.

The 5,000 or so women's self-help groups have been one of the main driving forces behind the project. As the women undertake new income-generating activities, they are becoming more self-assured and assertive.

Source: World Bank (2012a).

Tropical forest peatlands are estimated to store at least 42,000 million tons of soil carbon in Southeast Asia. However, human activities such as deforestation, drainage, and fires have depleted these reserves and disturbed the carbon balance. Hooijer and colleagues (2010) estimated carbon dioxide emissions from draining lowland tropical peatlands for agricultural and forestry. They found that 12.9 million hectares (ha) of the 27.1 million ha of peatland in Southeast Asia had been deforested as a result of increased land development, and had been mostly drained by 2006. They suggest peatland drainage in Southeast Asia contributes 1.3%–3.1% of global carbon emissions. If current peatland development and management practices continue, Hooijer and colleagues predict these emissions will continue for decades. Hence, they recommend the inclusion of tropical peatlands in climate policies. The reduced emissions from the deforestation and forest degradation program (known as REDD+), which is supposed to generate carbon credits for forestry management projects, is therefore essential for sustainable forest management and climate change mitigation in Asia (World Bank 2007). Boxes 4.3 and 4.4 exemplify such an effect.

Box 4.3

Climate Partnership Program

This program is a global 5-year environmental research program among HSBC, The Climate Group, the Earthwatch Institute, the Smithsonian Tropical Research Institute, and the World Wildlife Fund aimed at reducing the impact of climate change on people, forests, fresh water, and cities; and accelerating the adoption of low-carbon policies. The partnership's key goals have been to:

- Carry out innovative scientific research
- Develop demonstration projects and test out new methodologies
- Create working models, showing how the new ideas work in practice
- Provide clear policy solutions for governments to enact legislation

The India Regional Climate Centre, which opened in 2009, is located in the Sirsi Forest Division, Karnataka State in South India. This ambitious five-year global research program is one of five similar climate research centers throughout the world operating under the umbrella of the HSBC Climate Partnership Program. The landscape in Sirsi is a combination of evergreen and deciduous forest, with a range of rainfall regimes. Some of the forest is protected as Forest Department reserves while some is community forestland; local communities have full access to forest resources and some areas are privately managed as plantations.

The center was set up to research the impacts of climate change on forests. Earthwatch is working with the Indian Institute of Science, which has been conducting ecological and socioeconomic studies in the reserve, and in community and private forests, for nearly 25 years. The research aim is to compare how different forest types respond to climate. Methods include monitoring tree growth, mortality, annual growth cycles, and regeneration in forests under different management regimes. These changes are related to variations in climatic conditions. The findings will help develop an understanding of how India's forests will respond to climate change. Earthwatch and its partner organizations will develop guidelines for government and community forest managers, helping them maximize the resilience of their forests, and hence the carbon sinks, to changing weather patterns.

Source: Earthwatch Institute. http://www.earthwatch.org

Box 4.4

Climate Partnership Program, People's Republic of China

In the People's Republic of China (PRC), the main goal of the HSBC Climate Partnership Program has been to improve water quality for 30 million people by restoring water sources and reconnecting rivers and lakes. As part of this goal, the following 10 actions enhance people's awareness of climate change, promote low-carbon development, and improve resilience to climate change by improving natural ecosystems, especially freshwater ecosystems.

- Develop a 2050 Energy Vision for the PRC
- Assess climate change vulnerability of the Yangtze River
- Restore the environmental quality of the Yangtze River
- Demonstrate water source protection in Shanghai
- Develop environment-friendly agriculture
- Establish the Yangtze wetland and dolphin conservation network
- Promote Estuary Partnership
- Initiate a low-carbon city in the PRC
- Promote Integrated River Basin Management
- Develop a "Save Energy, Save Water, Save Nature" Campaign

As a direct result of work on the Yangtze, the PRC Ministry of Water asked the World Wildlife Fund to advise on how international best practice should be incorporated into the PRC's next 25-year master plan for sustainable water management. This plan will require managers of the seven biggest rivers in the PRC to ensure proper functioning of the rivers and wetlands, benefiting hundreds of millions of people, as well as animal and plant species. The work is conducted at the Regional Climate Centre in the eastern PRC's Gutianshan Forest reserve.

Source: HSBC (2010).

Technologies, Resources Management, and Food Security

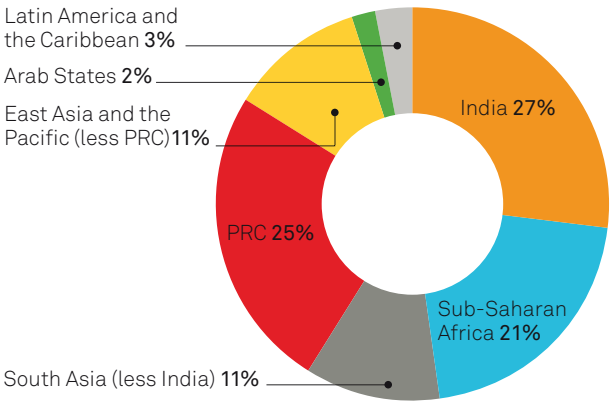
At least 3 billion people in developing countries rely on solid fuels (traditional biomass and coal) for cooking. About 2.6 billion rely on traditional biomass, while 400 million mostly use coal. Over 700 million people without access to modern fuels for cooking live in the least developed countries. Asia and the Pacific account for 75% of people in developing countries relying on solid fuels; India and the PRC alone account for 52% of the population in developing countries relying on solid fuels (Figure 4.4).

The majority of people in developing Asia use either wood or gas as their primary fuel for cooking. More than half of the people in South Asia use wood, straw, and agricultural residue, with dung a common fuel. Bioenergy is being developed to deal with rising fuel prices, increases in the demand for energy, and concerns about climate change and energy security (Escobar et al. 2009). Higher commodity prices from biomass and biofuels development will help farmers, and provide income to poor farmers and rural communities. This has the potential to create more jobs and employment. Developing Asian countries with tropical climates have an advantage in growing energy-rich biomass.

However, there are dangers. Higher commodity prices will mean price rises for consumers, even in countries in Asia without biofuel production (FAO 2008). International organizations have expressed concern about the impact of government policies to encourage increased biofuel production on food supplies and the incomes of the poor (OECD and IEA 2008). Studies show that rapid bioenergy expansion can cause some adverse impacts, such as upward pressure on international food prices, which cause staple crops to become less affordable for the poor (Msangi et al. 2007).

Figure 4.4

Population Relying on Solid Fuels for Cooking, 2007



Source: Derived from WHO and UNDP 2009; ADB–ADBI study team.

Significant adverse impacts can occur to land (soil quality and fertility) and water resources; and biodiversity and ecosystems (Cui and Kattumuri 2010). The study by Msangi and colleagues (2007) showed a potential food and water-versus-fuel trade-off. Research suggests that it is possible to mitigate the adverse impacts resulting from increased biofuel production through improving technologies, innovation, increased investment in technologies for biofuel conversion, and crop productivity improvements (Msangi et al. 2007). Implementation and regulation of policies that encourage comprehensive, human-centered, and sustainable land and water governance are also essential (Cui and Kattumuri 2010).

Health

Many studies such as Bosello, Roson, and Tol (2006), McMichael et al. (2007), and Guttikunda (2010) indicate that the transition to low-carbon green growth could have tangible health benefits. Measures to reduce GHG emissions to 50% of 2005 levels, by 2050, could reduce the number of premature deaths from chronic exposure to air pollution by 20% to 40%, according to Bollen et al. (2009). The most important health benefit comes from improvements in local air quality and lower emissions of particulate matter, sulfur, and nitrogen pollutants.

Solid fuel stoves create indoor air pollution, leading to chronic respiratory illnesses (Table 4.2). A study by Massachusetts Institute of Technology (MIT) found a very high incidence of respiratory illness. About a third of adults and half of children among 2,400 households in Orissa, India, had experienced symptoms of respiratory illness in the 30 days preceding the survey, with 10% of adults and 20% of children experiencing a serious cough. The study found a high correlation between using a traditional stove and having symptoms of respiratory illness.

Furthermore, the World Health Organization (WHO 2006) identifies three diseases with evidence of a link with solid fuel use:

1. Child pneumonia (up to age 5 years): risk for exposed children increased 2.3 times.
2. Chronic obstructive pulmonary disease (30+ years): risk for exposed people increased 3.2 times for women and 1.8 times for men.
3. Lung cancer (30+ years: where coal is used (mainly PRC), risk for exposed people increased 1.9 times for women and 1.5 times for men.

Programs to introduce low-emission stoves could avert millions of premature deaths and reduce emissions. Decreasing the proportion of carbon-based electricity generation would provide health benefits worldwide, particularly in lower-middle-income countries.

Table 4.2

Deaths Attributable to Solid Fuel Use

Country	Pneumonia	Chronic Obstructive Pulmonary Disease	Lung cancer	All deaths
	Children <5 yrs	Adults 30> yrs	Adults >30 yrs	
Bangladesh	25,000	24,400	…	49,400
PRC	9,100	505,900	33,900	548,900
India	167,900	319,700	600	488,200
Indonesia	8,700	36,600	…	45,300
Nepal	5,100	3,600	…	8,700
Pakistan	29,800	26,300	<100	56,100
Thailand	1,000	9,500	…	10,500
Viet Nam	2,000	21,100	700	23,800

Source: UNDP (2009).

Another important advantage of reducing emissions is the health benefit from improved transport systems. The WHO (2011) indicates that cutting emissions through walking, cycling, and reducing use of motor vehicles, by providing better public transport, would bring health benefits from reduced exposure to outdoor air pollution.

A recent study on the estimated air pollution and health benefits of a metro system in Delhi found that increased use of metro-rail resulted in reductions of about 7% of particulate and CO_2 emissions from road transport. Health benefits were significant ($164 million–$469 million in value), including reduced mortality and morbidity rates in Delhi (Guttikunda 2010). A good public transport system reduces congestion, energy demand for transport, and outdoor air pollution.

4.2.2 Dealing with the Cost of Going Green

Although many opportunities exist in low-carbon green growth, the transition entails structural change, which is often accompanied by some costs. Climate-compatible development, for example, is more likely if there is widespread carbon pricing to reflect the damages associated with emitting GHGs and to provide a market incentive to switch to low-carbon goods and services. However, carbon pricing raises prices paid by the rich and poor alike, particularly for energy.

Unfortunately, the evidence from developed countries suggests that the impact of carbon pricing on real incomes via consumer prices is regressive—i.e., lower-income groups take a proportionately larger hit—unless offsetting measures are taken. This result emerges from studies based on input–output tables (Symons, Proops, and Gay 1994); econometric studies (Barker and Köhler 1998); and general equilibrium models (Hassett, Mathur, and Metcalf 2009). The picture is not quite the same in developing countries because the poorest people do not generally have access to commercial energy supply. Just as fuel subsidies disproportionately benefit the relatively wealthy in developing countries, with the poorest fifth of a country's population receiving on average only 10% of the benefits, the absolute loss of real income from carbon pricing would fall primarily on the well-off (Coady et al. 2010). However, the poor would still find it most difficult to cope, as they are so close to a subsistence standard of living already. In addition, poor people faced by energy price hikes often take drastic action to salvage their livelihoods, such as selling off their few assets such as livestock and foregoing educational opportunities (Anbumozhi and Kawai 2009).

There are, however, several ways for policy makers to soften the blow of carbon pricing for poor people. First, direct cash transfer programs can be introduced to offer financial recompense. This was the course taken by Indonesia in 2005, when the government doubled consumer prices for petrol and diesel, and tripled consumer prices for kerosene, but accompanied these increases with a targeted, means-tested program. Iran took similar action in 2010 when it reformed the regime for pricing petrol and diesel, using lump-sum transfers (Aldy and Stavins 2012).

Second, conditional cash transfer programs can be implemented which offer monetary transfers to socially vulnerable households in return for the fulfillment of development objectives, such as enrolling children in school or taking them for check-ups at health centers. Such programs are becoming more popular given the apparent success of several Latin American experiments (e.g., Progresa scheme in Mexico). There is scope for extending the range of activities rewarded by cash transfers to include environmental objectives such as more sustainable land management practices, developing synergies between the pursuit of social inclusivity via cash transfers and environmental goals (Rodríguez et al. 2011). Direct payments for environmental services should be part of the armory of policy tools to encourage the transition to green growth. Third, stronger environmental policies can be accompanied by establishing stronger property rights for poor people, at the individual or community level. For example, empowering local communities and letting them receive the revenues from the sustainable management of the eco-services provided by forests would support the preservation of forests.

Fourth, in the longer term, the evolution of more comprehensive social safety nets using progressive tax-benefit systems can provide an automatic offset to the impact of environmental pricing. This is illustrated by the example of the United States (US), where indexation of social security benefits means that the regressive impact of carbon pricing would be sharply reduced (Fullerton, Heutel, and Metcalf 2011).

Social safety nets have to be paid for, but one advantage of using environmental pricing and removing harmful fuel subsidies is that the approach provides the public authorities with revenue to finance them. Appropriate pricing is also important to discourage rebound effects—higher demand for environmentally damaging products as a result of cash transfers. International climate change finance, as agreed under the auspices of the UN Framework Convention on Climate Change (UNFCCC), and receipts from carbon markets and the Clean Development Mechanism, can also be used in part to support safety nets.

4.2.3 Policy Implications

The opportunities from the transition to low-carbon growth are multiple and varied and could bring several decades of more inclusive, equitable, and sustainable growth across the world, both for developing and developed countries. Such changes will not be easy and there are many barriers, including vested interests. But none is insurmountable (Stern, Kattumuri and Rydge 2012). Policies such as off-grid solar energy, better-managed forests, and more careful use of energy and water are likely to involve greater economic growth and social inclusion.

The PRC's 12th Five-Year Plan, 2011–2015, is designed to accelerate the transition to a low-carbon economy. This plan identifies two key objectives: (i) increasing the share of consumption, and (ii) moving to a low-carbon and less polluting economy. The Indian Planning Commission set up working groups; conducted consultations across the country by organizations representing various citizens' groups including women, historically and socioeconomically weaker communities, and youth; adopted a web-based inclusive, consultative, and participatory approach; and identified 12 strategic challenges for its 12th Five Year Plan, 2012–2017. Managing the environment and ecology are among the key strategic challenges for the 12th plan and comprises five components: mitigation and adaptation to climate change; land, mining, and forest rights; water management and pollution abatement; reducing the degradation of forests and loss of biodiversity; and managing environment sustainability. It aims to increase forest and tree cover by 5% during the period. The 12th five-year plans in the PRC and India, two countries with over 1 billion in population, provide an avenue for developing green growth and achieving their development strategies. The main challenge is implementation.

It is important not to overlook the varied social contexts and uneven social consequences of policy interventions on climate change. The following are some recommendations for enabling greater social inclusion and equity, achieving significant social co-benefits as well as increasing the likelihood of success:

1. Overcoming knowledge gaps. One of the reasons for the slow uptake of emissions-reduction measures and technologies within developing countries is the lack of awareness of social and economic benefits that low-carbon technologies can bring and inadequate knowledge of how to use them cost-effectively. This can be overcome through creating awareness, disseminating information, and educating people.
2. Collective action. The framework of governance around climate change policies needs to be inclusive for effective collective action. Community-based management of common resources has been gaining momentum in many developing countries because of their contributions to rural livelihoods and environmental conservation. There is still significant debate as to whether community-based approaches to the management of common property resources are equitable when significant socioeconomic differences exist within the community (Adhikari, Di Falco, and Lovett 2004). Thus, the challenge for governments is to empower the marginalized and poorer sections of society. Grassroots communities can be the most important participants in protecting the global environment. If the link between protecting the environment and generating local benefits is made clear and tangible, communities can be actively engaged to cope with the challenges of climate change.

3 Developing an enabling environment: Social inclusion can be achieved through capacity building and a strengthening of local policies and institutions. Developing an enabling environment should include bridging a supply-side deficit by building the skills of the workforce (through inclusive training and development programs); and ensuring the supply of complementary infrastructure to support the changes associated with green growth. These require some effort but will help eliminate barriers to planning and implementation.
4 Collaboration between the public sector, businesses, the academic community, the media, and members of the public is essential.
5 National, state level, and local development plans must be strongly linked. Mainstreaming mitigation and adaptation strategies within developmental frameworks is critical.
6 Research and demonstration projects are needed. Pilot projects allow for the practical demonstration of the benefits of low-carbon technologies to local communities, as well as to prospective developers, users, and investors. Demonstrations are likely to be more successful when conducted on a larger scale and through partnerships with local research institutions, non-governmental organizations, and private sector organizations. Successful pilot schemes must be followed up to ensure implementation and must also allow for community participation (Ravindranath and Rao 2011). The lack of data on this in Asia makes more research crucial.
7 Social safety nets must be strengthened to protect the poor against any adverse consequences from environmental pricing such as carbon taxes.

4.3 Green Jobs

4.3.1 Opportunities and Challenges in Labor Markets

The transition to a more sustainable, low-carbon economy requires structural change and the growth of industry sectors producing environmentally friendly products. Adopting green growth requires that more labor resources be devoted to low-carbon activities, particularly in the near to medium term when the capital stock for low-carbon production has to be put in place and the capital stock embodying environmentally destructive technologies replaced. That provides the opportunity to create new jobs and offer new skills to workers, both of which are central to the promotion of a socially inclusive economy. The United Nations Environment Programme (UNEP 2011: 16) has argued: "the greening of economies need not be a drag on growth. On the contrary, the greening of economies has the potential to be a new engine of growth, a net generator of decent jobs and a vital strategy to eliminate persistent poverty." The greening of economies is not generally a drag on growth but rather a new engine of growth; it is a net generator of decent jobs, and it is also a vital strategy for the elimination of persistent poverty." The recent global economic downturn triggered many proposals for green fiscal stimuli to promote growth and, in particular, jobs (see, for example, Barbier 2010). The OECD has also suggested that investing in green activities has significant job creation potential (OECD 2011).

Several sectors of the economy are likely to benefit. In all economies, the construction sector is likely to gain from efforts to improve the energy efficiency of factories, commercial buildings, and homes. As construction is relatively labor-intensive, the job potential is considerable, both in the new-build sector and in retrofitting insulation and more efficient heating and cooling technology. Similarly, forest management, afforestation, and reforestation are labor-intensive and offer the potential for more jobs across Asia, while helping to sequester carbon and exploiting the economic potential of well-managed forests. Some low-emissions agricultural practices are also more labor-intensive than conventional practices, requiring the substitution of labor for chemicals. In the emerging economies of Asia, there are significant opportunities for increased employment in the manufacture and export of low-carbon products such as low-emissions vehicles, photovoltaic cells, and wind turbines.

Just as with innovation, "going green" requires that market failures beyond those arising from the central environmental problems be tackled—in this case, market failures afflicting labor markets rather than innovation. If this is done, there are likely to be widespread benefits for the quality and quantity of employment and growth. This is a more subtle argument than the more common one that investing in projects to introduce and disseminate cleaner, more environmentally friendly technologies and products will create jobs. First, it implies that one should consider more than simply the jobs in occupations directly associated with providing environmental services—one common definition of "green jobs." One should go beyond considering employment created in a narrowly defined set of environmentally benign industries. Changing demands for different skills and new patterns of demand for labor across regions within countries should also be considered.

Second, policy makers should bear in mind the adverse consequences of environmental policies for employment and skills as well as the attractive consequences. Environmental policies are in part designed to bring about structural change in economies, and structural change usually results in job losses as well as job creation. For example, if low-carbon technologies replace fossil fuels in the energy sector, jobs may be created in the solar and wind power sectors but destroyed in coal mines. If forests are managed as carbon sinks and centers of biodiversity, jobs may be created in forest management but destroyed in the lumber industry.

Instead of focusing on the gross number of green jobs created, it would be more useful to consider the net labor market effects of introducing low-carbon growth policies. The sectoral and regional location and skill requirements of the new jobs created can be compared with the location and skill needs of the jobs destroyed to assess the extent of structural change required. Policy makers can then judge whether this is significantly more than the structural change the relevant economy is used to accommodating. As a result of unleashing market forces, many Asian economies have undergone faster structural change within the past 50 years than will be required by climate change mitigation, but the pattern of change will be different.

Three main factors are likely to determine the net labor market effects. First, are measures adopted to make labor markets work better in allocating workers and skills to the sectors where they are most needed—especially the expanding environmentally friendly ones? Promoting so-called active labor market policies to encourage the acquisition of skills and to make workers more mobile between industries and occupations would help the green transition while enhancing growth prospects more generally. In many Asian countries, this would include facilitating the movement of workers from low-productivity traditional

agriculture to high-productivity manufacturing and services.

Second, to what extent is there involuntary unemployment and what is the reason for it? If unemployment arises from a deficiency of aggregate demand—in other words, a macroeconomic market failure—the transition to green growth is much more likely to lead to net job creation. In the wake of the most serious global economic and financial crisis since the Second World War, labor demand is still well below full employment levels in many Asian countries, even though Asia has not been as hard hit as Europe and North America. This was recognized early on by a number of Asian policy makers, who initiated green fiscal stimuli, notably in the Republic of Korea and the PRC (Barbier 2010). In circumstances of full employment, however, the net effect of the transition to green growth may be reduced overall labor supply, if real incomes are lower than they otherwise would be because of higher prices for carbon-intensive products (Goettle and Fawcett 2009). If involuntary unemployment results from labor market rigidities such as inflexible real wages or difficulties in moving workers from one sector to another, the transition may exacerbate the impact of these rigidities. The possible impact of constraints on real wage adjustment and on inter-sectoral flows of labor in different regions of the world have been analyzed by Babiker and Eckaus (2007), who found that the PRC and India are likely to be more adversely affected than the US and Europe by structural changes induced by carbon pricing, largely because the former need a larger reallocation of labor to implement low-carbon policy.

Third, are new green technologies more labor-intensive at prevailing wages, input costs, and interest rates than those they replace? An increase in renewable energy supply is a key component of global and local climate change policies. It appears that electricity generation from renewable energy is more labor-intensive than traditional fossil-fuel-based electricity supply, certainly per megawatt and probably per dollar, although there is uncertainty about how labor requirements are likely to evolve (Kammen, Kapadia, and Fripp 2004; Wei, Patadia, and Kammen 2010). Energy efficiency improvements also appear labor-intensive. Carbon pricing is likely to induce a substitution of labor for capital and energy more generally, although there is some debate about the impact on the demand for capital (see, for example, the discussion in Kemfert and Welsch 2000). Less is known about the labor market consequences of other environmental policies, such as support for biofuels and low-carbon land use. These are likely to be much more important in low-income countries than in high-income ones. In the longer run, there is also the question of how a shift toward technologies that are more labor-intensive might affect the returns on investment in capital and hence growth driven by capital accumulation.

The Asian Experience

There is considerable scope for creating new jobs in Asia's transition to green growth. Climate change mitigation offers opportunities for new employment in construction, manufacturing, transport, services, agriculture, and land management. Matta (2009) notes that, at a time when unemployment in several developing countries has been rising, there are greater benefits from moving toward a greener future by giving a major thrust to sectors that will generate employment, create durable assets, and help rebuild the livelihoods of the poor. Furthermore, since the advent of the world economic crisis, a greater focus has emerged on job creation in sectors with high labor–capital ratios. However, will a similar number of jobs be destroyed in existing industries, particularly in high-carbon sectors such as mining, by climate change mitigation efforts? Or, to put it

another way, can policy makers ensure that green growth improves the quantity and quality of employment by improving the functioning of labor markets while putting in place stronger climate change and environmental policies? This section illustrates the potential for gross green job creation and the scope for net job benefits.

One problem in assessing the potential for gross green job creation is the paucity of quantitative information about green jobs around the world. This point is made forcefully by the Global Green Growth Institute (GGGI 2011: 141), which states: "It is impossible at this stage to get the current statistics for green jobs, as the concept of green jobs itself is yet to be clearly defined." Writing about the Republic of Korea, it goes on to note: "ROK has yet to come up with a report on green job statistics. Existing data does not provide adequate information to analyze the ever-expanding green job market in a comprehensive manner." (GGGI 2011: 142). In the absence of definitive data on existing green jobs in Asia, let alone forecasts of their future growth, one way to assess how much gross green job creation is possible is to note the extent of current and future employment in green industries where this has been estimated and then to gauge the current extent of environmental degradation and resource use in Asian countries compared with these benchmarks.

UNEP et al. (2008) suggests that, at a conservative estimate, there were more than 2.3 million jobs in the renewable energy sector around the world in 2006, and more in construction, providing improved energy efficiency in buildings, low-carbon transport, and other environmental activities. That compares with an employed labor force globally of about 1.8 billion. It seems unlikely that the share of green jobs according to the UNEP definition is much more than 0.25% of global employment (although it should be noted that it excludes employment in traditional agriculture and land management that could become greener). However, UNEP envisages an increase in employment in the renewable energy sector to 20 million by 2030 with appropriate policies—a 770% increase compared with expected world population growth of 20%.

The European Commission's Directorate-General for the Environment estimates the number of green jobs by using the OECD–Eurostat definition of the environmental goods and services industry (OECD and Eurostat 1999), which comprises "activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes technologies, products and services that reduce environmental risk and minimize pollution and resources."

On this basis, green jobs constitute about 1.7% of total paid employment in Europe (European Commission 2007). This is higher than the UNEP approach would suggest.

The Pew Center, using data about individual companies, estimated the clean energy economy of the US to account for about 0.5% of all US jobs (Pew 2009). Its definition of the clean energy economy covers five categories: clean energy, energy efficiency, environmentally friendly production, conservation and pollution mitigation, and training and support.

Although there is no generally accepted definition of green jobs in the Republic of Korea yet, the environment industry is thought to be responsible for about 1.6% of total employment, of which about 45% are directly employed in green jobs (GGGI 2011).

UNEP et al. (2008: 23) pointed out: "Green employment has gained an important foothold in the developed world, but with the major exception of PRC and Brazil, it is still quite exceptional in most developing countries." So for lower-income

countries, there is likely to be at least the potential to increase employment in green jobs by at least 0.5% of their labor forces—and more if European levels of environmental goods and services production are reached. However, this is likely to be an underestimate, for two reasons. First, it does not take into account the need for countries, including those in Europe as well as Asia, to increase their efforts to mitigate and adapt to climate change. Second, it does not take into account the need for many Asian countries to bring about bigger structural change to achieve green growth because they start from a position where environmental needs are greater.

Studies have also illustrated the scope for green job creation in Asia. For example, the Global Climate Network sponsored case studies in a number of countries at different levels of development under the title Low Carbon Jobs in an Interconnected World (Global Carbon Network 2009). In the Indian study by Upadhyay and Pahuja (2010), the authors investigated the employment potential of the renewable energy industry, especially wind and solar power. The study focused on direct employment effects and did not consider second-round effects of expanding renewable energy supply through macroeconomic channels. The authors estimated the number of jobs that would be created per megawatt of energy generation capacity for a range of different technologies under various assumptions, drawing on India's National Action Plan on Climate Change. Such estimates are likely to show a bigger contrast between renewable and traditional energy than do estimates of jobs per dollar spent, because the cost of an extra megawatt of generating capacity is likely to be higher. There is a high degree of uncertainty about the employment needs of different renewable technologies, the authors acknowledged, but they concluded that extra employment would be a key co-benefit of a growing renewable sector in India – of the order of up to half a million jobs in wind and solar by 2020 and potentially up to 10 million jobs eventually in biofuels. Solar power looked more attractive than wind, because it is more labor-intensive and better able to meet India's requirements for small-scale, off-grid power; biomass, green transport, and public works in water and forest management also appeared to be effective ways of achieving both employment and environmental objectives.

This echoes Matta (2009), who argued that spending an additional $4 billion on forestry-related projects in India, through the mechanisms of the National Rural Employment Guarantee launched in 2005, could generate 1.5 billion person-days of employment, amounting to 8 million–10 million (part-year) jobs. Upadhyay and Pahuja (2010: 9) explicitly ruled out job losses in fossil-fuel power generation, believing that "investment in fossil fuels is going to be a mainstay" of the Indian economy, at least in the near term, given the need to expand the availability and reliability of electricity supplies. This, together with an implicit assumption of surplus labor, allows the authors to dismiss job displacement as an issue. However, the Global Climate Network study of the PRC, while noting the potential from increased employment in renewables, emphasized the potential employment losses from the planned sharp reduction in the energy intensity of PRC industry. The shift of the PRC economy toward services and away from heavy industry might generate more than enough jobs to compensate, however.

Carbon mitigation strategies can create employment through agriculture and forestry—afforestation, reforestation, improved management of natural forests, conservation, watershed protection, agroforestry, and urban forestry, among others. Deforestation rates are high in most of Asian countries (Figure 4.5). Nair and Rutt (2009) argue that providing employment in forestry activities would have the advantage of:

1. slowing down deforestation and degradation;
2. augmenting carbon sequestration through increased tree planting and improved management of forests; and
3. reducing the frequency and intensity of forest fires through better management.

Table 4.3 provides opportunities for job creation in key sectors. However, not all jobs created by the transition to green growth will be high-productivity: part of the benefit will be the creation of low-productivity jobs for those who would otherwise have no paid employment. As Upadhyay and Pahuja (2010: 19) write about India, "jobs like that of unskilled labor in biofuel and biomass production could be numerous but of low quality as they barely provide subsistence wages and have difficult work conditions." They suggest that environmental activities under India's National Rural Employment Guarantee Act, 2005, could be particularly beneficial in creating jobs for the unskilled, a point echoed by Matta (2009) (Box 4.5).

Box 4.5

Mahatma Gandhi National Rural Employment Guarantee Act, India

The National Rural Employment Guarantee Act is a rights-based parliamentary act of 2005 in India. It legally guarantees 100 days of employment to the poor in rural areas. It is the first nationwide employment scheme of this kind. The act is significant in three ways: it aims at eradicating acute poverty in villages by ensuring that the poorest of the poor are given sufficient employment; it aids in empowering local governments, as the act's implementation is vested with them; and it supports activities that create productive assets that could make villages self-sustaining. During 2006–2007, more than 100,000 villages implemented the scheme, each spending on average $20,000. Since April 2008, the act has been extended to all 596 districts in the country (Ministry of Finance 2009) and has an annual budget allocation of about $6 billion. As of April 2009, about 45 million workers, half of them women, were provided employment under the act (Ministry of Rural Development 2008).

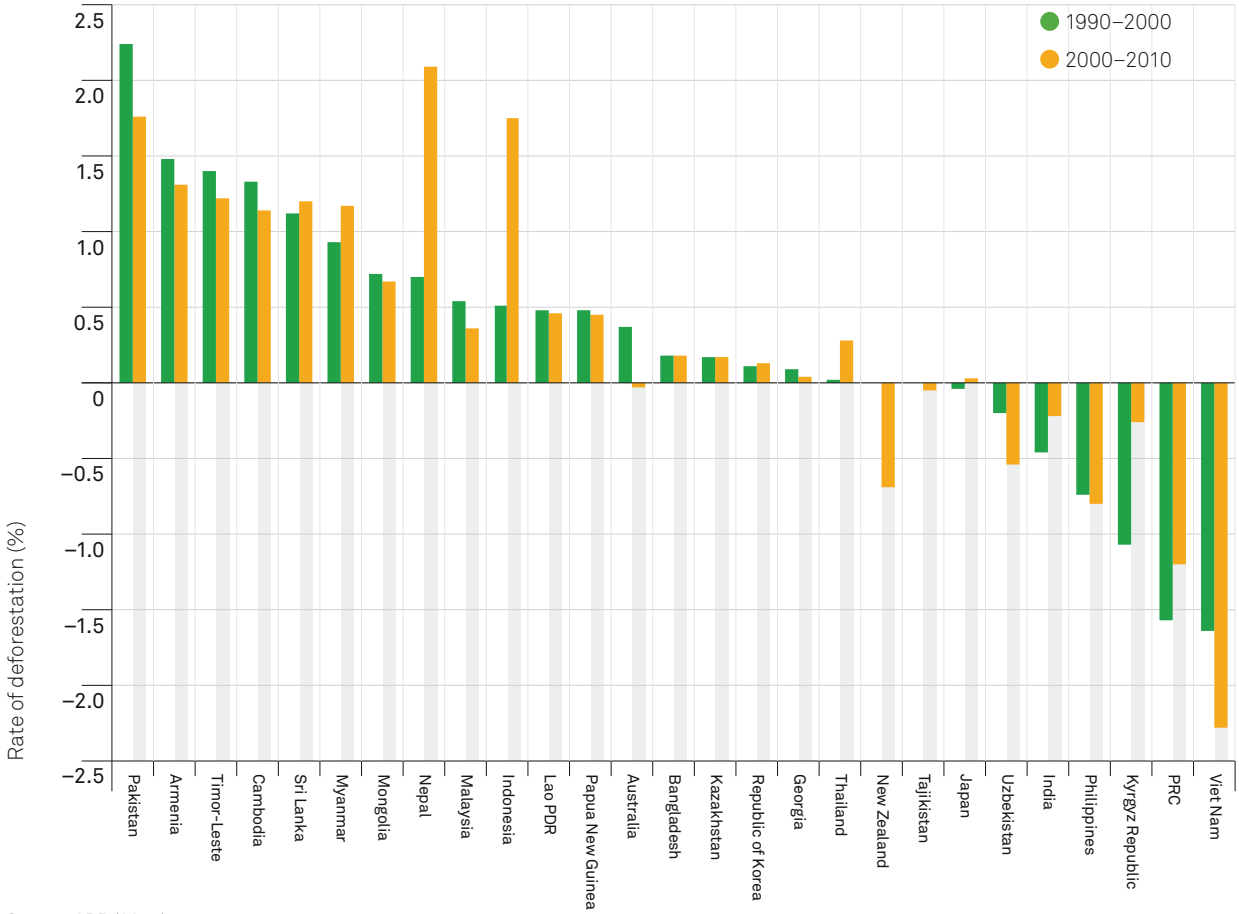
Enhancing the natural resource base in rural areas is among the main activities of the act and it is regarded as the world's largest ecological restoration program. Many villages have already benefited from its support to water conservation programs—critical in rain-fed areas of India, which sustain 40% of the nation's population.

However, a key criticism facing the act is the insufficient attention given to the sustainability of the employment opportunities generated (Matta 2009). In view of the target-based approach, implementation of the act emphasizes easily implemented works such as road building. Currently, activities related to tree plantation and drought-proofing account for about 8% of the act's funding, but forestry could be included to a larger extent to help trigger broader economic growth. Indeed, the National Forest Commission has recommended a substantial increase in the allocation of funds to forestry and watershed operations, to reach 20% of Rural Development Program funding.

Source: Aidindia.com; The Hindu.com.

Figure 4.5

Average Annual Deforestation Rates, 1990–2000 and 2000–2010



Source: ADB (2011).

Table 4.3

Opportunities for Job Creation from Green Policies

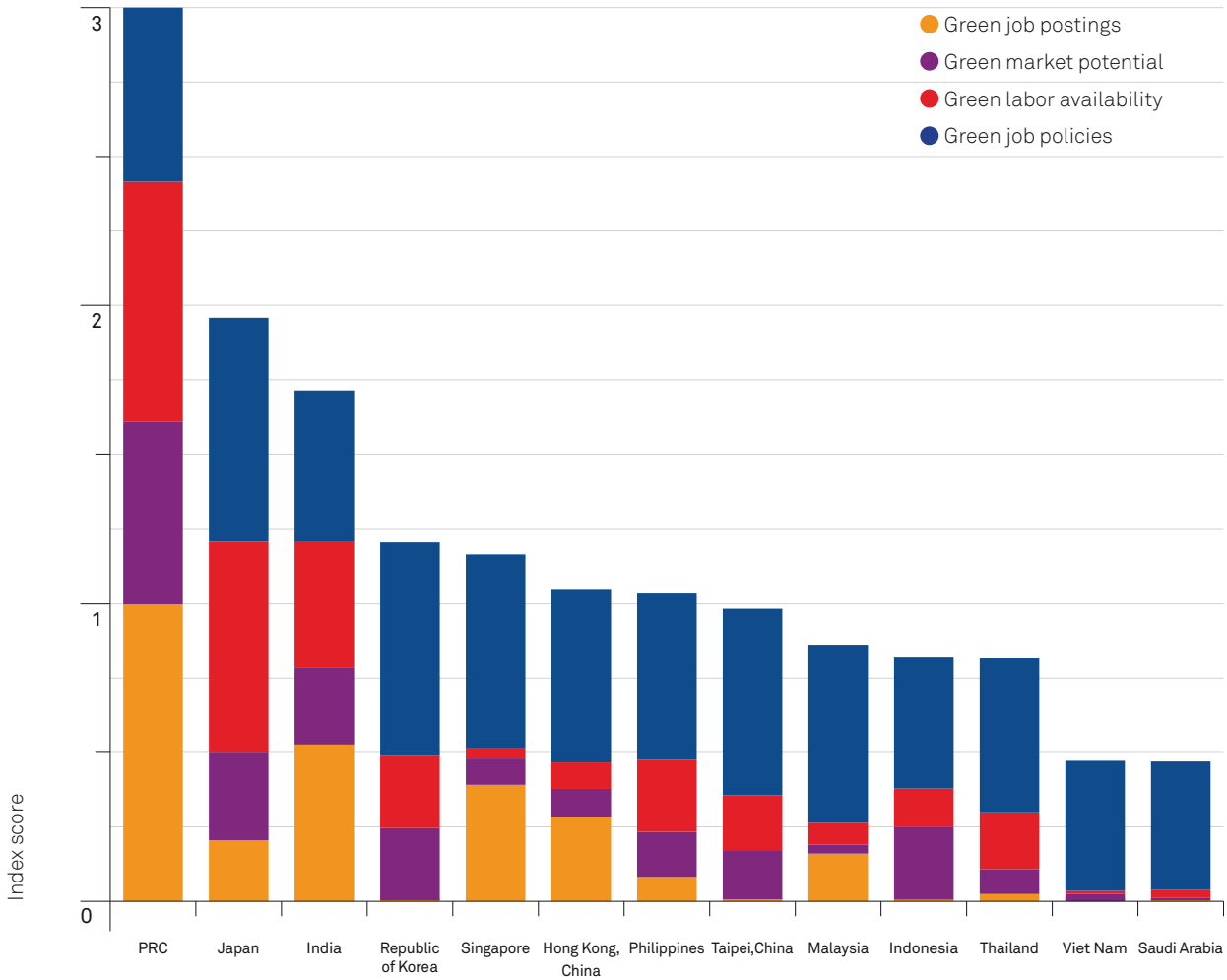
		Green potential	Green job progress to date	Long-term green job potential
Energy	Renewables	Excellent	Good	Excellent
	Carbon capture and storage	Fair	None	Unknown
Industry	Steel	Good	Fair	Fair
	Aluminum	Good	Fair	Fair
	Cement	Fair	Fair	Fair
	Pulp and paper	Good	Fair	Good
	Recycling	Excellent	Good	Excellent
Transportation	Fuel-efficient cars	Fair to Good	Limited	Good
	Mass transit	Excellent	Limited	Excellent
	Rail	Excellent	Negative	Excellent
	Aviation	Limited	Limited	Limited
Buildings	Green buildings	Excellent	Limited	Excellent
	Retrofitting	Excellent	Limited	Excellent
	Lighting	Excellent	Good	Excellent
	Efficient equipment and appliances	Excellent	Fair	Excellent
Agriculture	Small-scale sustainable farming	Excellent	Negative	Excellent
	Organic farming	Excellent	Limited	Good to Excellent
	Environmental services	Good	Limited	Unknown
Forestry	Reforestation/Afforestation	Good	Limited	Good
	Agroforestry	Good to Excellent	Limited	Good to Excellent
	Sustainable forestry management	Excellent	Good	Excellent

Source: ADB–ADBI study team based on UNEP (2008).

The Asia Business Council has drawn up a qualitative assessment of how well the countries in which it has members or activities are performing in establishing the conditions to create green jobs (Figure 4.6). It rates the PRC, Japan, and India as the countries where demand from firms to fill green jobs is highest (judging by "green job" postings on employment web sites and the extent of current employment in green sectors). Republic of Korea and Japan rank highest on policies to stimulate the transition to low-carbon green growth.

Figure 4.6

Preparing the Ground for the Creation of Green Jobs

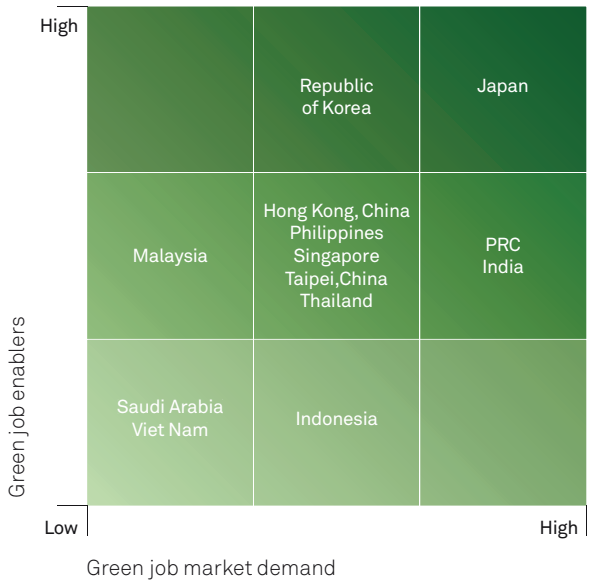


Note: Index scores range from 0 to 4; a higher score means more favorable conditions for green jobs.

Source: Asia Business Council (2009).

Figure 4.7

Relative Performance in Readiness for Green Job Creation: An Index of Green Job Enablers Plotted against an Index of Green Job Market Demand



Source: Asia Business Council Analysis 2011.

One of the most thorough studies of green growth and skills so far is International Labour Organization and European Center for the Development of Vocational Training (2011), which attempted to synthesize lessons from the results of 21 country reviews (including the PRC, India, Indonesia, the Philippines, Republic of Korea, Thailand, and Bangladesh). This study argued that the demand for skills is being affected in three ways by the transition to green growth.

First, there is induced structural change across industries, increasing the demand for the skills specific to expanding industries such as renewable energy and reducing the demand for skills such as those associated with coal-mining. Many of the expanding industries are likely to be using new products and processes, reflecting the transition to low-carbon technologies, so the generic skill requirements of many of the jobs created are likely to be higher than average as they have to allow for assimilation of unfamiliar tasks and working methods and "learning by doing."

Second, some new occupations are emerging, such as photovoltaic panel fitters and carbon-footprint assessors. But there appear to be relatively few unique green skills.

Third, the content of many jobs in existing industries is changing to reflect the transition to green growth, such as increasing emphasis on energy efficiency, switching from fossil fuels to renewable energy, and producing capital equipment for expanding green industries. The ILO-CEDEFOP report argued that this third channel is likely to have the most pervasive effects on the labor market, particularly in developing countries.

Green jobs appear very diverse in their skill requirements, the sophistication of the skills required, and their degree of novelty. Already, skill shortages are being reported as a factor obstructing green growth. They appear to result from general failings in education and training systems and reflect long-standing issues such as the lack of incentives for employers to invest in developing the transferable skills of their workforces, the lack of access to time and finance for training on the part of the disadvantaged, and the stickiness of relative pay rates.

Overall, it appears the scope for gross green job creation in Asia is substantial—probably on average at least about 1%–2% of the labor force, which is enough to make a dent in unemployment rates but not likely to transform the overall balance of demand and supply in the labor market. It is larger in many of the poorer countries in the region, because of the greater need to improve environmental conditions and adopt more sustainable production patterns and because of the scope for increasing employment in sectors such as forestry and agriculture, which are more important in these countries and are often ignored

in projections of green jobs. The opportunities for net job creation through the transition to green growth depend more on how labor markets work in individual countries. Some countries in Asia face the paradox that the opportunities are limited because their labor markets are already reasonably efficient in terms of achieving low and relatively stable unemployment.

According to the ILO's annual review of global trends in labor markets (ILO 2011), the labor market in East Asia has recovered relatively quickly from the global downturn, with unemployment rates low by international standards and falling, and high rates of labor force participation (Table 4.4). The picture in Southeast Asia and the Pacific is not quite as encouraging, because a strong rebound in output has not translated into strong employment growth and unemployment has eased down only a little.

However, in two other respects, several Asian labor markets, particularly in the lower-income economies, suffer disadvantages. First, the labor force is growing very rapidly in some countries, particularly India, Indonesia, and the Philippines (Figure 4.8) among the larger economies, and it is difficult to generate enough new jobs to employ all new labor market entrants. Second, underemployment and vulnerable employment—own-account workers and unpaid family workers—are at high levels in several of the poorer countries of Asia (Table 4.5), so the average incidence of vulnerable employment is high by world standards.

Together with the relatively high share of agriculture (Table 4.6) and traditional activities in these economies, this suggests scope for reallocating workers from low-productivity sectors to other sectors, including environmental services and climate change mitigation, which have higher private and social returns. The scope for improving the quality and productivity of jobs is illustrated by Asian Development Bank (ADB)(2011), which documents large differences across Asian economies. If policy makers in these countries work to remove the impediments to labor mobility, and barriers to entry to higher-productivity industries, that will facilitate the transition to green growth and reap substantial benefits in the form of new green jobs with higher productivity than those they replace.

Table 4.4

Regional Unemployment Rate Estimates

Region					Confidence Interval lower bound	Preliminary estimate	Confidence Interval upper bound
	2000	2005	2007	2009	2010	2010	2010
World	6.3	6.2	5.6	6.3	5.9	6.2	6.5
Developed Economies and EU	6.7	6.9	5.8	8.4	8.5	8.8	9.1
Central and Southeast Europe (non-EU) and Commonwealth of Independent States	10.9	9.4	8.6	10.4	9.1	9.6	10.1
East Asia	4.5	4.1	3.8	4.4	3.9	4.1	4.3
Southeast Asia and the Pacific	4.9	6.3	5.4	5.2	4.8	5.1	5.4
South Asia	4.5	4.8	4.5	4.4	3.9	4.3	4.6
Latin America and the Caribbean	8.5	7.9	7.0	7.7	7.2	7.7	8.1
Middle East	10.6	11.2	10.5	10.3	9.6	10.3	10.9
North Africa	14.1	11.6	10.2	9.9	9.1	9.8	10.5
Sub-Saharan Africa	9.0	8.6	7.9	7.9	7.6	8.0	8.4

Source: International Labour Organization (2011).

Table 4.5

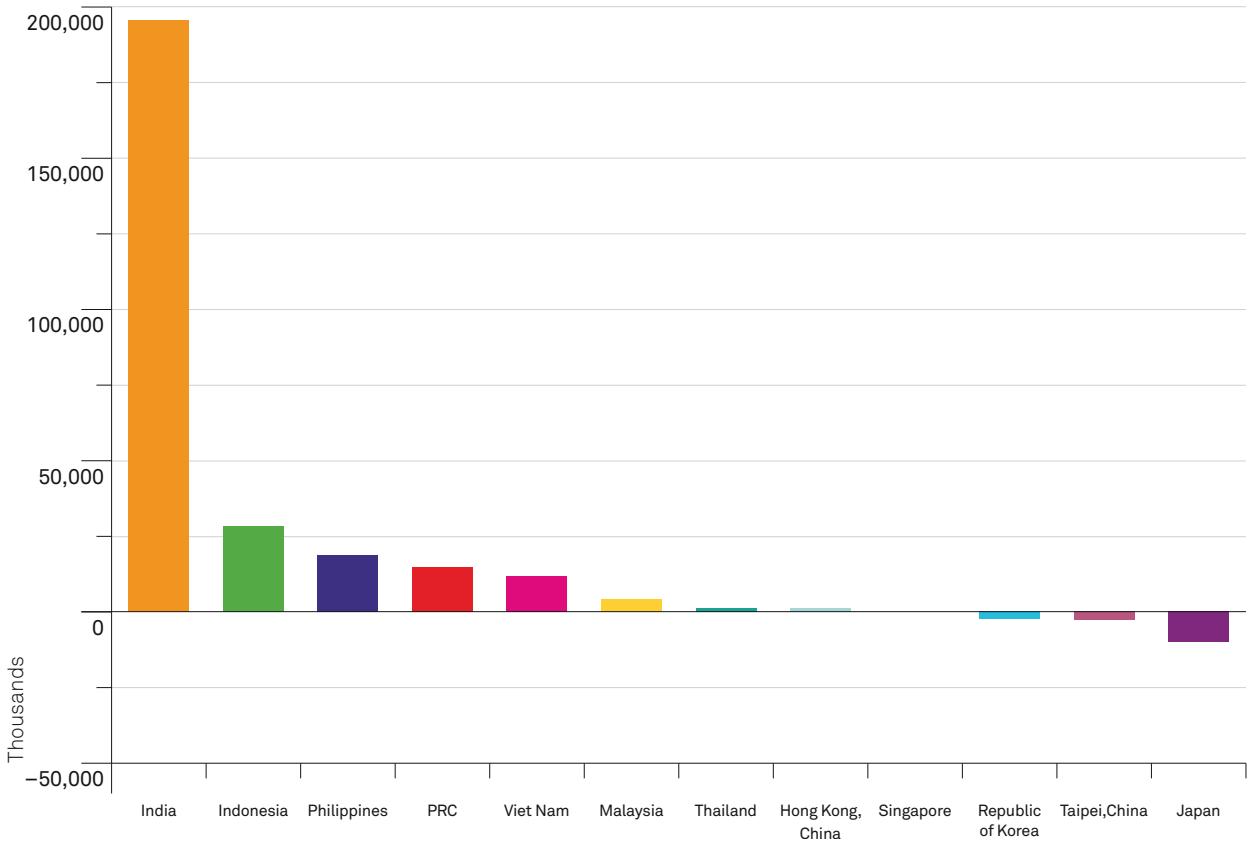
Share of Employment Deemed Vulnerable

Region	Agriculture		Industry		Services		Deemed vulnerable	
	1999	2009	1999	2009	1999	2009	1999	2009
World	40.2	35.0	20.6	21.8	39.1	43.2	53.5	50.1
Developed Economies and EU	5.6	3.7	27.6	23.4	66.9	72.8	11.1	9.7
Central and Southeast Europe (non-EU) and Commonwealth of Independent States	27.0	20.2	24.5	24.6	48.5	55.2	26.7	20.0
East Asia	47.9	36.9	23.8	27.8	28.3	35.3	60.2	50.8
Southeast Asia and the Pacific	49.3	44.3	15.9	17.8	34.8	38.0	66.2	61.8
South Asia	59.5	53.5	15.4	18.9	25.1	27.6	81.1	78.5
Latin America and the Caribbean	21.5	16.3	21.4	22.1	57.1	61.6	36.1	32.2
Middle East	22.1	19.1	25.9	26.1	52.1	54.8	36.0	32.7
North Africa	29.2	27.8	20.5	22.5	50.3	49.7	42.1	40.4
Sub-Saharan Africa	62.4	59.0	8.8	10.6	28.8	30.4	79.9	75.8

Sources: ADB (2011); ILO (2011).

Figure 4.8

Projections of Labor Force Growth: Change in Working Population Aged 15–64, 2010–2025



Source: World Population Prospects; United Nations Population Division; ABC analysis.

Table 4.6

Shares of Employment by Broad Sector

Economy	Sectoral labor productivity (2005 $ PPP per worker)		
	Agriculture	Industry	Services
Nepal	0.5	0.5	0.6
Bangladesh	0.6	1.7	1.1
Cambodia	0.3	1.3	13.4
Kyrgyz Republic	0.8	0.8	0.7
Pakistan	0.9	2.1	2.7
Viet Nam	0.5	2.4	1.8
India	0.5	2.2	4.0
Mongolia	0.9	1.2	1.5
Philippines	1.3	6.1	3.6
Indonesia	0.8	5.4	2.5
Samoa	1.4	4.1	21.1
Tonga	3.4	2.5	7.8
Sri Lanka	1.5	2.7	4.2
Georgia	0.6	5.9	4.4
Bhutan	1.2	5.2	2.4
Armenia	1.5	7.3	4.0
Maldives	4.1	4.8	8.9
PRC	0.9	6.9	4.7
Thailand	0.9	9.6	5.6
Azerbaijan	1.0	22.2	2.4
Kazakhstan	1.0	3.7	13.0
Malaysia	6.2	17.9	10.0
Republic of Korea	16.7	46.0	23.6
Hong Kong, China	13.4	36.4	60.3
Singapore	3.4	72.6	48.1

Source: ILO (2011).

4.3.2 Policy Implications

If governments can promulgate a coherent set of policies over the next 10 years to promote climate change mitigation, and convince the private sector these policies will remain in place over the long term, then the private sector will create new jobs across the economy wherever new low-carbon goods and services are produced. One challenge is to ensure the incentives are pervasive—across sectors and regions of the economy, types of enterprise, and varieties of occupation. Economy-wide carbon pricing is likely to be the most effective way of doing this. Policy makers also need to identify barriers to green employment creation and overcome them. These include insufficient innovation in low-carbon activities, slow adoption of new technologies from other countries, and insufficient attention to infrastructure needs, particularly in energy and transport. Some of these barriers will only be overcome by public intervention via regulation and consensus building about the future path of the economy.

Active labor market policies will be required. Otherwise, when jobs elsewhere in economies are destroyed, people will be left out of work. Several higher-income Asian countries have found ways of managing the labor market consequences of structural change effectively. In many countries, public employment programs are likely to be part of the solution (Lieuw-Kie-Song and Lal 2010). However, these require adequate public finance. Programs should be designed to encourage permanent employment increases in the longer term, and thus need to be underpinned by permanent price incentives to the private sector. Box 4.6 summarizes the policy conclusions of the ILO and CEDEFOP.

Box 4.6

Measures to Equip Developing Countries with the Skills for Green Growth

Developing countries need special measures to equip them with the skills for the transition to green growth:

- Capacity building for employers in the informal economy and micro and small enterprises to enter green markets in localities where they are most needed
- Entrepreneurship training and business coaching for young people and adults to start up green businesses in conjunction with microfinance projects
- Environmental awareness among decision-makers, business leaders, and administrators as well as formal and nonformal training institutions
- Capacity building to strengthen social dialogue and make training more accessible
- Increased capacity of formal education and training systems and institutions to provide basic skills for all and raise the skills base of the national workforce, including improving apprenticeship systems and building synergies with nongovernment organizations that provide education and training.

Source: ILO and European Centre for the Development of Vocational Training (2011).

Policy makers also need to dovetail green policies with macroeconomic demand management, taking advantage of periods of unexpectedly low aggregate demand to employ workers to reduce the backlog of socially beneficial environmental projects. The scope for job creation in rural areas should not be underestimated: managing common resources such as forests, water catchment areas, and biodiversity requires labor inputs. So does reducing pollution from current methods of farming, fishing, forestry management, water use, and natural resource extraction.

4.4 Expansion of Demand

4.4.1 Promoting Growth by Increasing Demand

Increased innovation and the removal of impediments to the efficient functioning of labor markets can increase the supply capacity of economies as well as tackling environmental problems. However, increased supply capacity has to be matched with increased demand if resources are not to remain idle and involuntary unemployment is not to rise. The ILO (2011: 2) found that, "In many developing economies, while growth has rebounded sharply, long-standing decent work deficits, including widespread vulnerable employment and working poverty continue to pose serious challenges, and the crisis has slowed progress on reducing these deficits."

Nations can also benefit from developing a comparative advantage in producing 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 both faster and greener.

Macroeconomic policies must stimulate demand while ensuring that debt-financed spending supports economic activities with high social returns, including environmental benefits (Bowen and Stern 2010). Given the degree of economic slack that still persists in several Asian nations, this provides an argument for increasing spending on green projects now, and being ready

in future to respond to unexpected downturns by reducing the backlog of green investment projects that has arisen as more countries adopt more ambitious environmental targets.

4.4.2 The Asian Experience

Asia has several examples of countries using short-term macroeconomic policies and longer-term industrial policies sensibly to stimulate increases in employment and real incomes while speeding the transition to greener sustainable growth. However, the experience has not been uniform.

After the 2008 global slowdown, UNEP proposed a Global Green New Deal in March 2009, recommending the expenditure of 1% of global gross domestic product (GDP) on green initiatives, to be spent primarily by the Group of Twenty (G-20) countries, which account for two-thirds of the world's population, 90% of global economic activity, and at least three-quarters of global GHG emissions. Figure 4.9 shows fiscal stimulus spending of major economies in Asia. A year later, Barbier (2010: 155) concluded that "only a handful of economies devoted a substantial amount of their total fiscal spending to green investments." The PRC and the Republic of Korea stood out as notable exceptions. The Republic of Korea 'Green New Deal' accounted for nearly all of its fiscal response to the global recession. The PRC apportioned around a third of its total fiscal spending to green measures."

The Republic of Korea projected substantial short-run increases in employment from key green projects under its program—nearly 1 million extra jobs (Table 4.8) (about 4% of the workforce in an economy with a total labor force of about 24.37 million). Forestry restoration was projected to be particularly labor-intensive, with 76.6 jobs created for every million dollars of additional spending. The vehicles and clean energy sectors were projected to be at the other end of the spectrum, given their capital-intensive nature, with just 9.6 jobs being created per million dollars in extra spending.

The Republic of Korea announced its Low-Carbon Green Growth vision and strategy in 2008. It is designed to transform the economy over 2009–2050. Green technology is seen as a source of jobs and export revenues and the Republic of Korea plans to increase its share of this global market from 2% in 2009 to 10% by 2020, supported by increased innovation, technology transfer, and greater domestic spending on research and development (R&D).

The PRC's 12th Five Year Plan also projects a change in industrial structure to "green" the economy and allow the PRC to benefit from fast-growing international markets for more environmentally friendly goods and services. It envisages a shift generally to less carbon-intensive service industries but also clean-energy vehicles and inputs to renewable energy production. 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. On 16 December 2011, The *Washington Post* (citing Photon International, Earth Policy Institute, and Wiley Rein) reported that the PRC's share of global solar cell production climbed to almost 48% in 2010, up from about 38% in 2009. Its rise came largely at the expense of Japanese and German manufacturers (Japan still won a share of 8.5% and Taipei,China 12.7%). Two PRC companies, Sinovel Wind and GoldWind Science and Technology, accounted for over 20% of the global wind turbine market in 2010 (GlobalData.com, accessed 10 January 2012).

Table 4.7

Projections of the Employment Effects of the Republic of Korea's Green Fiscal Stimulus

Stimulus measure	Employment	$ (million)
Expanding mass transit and railroads	138,067	7,005
Energy conservation (villages & schools)	170,702	5,841
Fuel efficient vehicles and clean energy	14,348	1,489
Environmentally friendly living space	10,789	351
River restoration	199,960	10,505
Forest restoration	133,630	1,754
Water resource management[a]	16,132	684
Resource recycling (inc. fuel from waste)	16,196	675
National green information infrastructure	3,120	270
Total for the nine major projects	702,944	28,573
Total for the Green New Deal	960,000	36,280

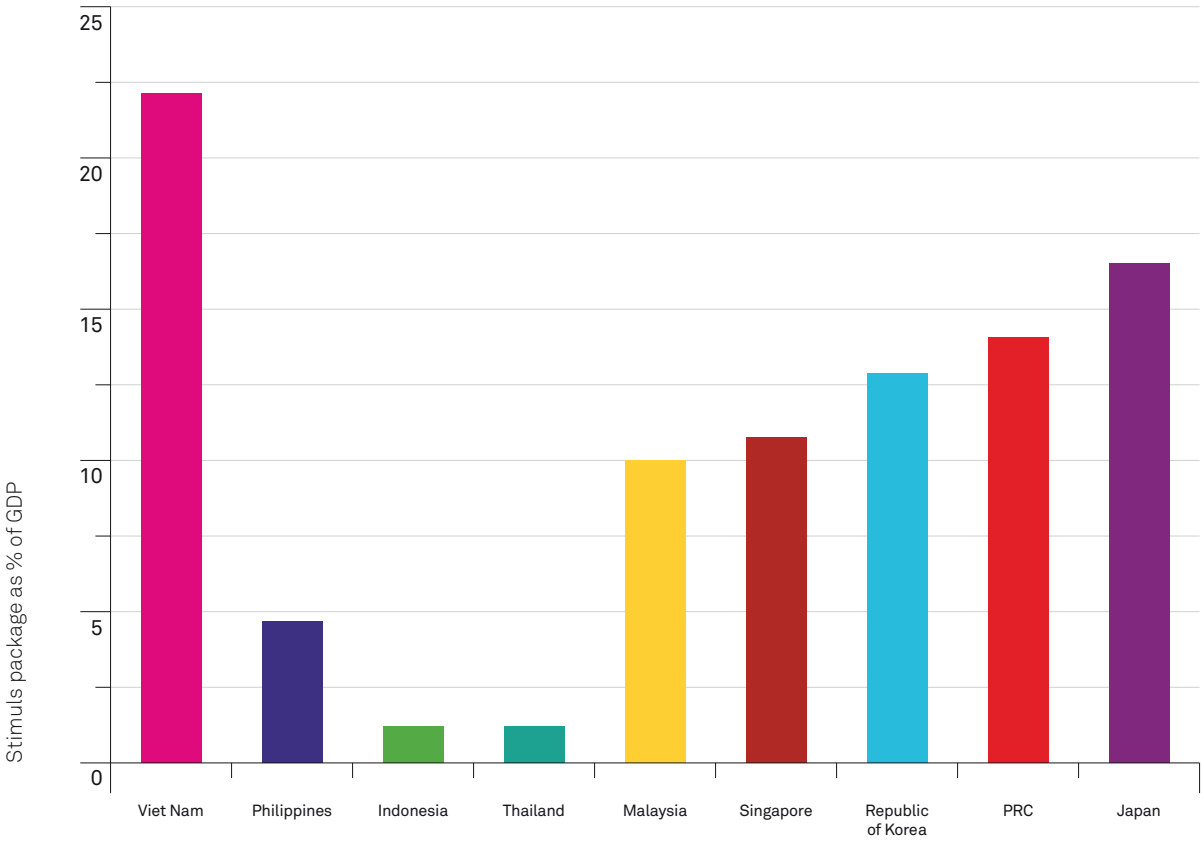
[a] Small and midsize dams.

Source: Ministry of Strategy and Finance, Republic of Korea.

India is also preparing a 12th Five Year Plan with an emphasis on sustainable growth and improving energy supply, in part through clean energy sources (Government of India, Planning Commission 2011b). By contrast, there is less emphasis on winning a larger share of expanding global markets for low-carbon and other greener products. India has, however, already set up a variety of national missions to support its National Action Plan on Climate Change, such as the missions on solar energy and energy efficiency. Some successes are already evident, such as Suzlon, the fifth largest wind turbine group in the world with a global market share of about 8% (Suzlon 2012). Business leaders have acknowledged that "green industry could be a very useful tool to promote economic growth, stimulate job creation as well as support long-term environmental sustainability" (Federation of Indian Chambers of Commerce and Industry [FICCI] 2011: 1). Some commentators have expressed concern about the ability of policy makers to deliver fully on the National Action Plan, partly because of the split of responsibilities between the all-India and state-level governments, and partly because the capacity to support new industries and products is not always sufficiently developed (see, for example, Rai and Victor 2009; Ockwell et al. 2008).

Figure 4.9

Fiscal Stimulus Spending Plans (as of July 2009)



Source: Anbumozhi and Bauer (2009).

FICCI has listed a number of factors impeding structural change in a green direction, including inadequate infrastructure, lack of access to clean technologies and adequately skilled manpower, lack of funding, and lack of confidence in the sustainability of demand. This draws attention to the importance for all countries of well-articulated, long-term, and credible environmental policies, especially on climate change.

4.4.3 Policy Implications

As far as macroeconomic policy is concerned, the PRC and the Republic of Korea in particular have shown it is possible to fashion fiscal stimuli that accelerate the transition to green growth in a fiscally responsible way. Debt-financed fiscal stimuli must be implemented with due regard for the social returns from additional spending and should be designed with an exit strategy in mind. Many—but not all—green projects are particularly suitable (Bowen et al. 2009).

Project spending must either be temporary—e.g., catching up with any backlog of green projects that do not require long preparation, such as improving the insulation of public buildings and housing stock—or be underpinned by plans for financing future support from tax revenues.

It is too early to judge the success of the ambitious 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 particular products or sectors as future winners worthy of government support is perilous. It is also impossible for all countries around the world to generate net exports in each expanding category.

Policy makers would be well advised to concentrate on correcting market and policy failures that could impede the growth of green sectors, in particular those affecting innovation and labor markets. Public authorities also need to stop well-established firms trying to discourage new entrants or new ideas that might challenge their traditional sources of revenue. Thus, competition policy is an important aspect of innovation policy.

Environmental pricing is a very efficient way of providing simple incentives to develop the new opportunities. This is central, for example, to recent recommendations (Box 4.7) addressed to the Republic of Korea by OECD researchers (Jones and Yoo 2011). They argue that the Republic of Korea's ambitious green growth program could be enhanced by more pervasive carbon pricing.

The unfamiliar nature of many of the products and industrial processes involved in low-carbon green growth is likely to inhibit private finance unless public agencies are able to reduce the risk facing private investments by providing expertise, seed capital, finance for demonstration projects, and innovative risk-sharing financial instruments. As one of the biggest risks involved is political risk—changes in governments' commitment to green policies, changes in regulatory regimes, and changes in international policy—some risk-sharing by the public sector, for example through public sector investment institutions, is desirable. International lending institutions such as ADB also have a key role to play.

Box 4.7

Recommendations for Mitigating Climate Change and Developing New Growth Engines in the Republic of Korea

Mitigating climate change

- Introduce market-based instruments as soon as possible to achieve the 2020 emission reduction target in a cost-effective way by ensuring abatement costs are equal at the margin across all options.
- Put a price on carbon emissions by creating a mandatory and comprehensive emissions trading system (ETS), thereby providing a clear price signal enabling appropriate investment decisions.
- Auction ETS permits and allow them to be banked for the future and, perhaps, borrowed.
- Introduce a carbon tax in areas not covered by the ETS and use the revenue, together with that from auctioning permits, to reduce other taxes.
- Accelerate the phasing out of environmentally-harmful energy subsidies and ensure that energy prices in each sector reflect the cost of production and distribution.
- Stop earmarking environmental taxes for transport construction, especially roads.

Creating new engines for growth

- Ensure good framework conditions, including openness to foreign investment and a strong competition framework, to facilitate the entry of new firms and the exit of firms in declining industries.
- Enhance flexibility in the labor market and ensure adequate training of workers.
- Ensure that the spending in the Five-Year Plan for Green Growth—2% of annual gross domestic product over 2009–2013—is implemented in a transparent and effective manner to address market failures.
- Promote innovation in green technologies by increasing their share of publicly funded research and development (R&D), focusing on basic research, particularly in areas related to large-scale projects by the private sector and in technologies too far from commercial viability to attract private investment.
- Improve the overall innovation framework by spending more on basic research; closely linking government research institutes, universities, and industry; and reducing the mismatch between human resources and research spending in universities.
- Encourage the development of renewable energy resources by removing noneconomic barriers and establishing a predictable and transparent support framework with incentives that decrease over time.
- Design the green certificate program and the green finance initiatives carefully to limit the risk of bubbles.

Improving the quality of life through a better environment

- Gradually reduce the level of emissions allowed under the cap-and-trade program covering air pollutants in the capital region to improve air quality to the level in advanced Organisation for Economic Co-operation and Development countries.
- Increase average fuel efficiency standards to reduce nitrogen oxide emissions.

Source: Jones and Yoo (2011).

4.5 Innovation

4.5.1 Why Innovation Matters

The transition to low-carbon green growth requires more innovation, particularly in low-carbon energy supply but also in the construction sector, transport, product and process design, urban planning, agricultural practices, and land management. New technologies need to be developed that are less dependent on fossil fuels, and existing technologies need to be made more efficient. Production processes need to be refined so that they are less polluting and resource-intensive.

However, innovation is inhibited by a range of market failures (Jaffe, Newell, and Stavins 2005), all capable of slowing the transition. For example, there are spillovers from new ideas because their use by those who first dream them up does not prevent their use by others. If someone thinks of a new way to reduce the use of water in an industrial process or a new product that is less carbon-intensive, many other people could use the new idea in principle. As a result, it is often difficult to appropriate all the returns on investment in generating knowledge, so people do not have the incentive to invest as much. Hence, the returns to R&D investment are often much greater than the private returns, perhaps on average by a factor of four (Jaffe 1986; Griliches 1992; Popp 2006). The returns to society as a whole from investing in environmental and energy technology R&D are likely to be comparable to those in other fields (Popp 2006).

Some approaches to correcting this problem by creating legally recognized intellectual property rights (IPR) can give rise to monopoly power for the original innovators, which can be a market failure itself. New ideas may be inhibited from spreading.

Second, there can be a tendency to path dependence of the choice of technologies and lock-in of high-carbon plant and equipment, with well-established technologies benefiting from higher productivity because of the experience firms have had with them (Unruh 2000; Acemoglu et al. 2009). A switch to alternative technologies and the adoption of innovations may be desirable, but individual firms may not have sufficient incentive to undertake them unless confident that other firms will, too. Thus, policy makers have to set credible incentives over an extended period of time.

If Asian policy makers are to pursue green growth, they will have to tackle these market failures that hold back innovation. If they do so, they will be able reap benefits across the board from faster technological progress; more rapid adoption of ideas from other countries; and better adaptation of new ideas to local needs, endowments of raw materials, and preferences. As Crafts (2010: 1) notes: "Strong and sustained technological progress is the key characteristic of modern economic growth that distinguished the post-Industrial-Revolution world from earlier times and is the fundamental force which has raised living standards over the last 250 years." Yet, as Crafts points out, many economies relied more heavily on capital accumulation and the reallocation of workers from less to more productive sectors of the economy to fuel their growth in the past. The scope for Asian economies 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. This can already be observed in advanced Asian economies such as Japan and Hong Kong, China.

The transition to green growth can facilitate a broader transition to greater reliance on innovation as a source of sustainable economic growth.

4.5.2 The Asian Experience

The pattern and pace of innovation in Asia has been mixed, with some countries leading the world according to some measures while others have failed to benefit as much. The absolute level of annual investment in R&D in some countries such as the PRC, India, Japan, and the Republic of Korea is now substantial. However, R&D as a percentage of GDP varies considerably. The Republic of Korea and Japan have levels comparable to those of the US, while the PRC and India are some way behind. Similarly, the number of scientists and engineers as a proportion of the population is higher in some Asian countries (e.g., Japan; Singapore; the Republic of Korea; and Taipei,China). Among all countries spending more than $100 million per year on R&D, some Asian nations have very low R&D spending as a proportion of GDP: the figures for Indonesia, the Philippines, Thailand, and Viet Nam, are 0.25% or less (Figure 4.10).

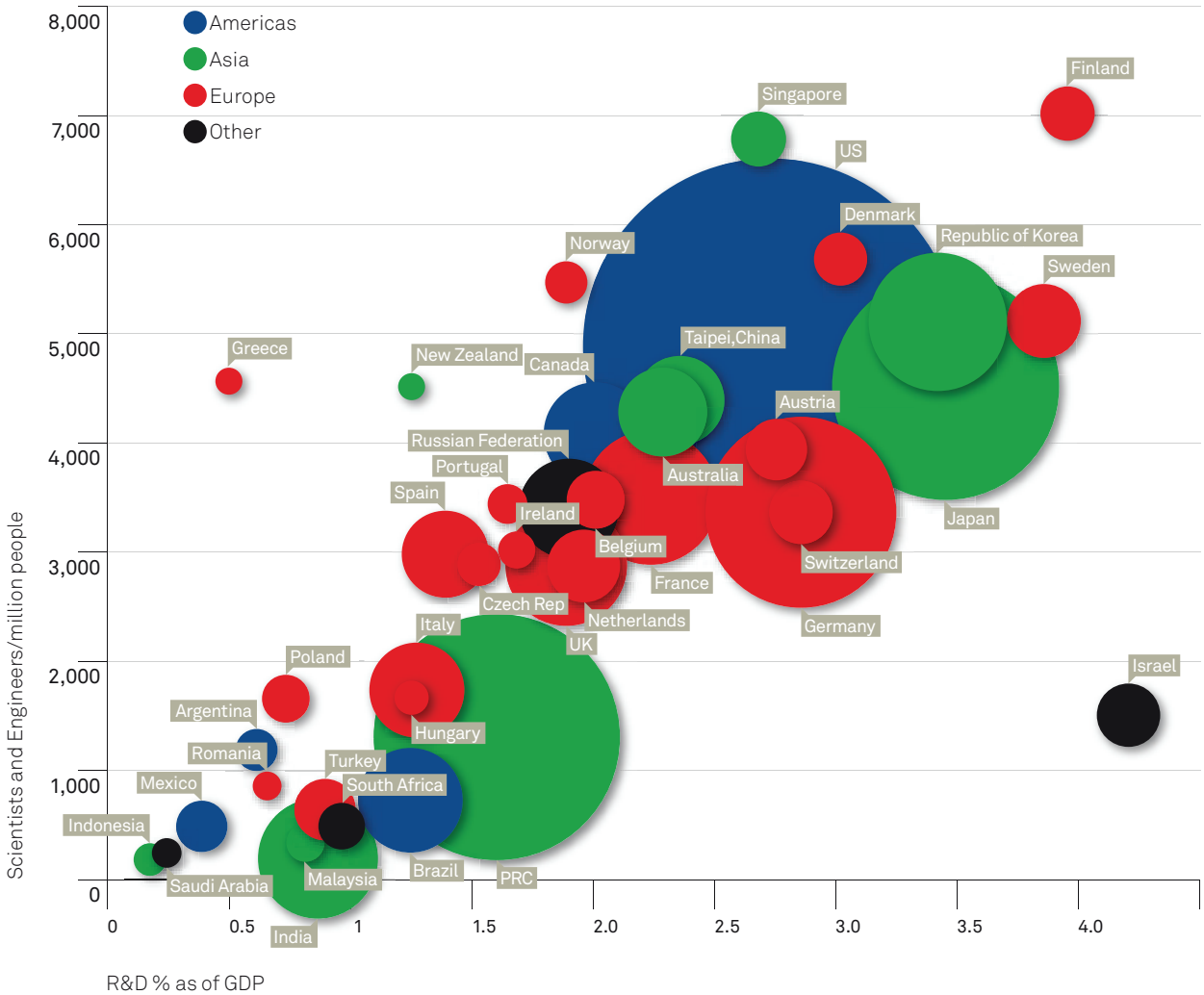
In some cases, notably Japan, R&D effort has been high for many years. The Republic of Korea's spending has increased rapidly in the past decade, as has that of the PRC (Figure 4.11). Indian R&D spending has also been increasing significantly. According to the UN agency WIPO (2011), low- and middle-income economies increased their share of global R&D expenditure by 13% between 1993 and 2009, with the PRC accounting for most of this increase—more than 10 percentage points—propelling the PRC to be the world's second largest R&D spender in 2009.

Yet most R&D spending still takes place in high-income countries—about 70% of the world total. They spend about 2.5% of their GDP on R&D—more than double the rate of middle-income economies as a whole. This dominance is also true if one focuses more narrowly on environmental innovations, for example in pollution abatement technologies (Lanjouw and Mody 1996). R&D is only one aspect of innovation—product, process, and managerial innovations not captured in R&D and patent statistics are important, as is the ability to assimilate and adapt the fruits of R&D elsewhere. There is considerable scope for many Asian countries to increase their innovatory activities in these areas, and tailor the results of innovation elsewhere to their needs. Water pollution control technologies in developing countries have tended to rely more frequently than have air pollution control technologies on local innovation, because local conditions are more important in shaping what these technologies have to do; they are also less likely to have been patented elsewhere. Dechezleprêtre et al. (2011) found that the most common climate-friendly patented innovations in the PRC and the Republic of Korea included technologies designed primarily for local markets, such as geothermal and cement manufacture. Process innovation can be tailored to the mix of inputs available to the country concerned: many Asian countries have abundant supplies of unskilled labor but are less well-endowed with raw materials and energy resources.

Part of the impetus for increased innovation in several Asian countries has already come from efforts to start the transition to green growth. Table 4.9 shows how the PRC and the Republic of Korea, for example, have moved up the rankings for patenting green innovations.

Figure 4.10

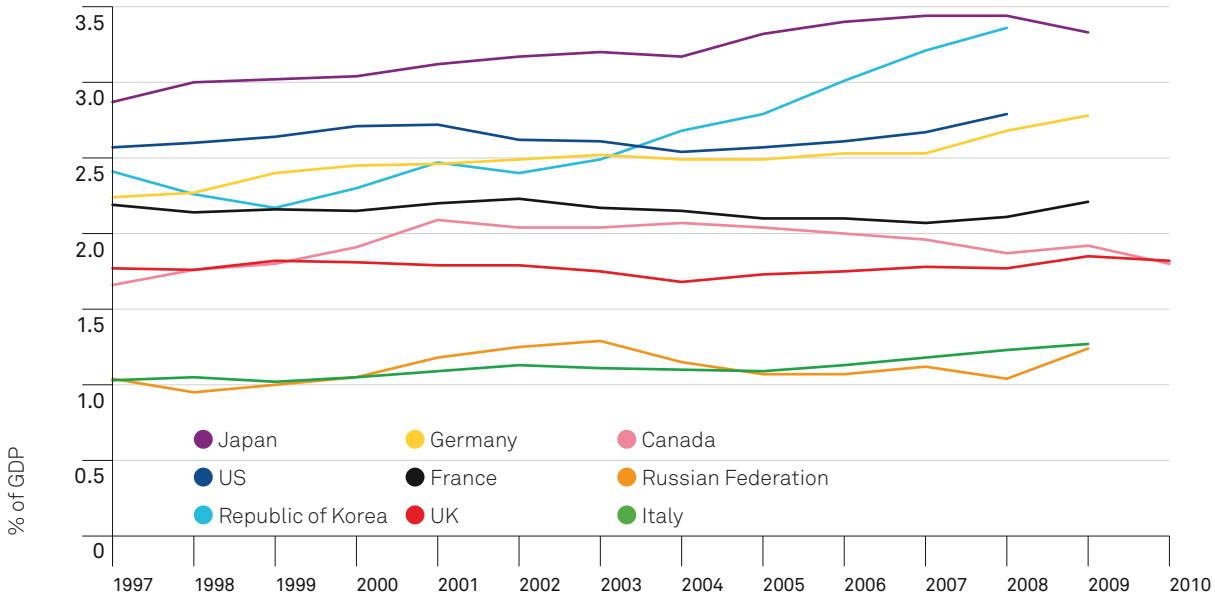
World Research and Development Spending, 2010



Source: R&D magazine (2010).

Figure 4.11

Total Research and Development Spending Relative to Gross Domestic Product among Major Global Economies—Public, Private, and Nonprofit



Source: OECD (2011).

Table 4.8

The Leading Countries for Green Inventions according to Patent Data

Country	1980–2007		2002–2007	
	Average % of world's inventions	Rank	Average % of world's inventions	Rank
Japan	20.2	1	20.8	1
Germany	19.8	2	17.8	2
US	15.4	3	14.1	3
France	5.1	4	4.4	5
UK	4.5	5	4.3	6
Australia	3.8	6	2.9	9
Sweden	3.3	7	1.7	13
Republic of Korea	3.1	8	5.6	4
Canada	2.2	9	3.0	8
Netherlands	2.1	10	1.8	12
Austria	2.0	11	2.1	11
Italy	1.9	12	2.3	10
Switzerland	1.9	13	1.3	15
PRC	1.9	14	3.9	7
Denmark	1.4	15	1.4	14
Total	88.6		87.4	

Source: Dechezleprêtre and Martin (2010).

The PRC's 12th Five Year Plan envisages increasing R&D expenditure to 2.5% of GDP by 2015 (broadly comparable to the current level in Germany), focusing on seven key strategic industries that are at the forefront of the transition to greener growth: environmental protection and energy efficiency, new types of energy supply, next generation information technology, biotechnology, high-end manufacturing, clean-energy vehicles, and high-technology materials.

Policy implications

In order for nations to stimulate green innovation in particular and innovation in general, they need to have effectively functioning national innovation systems, as stressed by two of the background papers to this report (Kumar 2012; Ramanathan 2012). Foxon and Pearson (2008) lay out five functions for which such systems are needed:

1. To create and diffuse knowledge
2. To guide and influence the direction of the search process among users and suppliers of technology
3. To facilitate the supply of required resources, including capital and competencies
4. To create positive external economies through the exchange of information, knowledge, and visions
5. To facilitate the formation of markets

The systems comprise institutions of government and the private sector, and also regulations and market-based incentives. They need to focus primarily on correcting the market failures in the innovation process. The key policy implication is that countries need to strengthen their national innovation systems. Policy interventions to promote eco-innovations need to ensure that the nation has the capacity not only to produce knowledge but also the ability to effectively deploy, internalize, and improve on it. That presents a particular challenge in poorer countries, in which small and medium-sized enterprises often have difficulty in assimilating innovations (Ramanathan 2012). However, some countries in Asia have much better developed national innovation systems (Kumar 2012); amongst them Japan, the Republic of Korea, the PRC, and Singapore. Even in these countries, there is scope for improving the pace and extent of innovation, as a recent OECD study of the Republic of Korea's innovation policy illustrates, emphasizing the desirability of green investments and services innovation.

Innovation in many Asian countries will rely to a large extent on adapting the outputs of basic R&D in high-income countries, so the IPR governing the international diffusion of innovation is important. At the moment, there are long lead times when developing-country firms try to acquire technology partners, finance, and skills (Ramanathan 2012). It is difficult to combine technologies derived from different sources subject to different IPR barriers, while potential partners are reluctant to transfer cutting-edge technologies. The United Nations Economic and Social Commission for Asia and the Pacific is tackling this issue with respect to energy through its Renewable Energy Cooperation Mechanism for Asia and the Pacific.

Policy makers have to make a sustained effort to redirect national innovation systems, because economies of scale and the higher returns to new ideas in larger, well-established industries tend to establish path dependence—firms will not be able to break out of their high-emissions paths without public assistance. This may entail support for infant green sectors, subsidies, and environmental pricing. Carbon pricing is an effective tool to direct innovation towards low-carbon techniques and products (Popp 2002), and its effects are non-discriminatory and pervasive.

4.6 Energy Security

4.6.1 The Two Dimensions of Energy Security

There are two distinct aspects to energy security. First, ensuring all who need energy have access to it. This is an element of ensuring social inclusion and fighting poverty. Second, the objective of maintaining an uninterrupted supply of energy in the short, medium, and long term. That requires a robust energy infrastructure, access to a variety of primary energy sources and diversification of sources of energy imports to reduce geopolitical risks. Coordination problems and economies of scale in the provision of networks such as electricity grids can impede purely private sector efforts to develop universal access to high-quality energy supplies. Government attempts to regulate the energy sector, maintain low energy prices, and control the rents from natural resource ownership can introduce inefficiency and even corruption. Energy resource endowments can therefore bring with them both market and government failures (Collier 2010).

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 particulate emissions. Asia has extensive renewable energy resources that could be further developed while extending access to energy. Greater use of electricity in the energy mix allows a variety of primary energy sources to be used while reducing the number of sites at which carbon is emitted.

Developing domestic renewable energy sources reduces dependence on foreign supplies of energy while mitigating climate change risks. This has been one of the major motivating factors, for example, of the European Unions (EU) ambitious efforts to increase the contribution of renewable energy from 11.6% in 2009 to 20% by 2020.

4.6.2 The Asian Experience

Both aspects of energy security are important for Asia. About 60% of the 1.6 billion people around the world who do not have access to electricity live in Asia (ADB 2009b). The electrification rate is only 20% in Cambodia and the Lao People's Democratic Republic (Lao PDR) and even lower, at 11%, in Myanmar. There is a high degree of reliance on traditional biofuels. In 2006, biomass and waste still accounted for 24% of energy for final use: 49% of the energy used in the residential sector in the PRC was derived from this source; in India, the figure was 68%.

Earlier in this chapter we discussed some of the successful initiatives in Asia to tackle this problem at the grassroots. More broadly, national energy policies have also facilitated a very rapid increase in energy supply. According to the US Energy Information Administration, electricity supply in Asia doubled between 1999 and 2006 and generation was growing at annual rates of 22.5% in Cambodia, 14.0% in the Maldives, 11.0% in Afghanistan, 9.5% in Bangladesh, 8.7% in Bhutan, and 7.9% in Nepal. Rural electrification has been very successful in several countries (e.g., Thailand).

However, energy demand has tended to outstrip domestic supply, notably but not only in the largest economies. The PRC switched from being a net coal exporter to be a major net importer in 2009 (Morse and He 2010). The PRC, India, and the Republic of Korea are among the world's top five oil importers.

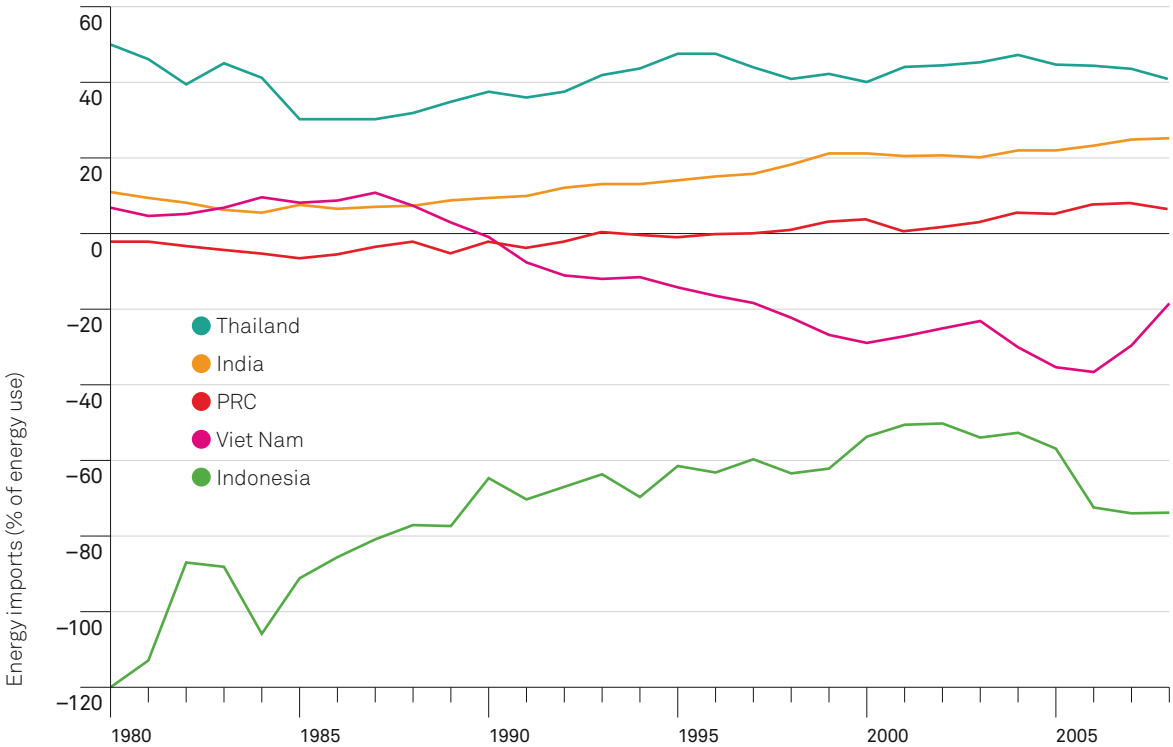
Imported energy has become more important in the energy mix of most Asian countries and reliance on fossil fuels is greater than the global average. Import dependence will rise (Figure 4.12) unless there is a step change in the exploitation of domestic energy resources, including renewables.

Concerns about energy security have led the PRC and India to purchase foreign firms owning fossil-fuel resources in other countries. At the same time, significant inefficiencies remain in energy supply, notably electricity. Transmission and distribution losses have been high in Asia, amounting to 11% of the electricity consumed in 2006; transmission and distribution losses were as high as 37% of total consumption in India, 35% in Bhutan, 32% in Nepal, and 39% in Myanmar (ADB 2009c).

As the 2009 ADB study showed, one response has been to stimulate the production of renewables through various policy measures (Table 4.10). But so far, these have not made a major impact on countries' energy mixes. Of the countries reviewed in REN21 (2011), Thailand was the only country in Asia with more ambitious plans (in percentage points) than the EU to increase the share of energy from renewables. The pros and cons of nuclear power are discussed from this perspective in Box 4.8.

Figure 4.12

Energy Import Dependency in Emerging Asia



Source: Howes and Wyroll (2012), based on World Bank (2011).

Table 4.9

Low-Carbon Policies in Asia

Country	Feed-in Tariffs	Renewable Portfolio Standards	Capital Subsidies, Grants or Rebates	Investment or Other Tax Credits	Sales Tax, Energy Tax, Excise Tax, or Value-Added Tax Reduction	Energy Production Payments or Tax Credits	Net Metering	Public Investment Loans, or Financing	Public Competitive Bidding
Cambodia			●						
PRC	●		●	●	●			●	●
India	[a]	[a]	●	●	●	●	[a]	●	●
Indonesia	●								
Philippines			●	●	●			●	
Sri Lanka	●								
Thailand	●		●				●	●	

[a] Some states/provinces within these countries have state/province-level policies, but there is no national-level policy. Only enacted policies are included in the table. However, for some policies shown, implementing regulations may not yet be developed or effective leading to lack of implementation or impacts.

Source: ADB (2009).

Box 4.8

Green Growth and Nuclear Power in Asia

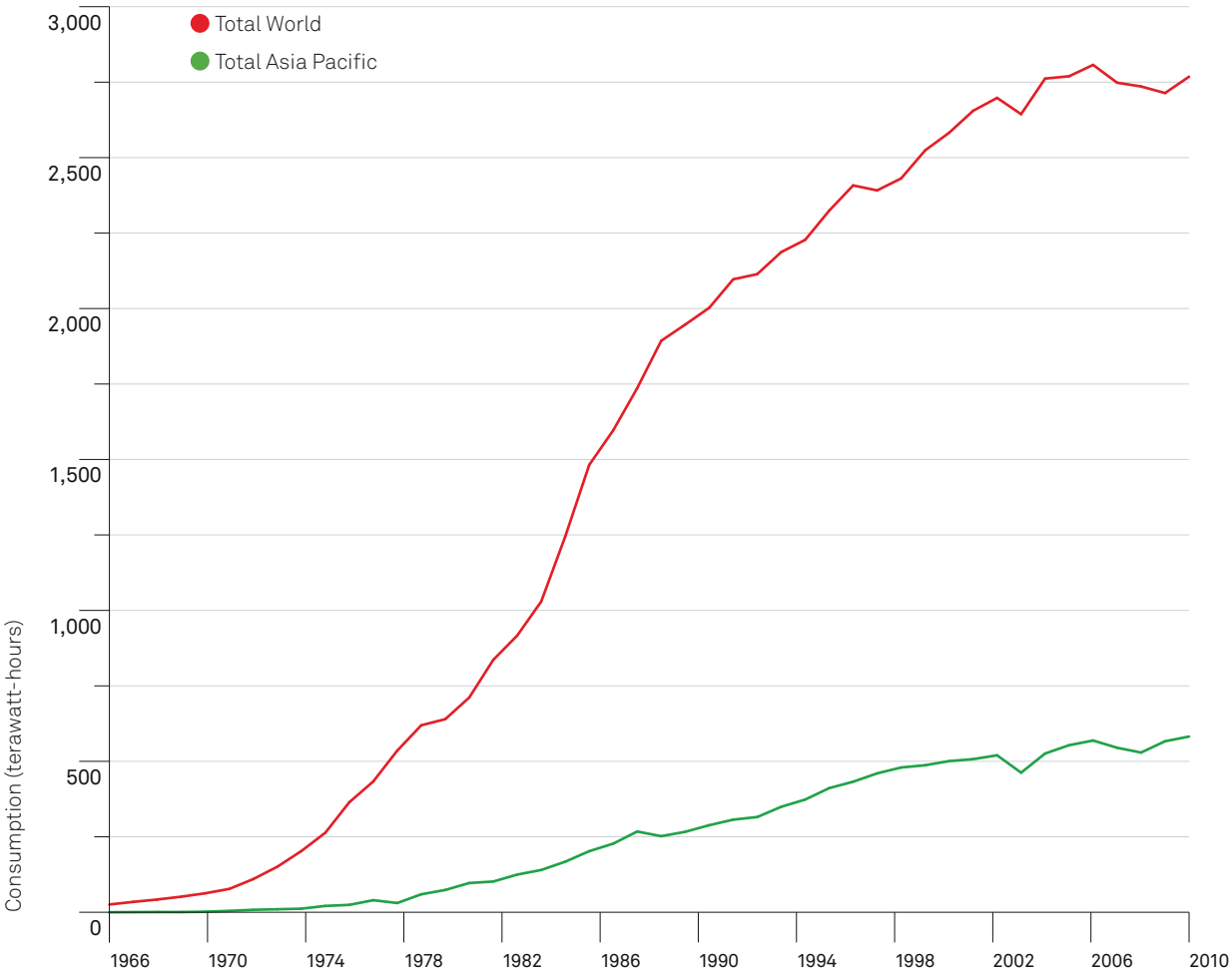
The aspirations of Asian nations to maintain rapid economic growth, increase households' and firms' access to energy, and contain rises in the real price of energy raise the question of what role nuclear power might play. As with renewable energy sources such as wind, nuclear power is associated with much lower carbon emissions per unit of electricity than fossil fuel power generation, even taking into account the design and construction phases. Capital costs are also much higher than operating costs, for both renewable and nuclear power. However, unlike most forms of renewable power generation, nuclear power can generate electricity continuously (apart from interruptions for maintenance), thus promising a more reliable supply to satisfy base load requirements. Although nuclear power is not renewable, and depends on finite resources of fissile material for fuel, known reserves and technological alternatives (using breeder reactors and reprocessing) suggest supply constraints are unlikely to bind as soon as with oil and gas. For such reasons, the nuclear industry has been anticipating a nuclear renaissance.

That renaissance has been slow in materializing. Since the Chernobyl incident in 1987, installed nuclear power capacity has grown at an average rate of only 1.3% per year while average annual growth in electricity demand was around 3% per year. In the decade 1996–2006, while total global primary energy consumption increased by 26%, installed nuclear power increased by only 15%. Rising concerns about climate change brought an expansion of nuclear power back onto the agenda but the tsunami damage that destroyed the reactors at Fukushima, Japan, on 11 March 2011 led several countries to review their nuclear plans. Other problems over the years have included high construction costs, large cost overruns, concerns about the safe disposal of long-lived radioactive waste, worries about nuclear proliferation, and fears of catastrophic malfunctions.

Source: Herberg (2011); Pacific Energy Summit 2012 Summit Papers.

Figure 4.13

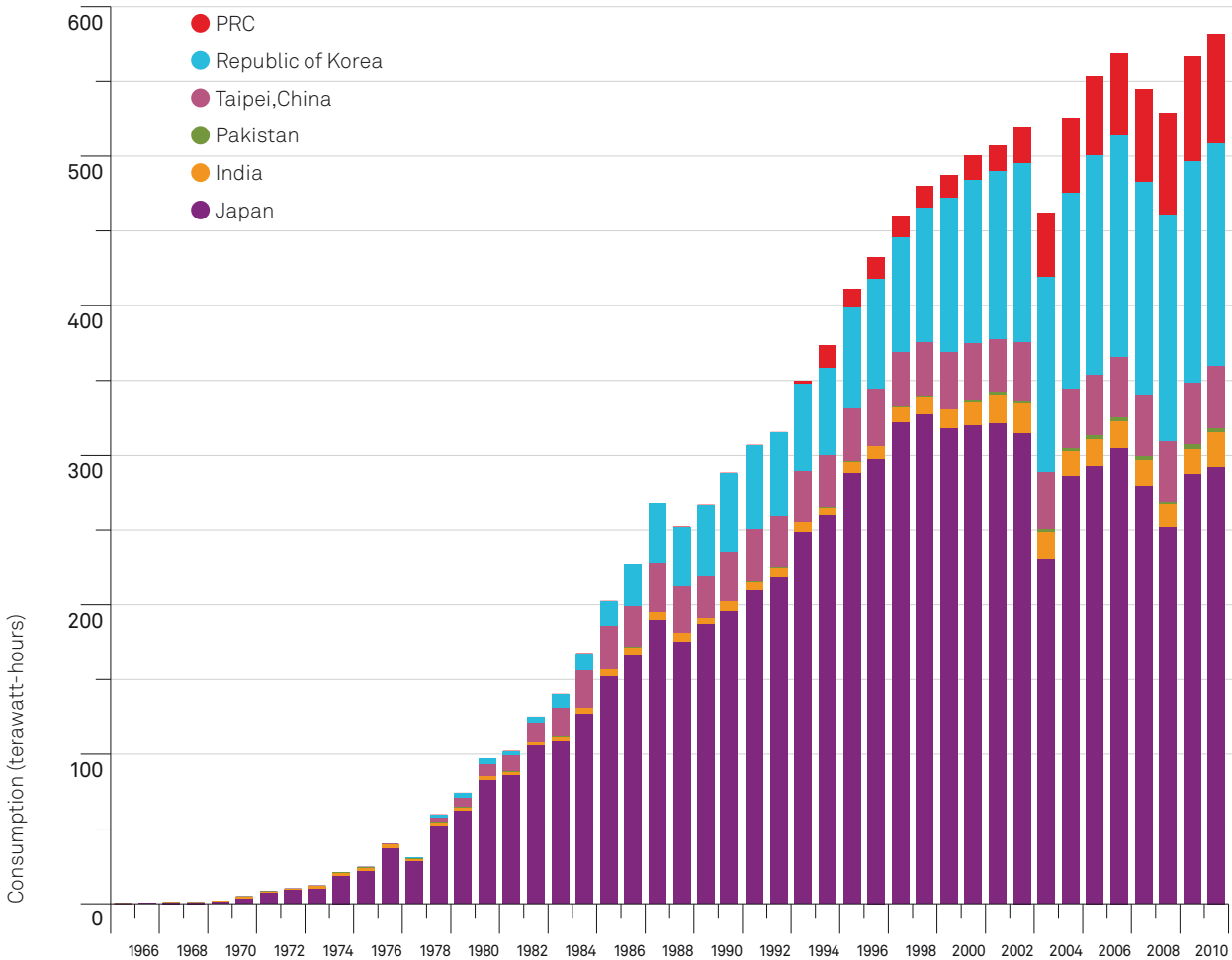
Nuclear Energy Consumption in Asia and the Pacific and the World



Source: BP. Statistical Review of World Energy June 2011.

Figure 4.14

Nuclear Energy Consumption in Asia and the Pacific



Notes: Based on gross generation and not accounting for cross-border electricity supply. Converted on the basis of thermal equivalence, assuming 38% conversion efficiency in a modern thermal power station. Nuclear energy data (expressed in terawatt-hours) are available at www.bp.com/statisticalreview.

Source: BP Statistical Review of World Energy June 2011.

Table 4.10

Nuclear Electricity-Generating Capacity 2012

Country	Cumulative Installed Nuclear Capacity	Number of Reactors [a]	Share of Electricity from Nuclear in 2011	Reactors Under Construction*	Capacity Under Construction
	MW		%		MW
Japan	44,215	50	18	2	2,650
Republic of Korea	20,671	23	35	3	3,640
PRC	11,816	16	2	26	26,620
Taipei,China	5,018	6	19	2	2,600
India	4,391	20	4	7	4,824
Pakistan	725	3	4	2	630
Viet Nam [b]				4	4,000
Philippines [b]				4	2,400
Thailand [b]				2	2,000
Indonesia [b]				1	1,000
Bangladesh [b]				1	1,000
Asia Total	86,836	118		42	40,964

[a] Not all reactors are currently generating electricity; for example, as of 5 May 2012, all of Japan's "operational" reactors were offline with no set date for restart. [b] Source for each country from http://www-pub.iaea.org/MTCD/Publications/PDF/CNPP2011_CD/pages/countryprofiles.htm Accessed May 26th 2012.

Source: Compiled by Earth Policy Institute with capacity and number of reactors as of 13 May 2012 from International Atomic Energy Agency (IAEA), Power Reactor Information System (PRIS), "Operational & Long-Term Shutdown Reactors," www.pris.iaea.org updated 13 May 2012; nuclear share of electricity from IAEA, PRIS, "Nuclear Share of Electricity Generation in 2011," at www.pris.iaea.org updated 13 May 2012; UK and world totals adjusted to reflect closure of Wylfa 2 reactor, from "Wylfa 2 Bows Out," World Nuclear News, 26 April 2012; world share of electricity from nuclear in 2010 from IEA, IEA (2011b: 451).

Figure 4.13 shows the trends in nuclear energy consumption in Asia. More countries in the region plan to establish nuclear capacity (notably Viet Nam and the Philippines) and the PRC's expansion plans are particularly ambitious (Figure 4.14). The target announced by the PRC's National Energy Bureau for 2030 is a capacity of 160,000 MW, which would easily make the PRC the world's largest producer of nuclear power (Table 4.11). Sovacool and Valentine (2010) argue that seven key factors appear to underpin support for nuclear power development, especially in India, the Republic of Korea, and the PRC:

1. Strong state involvement in guiding economic development;
2. Centralization of national energy policy making and planning;
3. Campaigns to link technological progress with national revitalization;
4. The influence of technocratic ideology on policy decisions;
5. Subordination of challenges to political authority;
6. Low levels of civic activism;
7. The influence of climate policy.

The future role of nuclear power in Asia's green growth is uncertain. Public opinion appears to have turned against it in Japan, following Fukushima. But several other countries, particularly the PRC and India, are likely to press ahead. Countries must have a strong regulatory capacity if they are to take this route, given the sensitivity of investment, cost control, and safety practices to regulatory incentives. Nuclear power cannot replace fossil fuels by itself. A portfolio approach has attractions, increasing the resilience of national energy systems and promoting energy security.

4.6.3
Policy Implications

Energy supply and energy efficiency need major enhancements in Asia if the continent's rapid growth is to be sustainable and access to energy resources is to be made available to all households. These are necessary if rapid growth is to be green and low-carbon, so that it can both continue in the long term and avoid dangerously high emissions and climate risks.

The ADB (2009a) study on Improving Energy Security and Reducing Carbon Intensity in Asia and the Pacific identified policy initiatives which would reap benefits:

1 Reducing price distortions in energy markets, particularly by removing implicit and explicit subsidies on fossil-fuel production and consumption (while introducing more targeted support for poor households)
2 Scaling up successful pilot projects and local initiatives in renewable energy
3 Improving the governance of publicsector energy supply and regulation 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 new technology such as "smart" grids that can leapfrog older technologies used in Europe and North America, and improve energy efficiency by making it easier for demand to respond to prices and easier to integrate energy from renewable sources
6 Offering incentives to the private sector to invest in renewable energy and more energy efficient capital stock
7 Integrating energy efficiency projects more effectively in the UNs' Clean Development Mechanism.

4.7
Towards a New Policy Approach

Low-carbon green growth is an essential strategy for sustainable development in Asia, improving living standards, and saving resources. It requires policies across a wide range of areas to correct market and policy failures, particularly those arising from environmental externalities and inadequate incentives for innovation. Well-designed policies can improve the productivity of economies, stimulating growth rather than holding it back, and reducing the risk of environmental catastrophes. Action is required in five broad areas, as summarized in the matrix in Table 4.11.

Table 4.11

Key Policy Actions Required

Area of policy	Actions required	Reasons for these actions
Energy sector	Unwinding of energy subsidies; introduction of pervasive and broadly uniform carbon pricing.	To send a clear signal about the direction of energy policy; to improve energy efficiency and generate tax revenues to fund other national objectives.
Innovation	Stimulation of locally appropriate innovation in production technologies, products, and management. That needs sector-specific initiatives, including time-limited public support for low-carbon research, development, deployment, and diffusion; and more regional cooperation.	Innovation is a key driver, along with capital accumulation and skills acquisition, of economic growth. Asia will be able to rely less in future on very rapid capital widening, movement of workers from low-productivity to high-productivity sectors and "catch-up" with today's technological leaders.
Resource use	Improvement of incentives for efficiency, particularly in the use of natural resources and the services provided by the natural environment. 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.
Labor markets	The promotion of labor market mobility and the acquisition of new skills.	Active labor market policies are needed to facilitate rapid structural change, including the transition to a low-carbon economy; that also helps to share the benefits of green growth more equitably.
Social inclusivity	Integration of the social dimension of growth with the macroeconomic dimension; mitigating the adverse impacts on the poor of taking the low-emissions path; using local knowledge to stimulate appropriate innovation.	Green growth should be pro-poor and pro-job but will not be so automatically; enhancing communities' capacities for collective action should improve economic, social, and environmental outcomes across the board.

Source: ADB–ADBI study team.

In all five areas, no-regrets strategies are available where the resource costs of action are relatively small and the likely benefits significant, while dangerous risks are reduced or eliminated. Beyond those, many investments are likely to have a high social rate of return and a competitive private rate of return, especially if environmental pricing is implemented. The costs of climate change mitigation could be offset to a very large extent (and, in some countries, completely) by co-benefits such as faster technological progress, lower environmental pollution, improved health, better matching of potential workers with jobs, and enhanced energy security.

However, a number of obstacles need to be overcome, including the design of efficient policies, strengthening social safety nets, and the political challenge of improving governance and overcoming entrenched economic interests benefiting from the status quo. The danger is that such obstacles will lead to delay. Asia needs to take vigorous action now to be a low-carbon leader in the future.