23 Supporting the Transition to a Low-Carbon Global Economy

Key Messages

Demand for energy and transportation is growing rapidly in many developing countries. The investment that takes place in the next 10-20 years could lock in very high emissions for the next half-century, or present an opportunity to move the world onto a more sustainable path. Investment in energy efficiency can reduce demand growth, and low-carbon technologies can further reduce the impact on climate change.

The transfer of technologies to developing countries by the private sector can be accelerated through national action and international co-operation.

Energy price and taxation reform will play an important role in improving the conditions for investment in more efficient and low-carbon technologies, as they can support other development priorities and encourage co-benefits from mitigation policies, including energy security and improved air quality.

Carbon pricing is essential to influence investment decisions in low-carbon technologies, including renewable energy and carbon capture and storage. The Clean Development Mechanism is currently the main formal channel for supporting low-carbon investment in developing countries, but in its existing form it has significant limitations.

The incremental costs of low-carbon investments in developing countries are likely to be at least $20-30 billion per year.

A transformation in the scale of and incentives for international carbon finance flows is required to support cost-effective reductions. This will require mechanisms that link carbon finance to policies and programmes rather than to individual projects, working within a context of national, regional or sectoral objectives for emissions reductions.

Long-term goals and early signals to provide continuity of carbon finance after 2012 are essential to deliver emissions reductions in developing countries.

There are opportunities now to build trust and to pilot new approaches to creating large-scale flows for investment in low-carbon development paths. The International Financial Institutions have an important role to play in accelerating this process, including through the creation of the Clean Energy Investment Framework.

The reduction of tariff and non-tariff barriers for low-carbon goods and services, including within the Doha Development Round of international trade negotiations, could provide further opportunities to accelerate the diffusion of key technologies.

23.1 Introduction

Shifting investment towards a low-carbon economy faces particular challenges in developing countries and economies in transition that will be explored in this chapter. Demand for energy is growing rapidly in many such countries. The choices made in the next 10-20 years on the levels of investment in end-use energy efficiency, the type of power generation systems, production processes and modes of transportation will affect greenhouse gas emissions for the next half-century. This chapter builds on the foundations of mitigation policy that are set out in Part IV to consider the key aspects of how best to assist developing countries to make the transition to a low-carbon economy.

This chapter first explores the context for investment decisions fast-growing emerging economies. There are significant requirements for investment in the energy sector, and finding resources to finance the incremental costs of investment in low-carbon technologies will be a challenge. There are also important financial, political and institutional barriers to clean energy investment in some developing countries and economies in transition.

Section 23.3 explores the role of national policy goals and reforms in making the transition to a low carbon economy. Energy price and taxation reform will play an important role in managing demand growth, as will improved end-use efficiency and facilitation of investment in more efficient and low-carbon technologies in several sectors. These reforms also support many other national objectives, because, as discussed in Chapter 12, mitigation policies have co-benefits such as improved air quality, increased access to modern energy services, and access to low carbon technologies. Many countries are already taking steps in these directions. It is in this context that assistance – financial, technical and so on, from both the public and private sector – can be enabled to facilitate a shift in the pattern of development.

As explained in Section 23.4, public policy also has a major influence in creating the conditions for the private sector to invest in and transfer low-carbon technologies (and the technologies relevant to adaptation) to developing countries. It is important to understand the various roles that the protection of intellectual property rights can play.

Section 23.5 discusses the essential role of lending and finance in supporting investment decisions in low-carbon technologies and energy efficiency, including through the Global Environment Facility. We consider what can be learned from the early experience of implementing the Clean Development Mechanism. Looking ahead, a transformation is required in these institutions to both generate and handle investment flows to enable developing countries to make the transition to a low-carbon economy. Section 23.6 examines the role of the World Bank and Regional Development Banks in creating frameworks to bring the issues discussed in this chapter together to ensure they complement each other. The chapter ends by examining the role that the international trade regime can play in supporting mitigation.

23.2 Understanding the context for energy sector investment

Demand for energy is growing rapidly in fast-growing emerging economies. The investment that takes place in the next 10-20 years could lock in very high greenhouse gas (GHG) emissions for the next half-century, or help move the world onto a more sustainable path.

Energy has a pivotal role in development – it helps promote access to better education, better health, increased productivity, enhanced competitiveness and improved economic growth. In many developing countries, under-investment in energy infrastructure is a brake on development[1]. The IEA (2006) has estimated that there are currently 1.6 billion people without access to energy (over a quarter of the world's population) and 2.5 billion using traditional biomass for cooking and heating[2]. Without new policies and financing, 1.4 billion people will remain without access to electricity by 2030.

In Chapter 12, we discussed the many co-benefits associated with reducing GHG emissions. Energy policy priorities in the developing world tend to be focused around facilitating economic growth and urbanisation; ensuring security of energy supply; providing access to energy; and reducing local and regional pollution from energy production and use[3]. These priorities can often lead to outcomes that reduce GHG emissions intensity – for example where there is a strong focus on energy efficiency, or when obsolete technologies are reduced or the use of carbon-

[1] The World Bank estimates that in some countries under-investment in energy is reducing GDP growth by 1-4% per annum.
[2] See Chapter 12 and World Bank (2006b) for the effects of this on health.
[3] CCAP, 2006 and World Bank, 2006b.

intensive fuels is reduced. But there can also be conflicts, particularly where coal provides a cheap and readily available source of supply.

The IEA has identified a requirement for investment in the energy sector for developing countries of around \$10 trillion to 2030[4]. This suggests that investment of around \$165 billion per year is required from now to 2010 in the developing countries' electricity sectors alone, increasing at 3% per year through to 2030[5]. Out of this, \$34 billion is required annually for energy access for poor people. This investment will come largely from national investment and from the private sector, and will depend to a large extent on the policy frameworks in place in the countries themselves.

There are financial, political and institutional barriers to encouraging clean energy in developing countries and economies in transition

Both the IEA and the World Bank note that the scale of actual current domestic and foreign investment is insufficient to meet these requirements. A large financing gap exists for investment in basic power sector infrastructure, in part because policy frameworks in the energy sector are not yet providing a sound environment for investment to take place. The World Bank estimates that there is a further significant gap, of around \$20-30 billion per annum, to meet the incremental costs of low carbon investment in the power sector in developing countries.

There are strong pressures in fast growing economies to expand the supply of energy as quickly as possible. The implied returns to investment in the energy sector mean it makes sense to expand generation capacity very quickly, often by using familiar capital stock and technology, and making use of domestic reserves of coal wherever possible, regardless of higher recurrent costs later through efficiency losses and local and regional environmental damage. These pressures have been particularly evident in China where power companies have been investing rapidly in new coal-fired power stations, but can also be seen in a range of other fast-growing economies. India and China's coal consumption is forecast to increase by 3% per year from 2004 to 2030, compared to an increase of 0.6% per annum for all OECD countries[6].

In addition, as Chapter 12 has noted, many developing countries subsidise their energy sectors – estimated at around \$162 billion per year between 1995 and 1998. Many also have also built extended networks, and established fuel chains and users of dirty energy sources over time. For example, recent research from the Economic Commission for Latin America and the Caribbean shows that many of the countries in the region have had active fiscal policy to soften the impact on final consumer prices for scarce supplies of petrol and diesel, and do not differentiate between the polluting potential of these fuels[7]. Removing these distortions and pricing energy appropriately[8] could deliver long-term benefits for the climate and economy, but it requires careful management of any resulting redistribution of income between different parts of society.

These pressures are exacerbated by the difficulty faced by national governments and local authorities in enforcing environmental regulations or insisting on investments in untried technologies. These factors can slow down the introduction of more efficient technologies that are already cost-effective in developed countries, for example super-critical boilers for coal-fired power stations. In addition, low levels of capacity relative to demand means that it is difficult for operators to take plants off-line to make improvements to energy efficiency and delivery, given implications for local residents and industry. Hence, old and carbon-intensive infrastructure tends to be maintained in operation even where it would be cost-effective to upgrade it.

[4] This figure is calculated as half of the IEA's (in press) total global capital investment estimate of US\$20 trillion would be required to meet projected demand in the energy sector between 2005 and 2030 (of which around 57% would be required in the power sector). Proportion taken from IEA (2005).
[5] World Bank, 2006b.
[6] IEA (in press).
[7] Acquatella and Barcenas, 2005.
[8] In many cases the appropriate level is marginal cost of production, but the policy choice should depend on capacity and costs of outages, revenue constraints, and in some cases the incomes of the purchasers.

The following sections consider how international co-operation can support the achievement of ambitious national policy goals in the transition to a low-carbon economy, by creating an enabling environment for investment, accelerating transfer of relevant technologies to developing countries, and how carbon markets are beginning to create additional financial flows.

23.3 Improving the enabling environment for investment

There are a number of domestic barriers to investment and market development in clean energy technologies, many were identified in Section 23.2. The importance of these barriers will vary between countries, and according to the level of development of the country, the state of its financial sector, existing regulations and policies, as well as the availability of natural resources.

Many emerging economies are already engaged in a process of reforming the energy sector and introducing policies for sustainable transport, supporting national objectives for energy security, environmental quality, public finance and economic growth.

Taking action to reform the energy sector can be difficult, but as underlying distortions in energy prices and subsidies are removed, cost-effective efficient and low-carbon technologies will be taken up more widely, and there will be a stronger foundation for carbon markets to work more effectively. This can also increase the use of domestic capital as well as foreign domestic investment. An enhanced energy efficiency drive can also harness opportunities for significant gains by removing obsolete generation technologies, cutting losses in transmission, and enhancing positive impacts of removing carbon-intensive and locally polluting fuels. A case study commissioned by the World Bank (2006b) showed that an effective policy environment helped Vietnam to meet a sustained and rapid growth in demand for electricity.

Many developing countries are already advancing along these lines. In the 1990s, for example, China experienced rapid economic growth and a sustained fall in the energy intensity of its economy as it allowed prices to rise closer to market levels[9]. The 11th Five Year Plan seeks to continue this trend. The two key objectives are to double economic growth from 2000 to 2010 while reducing energy intensity 20% from 2006 to 2010. These objectives are supported by a wide range of policies, including the use of sales taxes to encourage the purchase of cars with smaller engines, and the use of regulation and other policies to encourage energy efficiency in the largest industrial enterprises (see Box 23.6). Chinese researchers have considered the extent to which reforms to energy taxation might contribute to this goal, as described in Box 23.1.

[9] CASS, 2006.

Box 23.1 Modelling the potential impacts of energy taxation in China

China has now established a goal to reduce energy intensity by 20% between 2006 and 2010, reflecting concerns about energy security and air and water pollution. China has become increasingly reliant on oil imports (currently importing 43% of domestic oil consumption). Heavy reliance on the use of coal has caused high levels of air pollution[10]. Studies suggest that the economic costs of air pollution in China are between 2-7% of GDP, and that 16 of the 20 most polluted cities in the world are in China. China has also introduced legislation to promote energy conservation and the use of renewable energy, and is investing in a number of major national programmes to achieve the 20% energy intensity goal.

Research carried out for this Review[11] considered an illustrative example of how the introduction of energy taxation might support the delivery of China's energy, environmental and social objectives, including lower air pollution and greater public resources for priorities such as education and health. The results indicated that:

- a flat tax of 50yuan/tonne coal equivalent (tce) on coal, oil, and natural gas would elicit a 6.3% reduction in energy demand (around 123 million tce) by 2010 compared with business as usual.
- variable tax rates of 120, 100 and 80 yuan/tce on coal, oil, and natural gas respectively to reflect the different carbon intensities of the fuels would result in an energy demand reduction of 16.2% (around 400 million tce) by 2030.
- the costs of introducing the tax was likely to be limited (0.4% of GDP in 2010 and 0.36% in 2030). This may be an overestimate because the calculations do not model the positive effects of reduced reliance on energy imports and the potential growth in environmentally friendly industries.
- the implementation of such tax rates might be expected to strengthen China's own public finances, raising approximately $11.6bn in 2010 and $31.5bn in 2030.

The Indian Planning Commission (2006) released a report on Integrated Energy Policy to contribute to its 11th Five Year Plan. This recommends a wide range of measures to increase competition in energy markets and allow energy prices to reflect market forces. It also recommends regulating prices to include environmental externalities, reduce losses in the power sector, and improve the transparency and targeting of subsidies. These reforms support the Indian government's goals of encouraging economic growth by reducing the cost of power and industrial energy intensity and extending access to electricity to all households by 2010. Such measures will also reduce ill health and mortality associated with indoor air pollution. As part of this strategy, the Indian Ministry of Power is working to remove market distortions caused by existing subsidies for kerosene in favour of less polluting, low-carbon home cooking systems based on solar and biomass technologies.

Specific local pollution control measures can also help control GHG emission growth. These policies are often designed and implemented by municipal rather than national authorities. For example, Mexico City has removed locally polluting carbon-intensive oil plants and replaced them with high-efficiency gas turbines. Likewise, Beijing has set up a plan to change industrial coal-fired boilers to natural gas and expand the use of natural gas in the grid in its effort to clean the city for the Olympics.

[10] Coal accounts for 70%, 90%, and 67% of total soot, sulphur dioxide, and nitrogen oxide emissions respectively (China Statistical Yearbook, 2005).
[11] CASS, 2006.

Long-term strategic planning is also essential to deliver the infrastructure for sustainable developments for the transport sector. The city of Curitiba in Brazil developed a plan to prevent urban sprawl and a high-capacity public bus system to keep total car use at 25% of that of comparable cities[12]. Similar proposals are advancing elsewhere. Bogotá, Colombia's capital city, has developed a methodology to account for the reduced emissions from implementing a Rapid Bus transit system to generate CDM credits from this project[13]. Cities in Mexico, Chile and Peru are planning to follow suit. Likewise, with World Bank support, Mexico has developed an umbrella program to expand new technology used for a Monterrey landfill-gas processing plant to other cities in the region.

Policies designed to support the deployment of new technologies such as feed-in tariffs and renewable portfolio standards, as described in Chapter 16, can also support investment, technology transfer and the formation of new national industries. Many developing countries have introduced such policies[14]. China and India have encouraged large-scale renewable deployment in recent years and now have respectively the largest and fifth largest renewable energy capacity worldwide[15].

The success of key developing countries in realising their current domestic energy and transport goals will play a part in limiting the growth of GHG emissions, and will facilitate further reductions over time. Notwithstanding the achievements so far, the goals that many of the large developing countries have set are ambitious, and there is much that international co-operation can do to support their implementation.

A number of international institutions and partnerships are focusing on increasing support for national policy reform to improve the environment for private sector investment and technology transfer.

There are a number of measures that governments can take to create a suitable investment climate for energy investment and the adoption of new technologies, such as[16]:

- Removal of broad-based energy subsidies and tariff barriers;
- Establishment of credible legal and regulatory frameworks;
- Creation of market-based approaches such as emissions trading, energy service companies, energy performance contracts, and credit guarantees;
- Information dissemination regarding energy savings and clean energy options;
- Including environmental costs in the price for energy services;
- Strengthening intellectual property rights;
- Developing product standards;
- Making markets more transparent.

It is important to involve the private sector in designing co-operation to enhance the climate for investment and technology transfer. The Renewable Energy and Energy Efficiency Partnership (REEEP), funded by a number of developed country governments, actively structures policy initiatives for clean energy markets and facilitates financing mechanisms for sustainable energy projects. REEEP provides opportunities for concerted collaboration among its partners, and has a bottom up approach to reflect local preferences, with the organisation playing a supportive role to the partners and members that run programmes rather than dictating approaches. This has proved popular and led to a diverse range of projects ranging from pure policy advice, such as

[12] Michelowa and Michelowa, (2005): 22.
[13] This has been with support from a Regional Development Bank – the Corporación Andina de Fomento. Also see Colombia's proposal at the Latin America Carbon Forum at
http://www.latincarbon.com/docs/presentations/dia2/session2a/Presentaci%F3nMDLColombia-Ecuador.pdf
[14] REN21, 2005, p.20
[15] These are 2005 figures excluding large-scale hydropower. REN21, 2006, p. 6.
16 World Bank, 2006a.

compiling renewable energy legislation for Kazakhstan or devising clean energy policy and an action plan for Liberia, or more specific tasks such as promoting low energy buildings in China. [17]

The Asia Pacific Partnership, formed by Australia, China, India, Japan, South Korea and the US in 2005, takes a sectoral approach and, like the REEEP, focuses on the role of the private sector. The partnership includes a small amount of seed funding, but focuses on understanding the main drivers for investment in new technologies. Strong involvement of leading technology providers and investors provides a forum to explore practical steps to remove barriers to commercial co-operation on low carbon technologies. Over 90 private companies and industry groups and 150 senior representatives attended the inaugural ministerial meeting in January 2006. All eight sectoral task forces contain public and private sector members as equal participants rather than stakeholders.

The EU has its own partnerships on climate change and clean energy with China and India, as well as holding regular summits with the US, Canada, Russia and Latin America. Greater business involvement in these partnerships could provide an important channel for focusing on opportunities for profitable co-operation and priorities for policy intervention.

There are also opportunities to involve international lending institutions in identifying and advancing policy reform. This is discussed in Section 23.6.

23.4 Accelerating technology transfer to developing countries

Advances in technology play a key role in reducing the energy intensity of production in developed countries. The transfer of energy efficient and low-carbon technologies to developing countries allows developing countries to make similar progress.

The private sector drives significant transfers of relevant technology through markets, joint ventures, foreign direct investment and within policy frameworks such as the CDM. Governments have a role to play in creating the enabling environments for private sector transfers, and in setting the regulatory frameworks that govern international co-operation on intellectual property rights.

The creation of significant new national markets for a technology attracts foreign investors directly. For example, India's commitment to the expansion of wind power created the conditions for a successful joint venture between Vestas, the largest Danish wind turbine manufacturer, and India's RRB Consultants. This led to the creation of Vestas RRB, a wholly Indian owned company.

Joint ventures and licensing are a common entry vehicle for investment in emerging markets. There is some evidence that fear of competition and concerns relating to intellectual property rights may lead companies to offer older technologies[18] in such partnerships. However, the active role of the technology owner, particularly in the case of joint ventures, is likely to lead to effective technology transfer since they have an incentive to ensure that the tacit knowledge[19] is also transferred to encourage effective use of the technology. Joint ventures are an effective long-term route to embed local firms into the learning network of transnational corporations[20].

Joint ventures played a particularly important role in China, where restrictions on Foreign Direct Investment (FDI) meant that between 1979 and 1997 the majority of FDI into China was in the form of joint ventures[21]. At the time there were conditions placed on the investment designed to

[17] http://www.reeep.org/index.cfm?articleid=33
[18] Saggi, 2000.
[19] Tacit knowledge is defined as knowledge that is not covered by the patent but embedded in skills and know-how.
[20] Buckley et al, 2006.
[21] OECD, 2000.

spur technology transfer[22] that are no longer permissible following China's accession to the WTO. It is possible that these conditions reduced the overall supply of FDI, but they may have increased the quality of technology transfer in the FDI that did occur. The FDI to China had a significant impact on growth, especially through export growth[23].

The IPCC[24] conducted a study on the barriers that prevent the diffusion of key technologies relevant to climate change, and found that barriers arose at each stage of the process and varied by sectoral and regional context. The barriers included:

- Lack of information;
- Political and economic barriers such as lack of capital, high transaction costs, lack of full cost pricing, and trade and policy barriers;
- Lack of understanding of local needs;
- Business limitations, such as risk aversion in financial institutions; and
- Institutional limitations such as insufficient legal protection, and inadequate environmental codes and standards.

A recent report produced as part of a UK-India collaboration on the transfer of low-carbon energy technology[25] also explained that comprehensive technology transfer is much more than just hardware. It requires the transfer of skills and know-how for operation and maintenance and knowledge, expertise and experience for generating further innovation.

Barriers to technology transfer can be overcome through a combination of formal institutional mechanisms, measures to improve the enabling environment for private sector investment, and, where necessary, direct funding initiatives.

Formal co-operation on technology transfer can be built around any of the key stages in the technology transfer process. These stages were identified in the UK-India report as[26]:

- assessment of technology needs
- selection of technologies
- mechanism for technology import
- operating technology at design capacity
- adapting technology to local conditions
- improving installed equipment
- development of technology

Different policy interventions maybe required at each stage depending on which functions private markets can successfully provide. Relevant policy interventions vary according to the nature of the technology, its stage of commercial development and the political and economic characteristics of both supplier and recipient countries.

In order to be sustainable, technology transfer must take place as part of a wider process of technological capacity building in developing countries. Building technological capacity relies on the transfer of skills, knowledge and expertise as well as hardware, especially if technologies are to be assimilated and developed further within recipient countries. Capacity building must be adapted to local circumstances, because there are many examples where a lack of technical, business or regulatory skills resulted in a failed attempt at technology transfer. A total package of human skills for technology transfer will also focus on creating improved and accessible

[22] Watson and Liu Xue, 2002.
[23] Graham and Wada, 2001.
[24] IPCC, 2000 and UNEP, 2001.
[25] SPRU, IDS and TERI (in press). Comprehensive literature review and five case studies.
[26] SPRU, IDS and TERI (in press) and Kathuria (2002).

competence in associated services, organisational know-how, and regulatory management, to strengthen and coordinate the networks through which stakeholders facilitate transfer.

The UNFCCC includes provisions on the transfer of technology to enable developing countries and economies in transition to mitigate greenhouse gas emissions and adapt to climate change. The UNFCCC Expert Group on Technology Transfer has recently completed a special report[27] that explored specific measures that can help develop technology flows across national borders, enhancing the technology framework under the UNFCCC. The key elements of the current approach to technology transfer include country-driven technology needs assessments; the provision of information through TT:Clear; a focus on understanding the aspects of national policy environments that facilitate private sector technology co-operation; and capacity building, for example, to help developing countries with project development process to meet lending criteria. The Special Climate Change Fund includes a provision for funding technology transfer. Intermediaries such as independent energy labs and foundations, such as the Energy Foundation[28], have played an important role identifying appropriate technologies.

A Technology Needs Assessment (TNA) is a country-driven activity that identifies the mitigation and adaptation technology priorities. It involves different stakeholders in a consultative process to identify the barriers to technology transfer and measures to address these barriers through sectoral analyses. It also examines regulatory options, fiscal and financial incentives and capacity building. More than 20 countries[29] have carried out assessments, including least developed countries, economies in transition and small island states (see Box 23.2 below for an example). For mitigation, key technologies identified included renewable energy for small-scale applications, such as biomass stoves; combined heat and power; and energy efficient appliances and building technologies such as compact fluorescent light bulbs. For transport, traffic management and cleaner vehicles for public transport were most important. Institutional mechanisms and actions by intermediaries can help identify opportunities for private sector action.

The key barriers were identified as economic (including high upfront costs and incompatible prices, tariffs and subsidies), and lack of information about appropriate technology options. The Assessments have been followed up in various ways. Specific projects have been developed and presented to the GEF and to the UNFCCC workshop on innovative financing mechanisms. Some countries have used the results to make changes to their own development plans and enabling environments.

[27] http://unfccc.int/resource/docs/2006/sbsta/eng/inf04.pdf#search=%22FCCC%2FSBSTA%2F2006%2FINF.4%22
[28] http://www.efchina.org/home.cfm
[29] Synthesis Report on Technology Needs identified by Parties not included in Annex 1 to the Convention, SBSTA/2006/INF.1 available at http://ttclear.unfccc.int/ttclear/jsp/index.jsp.

Box 23.2 Ghana's Technology Needs Assessment

Ghana submitted its TNA to the UNFCCC in 2003[30]. The assessment received major funding from the UNDP/GEF and technical support from the National Renewable Energy Laboratory in the US with funds from the Climate Technology Initiative and the US Department of Energy highlighting the role of international support and intermediaries.

The goal of the TNA is to communicate Ghana's climate change technology requirements by identifying a portfolio of technology development and transfer programmes that have the potential to reduce greenhouse gas emissions and contribute to Ghana's sustainable development. The assessment applied selection criteria to establish top priority technologies:

- Industrial energy improvements –demand side management including boiler efficiency enhancement
- Methane gas capture from landfill sites
- Use of bio-fuels (jatropha)
- Energy efficient lighting using Compact Fluorescent Lamps (CFLs)

Since the assessment, CFL promotion policies – including changes to Ghana's import tariffs, installation task forces and sales through employers and retail outlets – have led to a dramatic increase in adoption. This transformation in the lighting market has been sustainable and self-financing. An evaluation of the scheme shows it added US$10 million[31] to the Ghana Economy. Prior to the CFL support programme, lighting represented a third of energy consumption, and use of lighting also coincided with the peak consumption placing pressure on peak capacity. CFL promotion has reduced electricity consumption by around 6%, reducing the risk of a power crisis and demand for new generation capacity, and reducing the impact on consumers of a doubling of electricity price following reforms.

In many cases intellectual property rights are not the key barrier to transfer of technology.

Within international debates on climate change there has been a particular focus on the role of intellectual property rights (IPR) as a barrier to the international diffusion of technologies. In principle, patents that protect IPR and reward the innovator are important as they provide an incentive to invest in developing new products. Weak IPR may deter domestic firms in developing countries from purchasing technologies as their competitors may be able to copy them without paying[32]. Companies with advanced technologies often cite insufficient IPR protection in developing countries as a barrier to technology transfer, and suggest stronger protection, for example by full implementation of the TRIPs[33] agreement, would help them deploy advanced technologies. Increasing the incentives for mitigation (for example by introducing a carbon price) increases the value of patents for low-carbon technologies and acts as a stimulus to investment in innovation in this area. The benefits of having an intellectual property (IP) regime do not imply that such rights should be increased without limit, especially if they reduce the beneficial effects of product market competition.

Patents can also be seen as creating a short-term monopoly and thus limiting efficient diffusion whilst the owner enjoys monopoly rents. From this point of view, patents on new products that could help developing countries to reduce their emissions or improve the resilience of their

[30] For full report see http://ttclear.unfccc.int/ttclear/jsp/index.jsp.
[31] Benefits based on net present value calculated using a 25% discount rate (lower rates increase benefits). See http://www.oecd.org/dataoecd/37/53/34915266.ppt.
[32] Philibert and Podkanski, 2005.
[33] The agreement on Trade Related Intellectual Property Rights (TRIPs) is an international treaty administered by the World Trade Organisation which sets down minimum standards for most forms of intellectual property regulation within all WTO member countries.

agriculture are inefficient – they make it more difficult to secure a global public good. IPR may have little impact on innovation and diffusion in countries without sufficient capacity to innovate, so could impose additional costs[34].

Company surveys indicate that patenting is the most important means of IP protection in only a few industries, such as pharmaceuticals and scientific equipment. A majority of companies in other industries make use of alternative protection methods. In an OECD report on innovation in the business sector[35], econometric estimates suggest that stronger IP protection has a substantial positive effect on patenting, but only a limited effect on R&D. Stronger patent regimes did help direct innovation towards patentable activities but such activities need not offer the greatest benefits for society as a whole. Other studies have found evidence that cross-country differences in patenting are positively related to cross-country differences in the strength of IP protection. However, others have suggested that the benefits of stronger IP protection are positive only when IP protection is initially weak. Most increases in patent claims in countries that have enhanced patent protection have been found to come from foreign residents, suggesting that strengthening patent protection, at least to some threshold level, can help to improve access to foreign ideas.[36] There is some evidence that a more robust IPR regime encourages transfer and that firms respond to changes in the stringency of IPR regimes. Different firms choose different modes of entry due to their relative sensitivity to protection. Firms with natural barriers to imitation tend to choose licensing, and vulnerable firms choose FDI, but stronger IPR may cause substitution between these modes. Not only is there an increase in FDI and licensing with stronger IPR, but also a change in the composition of technology transfer[37]. Another study[38] provides strong evidence that US multinationals respond to such changes in IPR regimes abroad by increasing technology transfers. The results of the study are however not sufficient to demonstrate that IPR reforms are welfare enhancing for the reforming countries.

In a series of case studies undertaken by the OECD, IPR did not appear to constitute an obstacle to technology transfer[39]. Some of the case studies found that there are many environmental technologies available that are not protected by patents, so IPR were not relevant to much of the volume of clean technology transfer. They also indicated that even when clean technologies were under patent, these patents were not a major concern either to importers or exporters. In general, exporters were willing to accept the risk of patent infringements, as by the time a process had been copied, it will have been overtaken. Importers of patented technologies did not generally find royalty fees to be a major obstacle, and were more concerned about other costs, such as that of capital investments in new plants and machinery[40].

IPR protection is just one issue in a complex process for technology transfer, and only a component of the cost of a technology and should not be overplayed. The level of tacit knowledge[41] not covered by the patent may prevent effective transfer rather than the IPR cost itself. Tacit knowledge ensures that transfer requires the co-operation of the IPR owner, and may mean that joint ventures and strategic programmes to enhance the capacity to manufacture and operate the equipment are the most effective means of accelerating the diffusion of key technologies.

There are also issues that arise in the case of advanced and dual use technologies such as nuclear power[42] and the advanced technology for gas turbines required in IGCC power stations. These are sensitive issues that require careful risk assessment, and can be resolved through

[34] Falvey and Foster, 2006.
[35] OECD, 2005, pp. 39-42.
[36] Lerner, 2002.
[37] Nicholson, 2003.
[38] Branstetter et al, 2004.
[39] OECD, 1992.
[40] Less and McMillan, 2005, p. 24.
[41] Tacit knowledge is defined as knowledge that is not covered by the patent but embedded in skills and know-how.
[42] See, for example, the recent US-India agreement on the use of civilian nuclear technology.

proactive bilateral and multilateral diplomacy. Box 23.3 explores the case for public ownership of IPR.

Box 23.3 Public ownership of IPR

In the pharmaceutical sector, production costs represent a small share of the price, so IPR provides an incentives during the costly research process. The demand for and impact of the drugs is predictable, so governments have a clearer understanding of the value of specific technologies, and have established channels to ensure that the drugs will reach those that need them. Public-private partnerships are useful in such settings, and may include:

- Purchasing commitments as an incentive for the development of new drugs[43]
- Voluntary buy-out of IPR for existing products, whereby governments agree a price with the IPR holder to buy all or limited rights to the IPR.
- Compulsory licensing approach whereby the government forces the holder of the IPR to grant use to the state or others. Usually, the holder does receive some royalties, either set by law or determined through some form of arbitration.

For key mitigation technologies, such as electricity generation, IPR generally represents a much smaller component of cost due to the scale of the capital investments and running costs. A broad range of technological solutions is also available, so Governments will have difficulty in picking appropriate technologies and lack the information to negotiate a suitable price. Also, the tacit knowledge associated with using these technologies and challenge of re-engineering advanced energy technologies requires continued co-operation with the owners of the technology. This makes them less suitable for public funding of IPR or compulsory partnership. These factors all make public-private partnerships in this area, such as buying IPR rights for established technologies, problematic.

The development of new technologies, particularly those with significant public funding, will be more conducive to public IPR ownership. As these technologies would be collaboratively developed, the IPR could potentially enter into joint ownership by the partners involved with the aim of making the IPR available as a free or low cost public good. Some areas of adaptation, where there is a strong public good element, may also provide good reason to extend existing efforts to overcome IPR barriers, for example to deal with effects on health from climate change such as malaria.

23.5 International financial flows for energy efficient and low-carbon investment

Acting now, to ensure the current wave of investment in fast-growing economies incorporates energy efficient and low-carbon technology, will reduce the global cost of stabilising greenhouse gases in the atmosphere.

Private sector resources for energy sector investment far outweigh those available from governments and multilateral institutions, and public finance or loans can even be under-utilised in such countries. Middle-income countries, where the bulk of future GHG emissions growth is concentrated, have good access to capital from the private sector[44]. Public sector resources and flows of carbon finance provide an important lever to channel these larger flows of domestic and international private sector investment to energy efficient and low-carbon technologies.

[43] Kremer and Glennerster, 2004.

[44] Miller (2006) www.iddri.org/iddri/telecharge/climat/climat_dev_sept06/session_33/**miller**_finance.ppt.

The Global Environment Facility has a strong track record in financing programmes for energy efficiency and renewable energy, but is small relative to the scale of the challenge.

The main funding framework in the application of established low-carbon energy technologies is the Global Environment Facility (GEF)[45], working through its Implementing Agencies and with a range of multilateral and bilateral donors. Since its inception in 1991, the GEF has provided $6.2 billion in grants and generated over $20 billion in co-financing from other sources to support over 1,800 projects that produce global environmental benefits[46] in 140 developing countries and economies in transition[47]. The GEF has financed the diffusion of energy efficient and renewable energy technologies, supported by wider investment in demonstration projects, local capacity building and institutional development. Projects to raise efficiency in a number of areas including boilers, lighting, and biomass stoves have delivered significant energy savings and related reductions in greenhouse gas emissions.

The World Bank has recently suggested that the GEF could play an enhanced role in encouraging technological learning and bringing down the cost of the low-carbon technologies that are most relevant to developing country priorities. Any increase should seek to overcome existing implementation challenges[48]. Current funds are small relative to the scale of the challenge. The GEF would require up to a two to three fold increase in current financing in order to ensure sustained market penetration of energy efficiency and renewable energy technologies over the next ten years. Financing a strategic, global programme to support the reduction in costs of pre-commercial, low GHG emitting technologies such as IGCC with CCS, solar thermal, or fuel cells would require more than a ten-fold increase[49]. This would in turn require significant changes in the GEF's institutional arrangements[50]. Whether it is through GEF or other institutional mechanisms, an expansion in the scale of funding is required if the deployment of low-carbon technologies is to be supported, and strong legal and regulatory environments and local partnerships are important in determining success. International efforts to develop low-carbon technologies are discussed in Chapter 24.

Lending can play an important role in supporting energy efficiency.

Financial institutions have a unique opportunity to encourage their clients to seek advice on the energy efficiency of proposed investments. By building this advice into the planning and financing stage of major investment in upgrades or new infrastructure, transaction costs can be greatly reduced. The European Bank for Reconstruction and Development has developed an effective business model for this, as described in Box 23.4.

The US Department of Energy is supporting the development of an International Energy Efficiency Project Financing Protocol as a method to accelerate the transformation of clean energy financial practices. This would provide standard methodologies and good practice guidelines for commercial lenders, especially to reduce the transaction costs associated with relatively small projects [51].

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[45] The Global Environment Facility (GEF) provides financial support through the World Bank, UNDP and UNEP to achieve the aims of the UN Framework Convention on Climate Change, Convention on Biological Diversity and the Stockholm Convention on Persistent Organic Pollutants.
[46] Including benefits from reducing GHGs and other pollutants and increasing biodiversity.
[47] The GEF enjoys a 4:1 leverage ratio of total project funding to its initial contributions.
[48]Miller (2006) http://www.makemarketswork.com/client/makemarketswork/upload/Biography%20Miller.doc.
[49] World Bank, 2006b: 23.
[50] World Bank, 2006b.
[51] See http://www.evo-world.org/index.php?option=com_content&task=view&id=60&Itemid=148.

Box 23.4 Lending for energy efficiency: the EBRD model

The European Bank for Reconstruction and Development has developed a successful business model to raise energy efficiency through financing industrial, SME, municipal infrastructure and power sector projects in transition economies. A dedicated energy efficiency team, operating at the core of the organisation, screens every new project proposal to identify potential energy efficiency financing opportunities. Comprehensive energy audits are provided to define the energy efficiency potential of a project and its financial return at the most relevant stage in the project lifecycle.

The EBRD is setting financial intermediation facilities across its regions of operations with local commercial banks to support energy efficiency investments in SMEs. Technical assistance is provided for market studies to assess the size, opportunities and constraints for the financing of SME energy efficiency projects and for project preparation and implementation support. The EBRD has signed energy efficiency credit lines with 11 banks in three countries targeting industrial SMEs, small renewable energy projects and the residential sector

In addition, the EBRD has financed 35 industrial energy efficiency projects between 2002 and 2005 with €276 million of EBRD investment in energy efficiency components within a total project value of €1.45 billion. This has contributed to energy savings over 600,000 toe/year and to an estimated annual CO2 reduction of 2.5 million tons. The Bank has financed 11 (largely municipally owned) district heating projects since 2001 with a total Bank investment of €265 million resulting in significant energy savings. It has also financed a portfolio of projects to improve the energy-efficiency of public transport vehicles and traffic management systems.

With the launch of its Sustainable Energy Initiative and the Multilateral Carbon Credit Fund in 2006, combined with the full integration of its energy efficiency activity across banking operations, the EBRD aims to step up its climate change mitigation investment to €1.5 billion during for the next three years[52].

***The Clean Development Mechanism provides an important channel for private sector participation in financing low-carbon investments in developing countries*.**

Under the UNFCCC and Kyoto Protocol, developing countries took on an unquantified responsibility to participate in action to limit the risks of climate change, in the context of their own priorities for economic and social development and poverty reduction. The Kyoto Protocol created a project-based mechanism – the Clean Development Mechanism (CDM) – to allow rich countries to use credits from investment in emissions reductions in poor countries to offset against their own emission reduction commitments[53].

The CDM has played an important role in building co-operation between the developed and developing parties to Kyoto, and it has helped to strengthen understanding of the main opportunities for abatement. It has also stimulated a strong private sector interest in climate change co-operation. Implementation has involved significant efforts at capacity building and project identification, both by bilateral government programmes[54] and the World Bank's Prototype Carbon Fund (PCF). A wide range of methods have been developed for crediting emissions reductions, ranging from industrial gases through energy efficiency to renewable energy projects.

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[52] See http://www.ebrd.com/new/pressrel/2006/54may19.htm.
[53] See Grubb (1999) for a general introduction to the CDM.
[54] Such as Certified Emission Reduction Procurement Tender (CERUPT), a programme set up by the Netherlands to purchase greenhouse gas reductions through the CDM.

The CDM in its current form is making only a small difference to investment in long-lived energy and transport infrastructure. Its role is limited by factors such as transaction costs, policy uncertainty, technology risk and other barriers.

While a substantial international flow of funds is being generated through CDM[55], it falls significantly short of the scale and nature of incentives required to reduce future emissions in developing countries.

Around 35% of CDM credits in the current pipeline[56] come from 15 projects for industrial gases. Such projects are attractive because industrial gases have a very high global warming potential and thus generate a very large volume of emissions reductions compared to, for example, renewable energy projects[57]. There are still relatively few projects in many sectors that are important for the long-term reduction of GHG emissions. There has also been limited use of the CDM in the poorest countries, raising concerns about distributional equity of the CDM, and the appropriate mechanisms to tackle low-carbon infrastructure to support wider access to energy for poor people. There are a number of related reasons for these trends.

- The CDM provides funding on a project-by-project basis to offset against absolute reductions that would otherwise have been made by countries with commitments to reduce emissions under the Kyoto Protocol. For this reason, there are procedures involved in demonstrating additionality[58] on a case-by-case basis, which leads to high transaction costs.
- It has proved difficult, for example, to establish methodologies for energy efficiency in sectors dominated by small and medium-sized enterprises and for transport infrastructure and demand management[59], which may be more relevant to poorer countries.
- The CDM provides a funding stream on the basis of the carbon price, but does not necessarily cover the learning costs associated with the higher risks of using new technologies including advanced renewable energy technologies.
- Projects with longer payback periods may be affected by other capital market failures: where the benefits of long-term energy savings that occur beyond the standard pay-back period used in investment appraisal or are very heavily discounted both for time and uncertainty. This does not only happen with large projects – for example, this affects the uptake of small-scale solar technologies[60].

There are several proposals to streamline the CDM in its current form, including those described in Box 23.5 below.

[55] Estimates as at October 2006 suggest that there are approximately 1.4billion CERs expected from projects up to 2012, valued at around $14billion (assuming a $10 price).
[56] As at October 2006.
[57] REIL, 2006: 9.
[58]Additionality is defined in the Marrakech accords: “A CDM project is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity”, This involves some difficulties in interpretation in practice.
[59] Browne *et al,* 2004.
[60] Philibert, 2006.

Box 23.5 Proposals to streamline the CDM in its current form

Programmatic CDM was approved at the UNFCCC COP/MOP1 at Montreal in December 2005. It allows for specific programmes taking place in the context of national/regional policies to be credited. It can build upon national policies deployed by national or sub-national bodies to tackle both their own development objectives as well as reduce GHG emissions. Its main aim is to produce larger CDM projects with lower transaction costs. A programmatic approach to CDM can do so by aggregating smaller projects within a programme, for example incorporating reductions from households, small enterprises, rural electrification and transportation. These sectors cannot be tackled on an individual basis but can be tackled through an intentional government-led programme to facilitate reductions. Variants still being developed could boost incentives for developing countries to initiate such programmes.

Technology CDM would involve moving away from verification of project-specific information under the current CDM, towards a more principled or standardised approach to selection of eligible technologies and relevant baselines using technology standards. One variant of this approach is already possible under existing CDM rules, but is costly and complicated due to the need to determine appropriate technological benchmarks. A more streamlined approach, including prior crediting on the basis of an index of approved technologies, would enhance the attractiveness of the mechanism to investors, but at the cost of some environmental certainty – particularly if emissions reduction is about management performance as well as technology. Discounting or capping credits for these “wholesale” purchases might handle some of these concerns. This would require significant reform to the CDM modalities and procedures.

The CDM plays a valuable role, but it has important limitations as a model for international co-operation in the longer term.

The CDM is explicitly designed to provide offsets to enable developed countries to meet their commitments more cheaply, while allowing developing countries to participate in carbon reduction and gain co-benefits from technology transfer. At the same time it allows the leveraging of investment in projects that meet local priorities for sustainable development. However, it does not represent additional net emissions reductions over and above those required by developed country limits. Given the relative growth of emissions in both developed and developing countries, and the scale of the challenge represented by climate change, this approach can be seen as an important building block along the way to arrangements that support reductions on a much greater scale, rather than as the final shape of long-term structures for co-operation.

In particular, project-based carbon finance does not internalise the cost of the greenhouse gas externality for firms and consumers in the host country or for goods exported from the country. Project-based carbon finance acts as a form of subsidy; it reduces the emissions from a particular project, but it does not affect the demand for high carbon goods and services across the economy as a whole, so the overall level of emissions can remain high or increase. It also creates issues of moral hazard and gaming, where there are incentives to manipulate the system to increase the rewards received (or reduce the costs paid). For example, in the case of low-carbon investment, the implementation of second-best emissions reductions policies (such as increasing renewables within a subsidised power sector) may raise the costs of implementing first-best policies (such as removing subsidies). Both policies are important to implement in the long-term.

Improvements can also be made to carbon finance to raise the scope for emissions reductions programmes in the transport and buildings sectors. For example, complex decisions to channel resources to land-use planning, urban development, public transport and bicycle and pedestrian infrastructure are most important for sustainable transport use, as it is difficult to amend this infrastructure once in place. In many cases, this may suggest the use of non-uniform approaches in these sectors, including pilot approaches to carbon finance as well as direct funding – for example through bilateral assistance and GEF funds[61].

The transformation of carbon finance flows between developed and developing countries is required to support cost-effective reductions through policy and structural reform in developing countries. This, in turn, is likely to widen the scope of carbon finance to more regions and sectors and reduce global costs of mitigation.

Section 23.2 has demonstrated that large-scale flows are required to support the transition to a low carbon economy in developing countries. We provided illustrative calculations in Chapter 21 to demonstrate that large flows of carbon finance – up to around $40 billion a year – would be generated if developed countries were to *take responsibility for* significant emissions reductions to 2050 on 1990 levels, and if they were to meet a proportion of those through financing action in developing countries[62]. To reach long-term international goals, it would remain important for developing countries to take on their own commitments in suitable forms and with appropriate support. Investment flows could be directed to helping generate emissions reductions, for example, by financing the kinds of reforms suggested in Section 23.3. But this would also require a transformation of flows of carbon finance such as currently generated through the CDM.

The most cost-effective, large-scale emissions reductions are likely to be linked to strategic programmes, for example in supporting integrated programmes for urban transport and development, or in tackling a wholesale transition to lower carbon power generation including the retrofit of inefficient plants and the systematic use of carbon capture and storage. Programmes on this scale can take place only in the context of structural reforms and development policies implemented by national or regional governments. Investment in CDM projects tends to be directed towards countries where there is a strong enabling environment for private sector investment (for example, economic and political stability, liberalised markets, strong legal structures), and countries that have built up national capacity for using this source of funding[63]. This provides strong incentives for countries to develop such environments.

Useful lessons for broadening the scope of the CDM can be learnt from the proposal to use funds from intergovernmental emissions trading for programmes to reduce emissions in central Europe. Romania, Bulgaria and Hungary, for example, have all indicated a willingness to earmark funds from sales of their surplus allowances under the Kyoto first commitment period to emission reduction efforts, for example through programmes of building renovation. The countries would play the major role in identifying opportunities for these programmes and directing funds towards priority areas. The OECD/IEA and World Bank have examined these 'Green Investment Schemes'.[64]

Action at scale requires appropriate incentives across the economy. This implies moving carbon finance mechanisms closer to full emissions trading or to programmes that in other ways support the transition to carbon pricing in developing countries.

Carbon finance mechanisms could evolve to support the transition to full emissions trading in several ways or stages. One option is to design a policy-based CDM that would provide credits directly to developing country governments that introduce a policy relating to emissions reductions[65]. This approach could be used to provide incentives for emissions reductions in sectors that, for example, may not be immediately suited either to project-based CDM or to emissions trading, but where the early implementation of relevant policies could lead to long term emissions reductions. The policy reform could be credited using an estimate based on factors

[61] Browne *et al,* 2004.
[62] Our methodology is described in Chapter 21.
[63] Fankhauser and Lavric, 2003.
[64] Blyth and Baron, 2003 and World Bank, 2004.
[65] This proposal is in early stages. It was not approved following initial discussion at the UNFCCC COP/MOP in Montreal in December 2005.

including volume of emissions sources affected, price elasticities and so on – for example to determine the impact of removing a subsidy. Where credits are granted without project-level monitoring and verification procedures, techniques including discounting, taxing or phasing of credits could be used to recognise uncertainty about final outcomes.

One challenge of policy-based approaches is that credits are likely to flow to the government while the costs of complying with the policy will fall on the private sector[66]. The design of policy-based schemes must therefore incorporate incentives for their implementation by the private sector. For example, revenues from credits could be used to compensate owners of inefficient facilities that would be closed down as part of an industrial restructuring policy, or could be used to encourage property developers and energy suppliers to introduce energy efficient lighting technologies or smart metering in new buildings.

Some sectoral crediting mechanisms and 'no-lose' commitments described in Chapter 22 would also move carbon finance in this direction. These approaches all require preparatory work, particularly regarding systems for data reporting and monitoring, and capacity building to enable firms to participate in the schemes. Some countries are already engaged in policies that would make it much easier to move in these directions; for example, China's programme to reduce energy use by its 1000 largest enterprises, described in Box 23.6. A number of international initiatives will also provide information to lay foundations for these approaches. For example, the IEA and World Bank have also announced co-operation to develop sector-specific benchmarks for energy efficiency for Brazil, China, India, Mexico and South Africa, as part of the Energy Investment Framework, to be discussed in Section 23.6[67].

Box 23.6 China's 1000 Enterprises Program

Industry accounts for approximately two thirds of total energy use in China. Improving industrial energy efficiency, in sectors such as iron and steel, is critical to delivering China's 11th five-Year Plan goal to reduce its energy use per unit of GDP by 20% between 2006 and 2010.

In March 2006, the Chinese government announced a program to manage and improve energy use among just over 1000 major energy consuming industrial firms and utilities that reportedly account for 47% of total industrial energy use. The program aims to save 70 Mtoe cumulatively over five years. This represents a major contribution towards the target of reducing overall energy intensity by 20% (which implies a reduction of approximately 170 Mtoe).

Under the scheme, each enterprise will have its energy use monitored and benchmarked against national and international market participants. Each will agree plans to deliver targets on the energy intensity of its outputs (such as average energy consumption per production unit). Those that meet or exceed their targets receive positive incentives, such as faster management promotion, while those that fail to deliver are publicly criticised as energy wasters.

China received assistance from the Energy Foundation to design the programme and seconded a member of staff from DEFRA for a year (partially sponsored by REEEP). Collaboration between the IEA and the Chinese administration may also assist delivery of the scheme, for example in developing indicators or statistics as part of the sector benchmarking process.

Long-term goals and early signals to provide continuity of carbon finance after 2012 are essential to underpin emissions reduction policies in developing countries.

Debate on the future of the CDM is an important element of the international negotiations for co-operation on climate change beyond 2012. There is increasing interest, from governments and

[66] Michaelowa, 2005.
[67] World Bank, 2006a.

emissions trading schemes established inside and outside the Kyoto Protocol, in purchasing project-based credits from developing countries.

In the long-term, deep global reductions in GHG emissions will require that all countries with significant requirements for energy incorporate the externalities of using carbon into the structure of incentives in their own economies. This could take the form of full participation in international emissions trading, or could be achieved by a combination of domestic tax and regulation.

Long-term goals to underpin these developments are crucial. Ongoing research suggests that a lack of long-term goals and domestic policy frameworks could prevent carbon finance from facilitating the transition to a low-carbon future[68]. Therefore, early signals about the acceptability of particular types of credits from developing countries after 2012 in trading schemes worldwide could help to extend the role of carbon finance in advance of agreement on the final form of future mechanisms. This could include signals about the potential to reduce or remove the current restrictions in the EU ETS on the volume of project credits that can be used, and signals about the types of large-scale programmes that could become eligible for accelerated recognition. For example, the EU is examining changes to the ETS monitoring and verification methodology to incorporate carbon capture and storage, but a signal on whether and how CCS may be eligible for crediting under CDM could provide important incentives.

23.6 Developing an integrated approach to enhance investment in developing countries

The moves towards strong national goals, aspirations and policies described in Section 23.3 could provide a platform for enhanced co-operation based on international flows of carbon finance, public and private investment, risk guarantees and other instruments. And, as described in Sections 23.4 and 23.5, these flows can themselves be used to support the introduction of further domestic policies including energy market reforms and the use of new technologies. Therefore, channelling investment in developing countries towards energy efficient and low-carbon options requires an integrated approach.

The International Financial Institutions (IFIs) have an important role to play in accelerating this process. They work with national governments, providing technical assistance to set policy and institutional frameworks to create the right incentives in relevant sectors. They can help overcome capital market failures that lead to underinvestment in energy efficiency, and work with the private sector to increase the scale of low-carbon investment. Climate change is now a significant issue for economic growth and development and should be considered within country assistance strategies. The World Bank and Regional Development Banks (RDBs) are developing Clean Energy Investment Frameworks. The RDBs are working on specific initiatives or approaches to mitigation and adaptation that are likely to have resonance within their respective regions. These are described in Box 23.7.

These frameworks also provide the opportunity for IFIs to help facilitate the development of large-scale pilot programmes, for example to explore how the broadening of carbon finance or limited participation in emissions trading could be implemented in practice. This would require early agreement between developing countries willing to explore new approaches and developed countries with emissions trading schemes or other mechanisms to purchase credits that would be generated.

[68] Garibaldi, 2006.

Box 23.7 The Clean Energy Investment Framework

At the G8 Summit in Gleneagles in 2005, the World Bank and the Regional Development Banks were asked to work with all their stakeholders to develop frameworks for investment in clean energy.

The approach presented by the World Bank at its Annual Meetings in September 2006 has three pillars: energy for development and access for the poor; transition to a low-carbon economy; and adaptation. The first two pillars of the framework focus on improving the coordination and coherence of existing sources of energy investment and risk management instruments from domestic and international capital markets as well as from the multilateral institutions. The framework will also combine financial and technical assistance to support developing countries on policy reform or sectoral initiatives, and help countries develop policies and enabling environments that are conducive to private sector investment.

Financing under the EIF is expected to include projects that accelerate the take up of technologies that enable more efficient and cleaner energy production and use, including the deployment of advanced super-critical coal-burning technologies in power stations and the introduction of more efficient operating practices and grid management and audits of energy-users to improve efficiency. The World Bank is examining vehicles for doubling concessional support to $4 billion per year in order to improve energy access for poor people. The Bank is also looking at how to increase the efficacy of its instruments and procedures (especially under its proposed Middle Income Strategy), as well as proposals to develop new instruments.

The EBRD has defined and is currently implementing the Sustainable Energy Initiative aimed at scaling up and accelerating the pace of investment in climate change mitigation projects in Central and Eastern Europe. Key target sectors include industry (both large corporates and SMEs), the power sector (including renewable energy) and the municipal infrastructure sector (including district heating, urban transport and solid waste).

The Asian Development Bank is focusing on both energy efficiency and transportation issues, and including additional carbon finance and adaptation components. Transportation is one of the largest causes of increased GHG emissions in Asia. The Inter American Development Bank is also developing a framework with four components: energy efficiency, renewable energy sources, biofuels, and adaptation. It also considers the development of carbon finance.

Combining carbon finance with public and private investment flows, risk guarantees and other financial instruments can support the deployment of emerging technologies.

Commercialising emerging technologies requires risk capital that is often unavailable in developing countries. Carbon finance alone may not be sufficient to fund incremental costs, and other types of support may be needed to make a project viable. Emerging technologies are perceived as higher risk and are thus less likely to attract domestic private investment or to receive export guarantees. There are significant opportunities for the IFIs to play a role in improving the pipeline of ‘bankable’ low-carbon projects that have risk profiles and business plans suitable for attracting private sector support, including through the use of public funding to improve project identification and the preparation of investment proposals. The use of financial and risk management instruments can reduce transaction costs, increase transparency and competitiveness of loan pricing, and share country and project risk.

Investment in the most advanced technologies may require a different approach. The IFIs are normally constrained by their procurement rules to purchase standard technologies rather than advanced technologies in their mainstream investment programmes. Initially, investors and managers in developing countries may require assistance including information and capacity building to use such technologies.

Public-private financing initiatives also have a role to play in reducing market place risks. The Johannesburg Renewable Energy Coalition (JREC) is made up of governments who have decided to co-operate actively on the promotion of renewable energy sources on the basis of concrete, ambitious and agreed objectives. The JREC Patient Capital Initiative[69] aims to develop an innovative public-private investment mechanism that creates and delivers risk capital to renewable energy project developers and entrepreneurs at affordable conditions. As part of this programme the European Commission is sponsoring the development of an innovative public-private financing mechanisms. The European Commission proposed Global Energy Efficiency and Renewable Energy Fund[70] in October 2006. It aims to contribute €80million over the next year, which, in addition to €20 million from other public and private sources, is expected to contribute to the financing of projects up to the value of €1 billion. It will lead to the creation of sub-finds that are tailored to developing countries and economies in transition in each region of the world, improving the access to clean, secure and affordable energy.

23.7 Enhancing trade in low-carbon goods and services

The incorporation of environmental benefits within the international trade regime could support some aspects of mitigation.

Co-operation within the international trade regime to account for the environmental benefits of traded goods can influence the extent to which mitigation is possible[71]. In a globalised, interdependent economy, the goods and services for effective mitigation and adaptation for climate change will often cross borders. Over and above the merits of wider liberalisation, there is a clear case for lowering tariffs on these goods. Increased trade allows effective and efficient mitigation or adaptation to climate change, and larger markets for these goods, allowing returns to scale and progression along learning curves and a contribution to global public goods. Reduced tariffs encouraged the adoption of energy efficient lighting in Ghana (see Box 23.2) and could help the development and dissemination of other technologies such as solar thermal technologies[72]. The reduction of subsidies for oil, coal and gas could also remove barriers to clean energy.

As part of the Doha Development round, which began in 2001, Ministers agreed to examine the reduction or, as appropriate, elimination of tariff, and non-tariff barriers to environmental goods and services. It would be important to establish broad principles over which goods should qualify taking into account climate change and other environmental effects. REIL (2006) suggest that in negotiations countries could identify a set of “positive green box” subsidies for clean energy that they would not challenge because of their positive environmental effects.

23.8 Conclusions

Many developing countries are already making efforts that will reduce their greenhouse-gas emissions in the long-term for many reasons, including local co-benefits. However, the challenge of building up and transforming institutions and mechanisms to handle large-scale low-carbon investment flows and to facilitate the diffusion of low-carbon technologies is now urgent. Long-term goals and supportive national policy environments will support the scaling up of these activities.

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[69] http://ec.europa.eu/environment/jrec/pdf/pci_summary_brochure_final.pdf
[70] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/1329&format=HTML&aged=0&language=EN&guiLanguage=en
[71] Border tax adjustments are discussed in Chapter 22.
[72] Philibert (2006b).

Actions outlined in each section of this chapter will complement actions taken elsewhere. Encouraging technology transfer and improving the enabling environment for investment will diminish the scale of the challenge for IFIs and carbon markets. Similarly increasing the scale of finance in low-carbon markets will encourage technology transfer and improve the environment for private sector investment. These will also build on the national actions outlined in Part IV of this Review.

Developing countries have a significant opportunity to work with the International Financial Institutions and with regions and countries that are willing to engage in emissions trading, to create large-scale programmes that will act as pilot schemes for new approaches and provide experience for negotiators to draw on for the future.

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