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Introduction

In the Copenhagen Accord at the UN climate negotiations in Copenhagen, 117 heads of state concluded that low-emissions development would be necessary in order to combat climate change. However, at the end of a two-year negotiation marathon, they could not agree on emissions targets. In the following months, eighty-three countries submitted proposals to the United Nations Framework Convention on Climate Change (UNFCCC) secretariat for nationally appropriate mitigation actions (NAMAs), thus supporting the Accord and gradually rebuilding momentum for international climate co-operation.

One major challenge for the negotiations in Copenhagen was the shift of emphasis from marginal emissions reductions to low-carbon development. This is illustrated by the discussions on support mechanisms for climate policy in developing countries.

The Kyoto Protocol defined an international off-setting approach, the clean development mechanism (CDM): large emitters in developed countries can finance individual projects to reduce greenhouse gas emissions in developing countries if this is cheaper than reducing their own emissions (UNFCCC 1997). In this way, the cost of achieving the Kyoto emissions targets for the period 2008–2012 are

reduced, but so are incentives to pursue more-ambitious mitigation actions in developed countries. As projects are directly supported within this international mechanism, domestic policy makers in developing countries have only limited involvement.

The Copenhagen Accord of 2009 emphasises the role of low-emissions development strategies. It invites developing countries to submit descriptions of NAMAs they envisage using for the implementation of these strategies. The Accord outlines technology co-operation and finance mechanisms to provide international support for their implementation. This includes a commitment by developed countries to provide new and additional resources approaching $30 billion for the period 2010–2012 and ambitious financing goals for 2020.

The shift of emphasis from marginal emissions reduction to low-carbon development was triggered by rapid evolution in the scientific/economic landscape. More-ambitious and more-timely emissions reduction is necessary and is perceived to be more possible today than was anticipated at the time of the negotiations of the Kyoto Protocol:

1 Scientific evidence of the mechanisms of climate change has been strengthened, and the identification of climatic trigger points has further increased concern. Regional climate-change impact assessments have raised additional concerns as many of the most vulnerable societies will be exposed to the greatest changes. Thus, the Intergovernmental Panel on Climate Change (IPCC) concluded that by 2050, global CO_2 emissions must be 50–85 per cent below 2000 levels in order to limit global average temperature increases to 2.0–2.4 °C (IPCC 2007).
2 The urgency and scale at which global emissions have to decline to meet the 2 °C target have increased as developed countries have only pursued moderate efforts to mitigate greenhouse gas emissions during the last twenty years and emissions in several developing countries have increased rapidly in parallel with strong economic growth.

3 Economic analysis has demonstrated that low-carbon development is viable. Simulations for the global economy with ambitious climate-change targets project a one-off gross domestic product (GDP) reduction in the order of 0–3 per cent. This is small compared with GDP growth projected for the modelling horizons. It requires technology innovation and the early shifting of investment from carbon-intensive to low-carbon and energy-efficient infrastructure, buildings, industry and transport choices.

The increasing emphasis on low-carbon development also shifts more emphasis on to the role of domestic policy frameworks. New technologies can enter the market only if regulatory structures provide for planning, standards and the necessary support infrastructure. Equally, investment will shift to low-carbon options only if investors feel comfortable with the implied risks. In particular, delays inherent in new sectors and technologies and uncertainty about future revenue streams are of concern. Policy choices on subsidies, taxes, tariffs and carbon-price schemes jointly determine such revenue streams and remain largely in the domain of national and regional policy makers. Any changes necessary to facilitate low-carbon development also need to be initiated by domestic policy makers. They can gather domestic political support by addressing the specific circumstances and concerns.

This book describes the experience of the domestic implementation of climate policies through the example of carbon pricing, and discusses the implications for the design of international climate co-operation. Carbon pricing lends itself particularly well to such an analysis, as it can achieve multiple objectives. At the domestic level, it can shift production, consumption and investment to low-carbon choices. At the international level, it has been envisaged as a mechanism to facilitate commitment to mitigation targets among developed countries and to provide resources to finance mitigation action in developing countries. Moreover, both levels often interact – for example, in the industrial sector. However, as many industrial

products are internationally traded, unilateral carbon pricing could arguably result in the relocation of production, and thus emissions, rather than in their reduction.

Through the lens of carbon pricing, this book explores how international climate co-operation can be designed to support the domestic implementation of policies for low-carbon development. International co-operation creates a shared sense of action and responsibility, it can it provide an external framework of commitments to turn longer-term climate objectives into short-term policies and programmes and it can it provide support for mitigation and adaptation action in developing countries. Finally, international co-ordination is necessary to ensure that the various parts of the global effort combine to achieve global climate objectives.

Chapter 2 explores the role of a climate policy mix. Carbon emissions from energy production and industrial processes are deeply entrenched in our economies. To mitigate the risk of catastrophic climate change, these emissions need to be reduced to a fraction of 2011 levels. The challenge is now to implement policy instruments to deliver the necessary emissions reduction.

In the past, many of the climate policy discussions focused on marginal emissions reduction. To achieve this, economists recommend exposing producers and consumers to the environmental cost of carbon, thus creating incentives for efficiency improvements and for less-carbon-intensive production and consumption choices. The theoretical foundation for this approach is the first fundamental theorem of welfare economics: the 'invisible hand' of the market will result in efficient production and consumption decisions. This requires that a set of assumptions be satisfied, including market participants' exposure to the costs of environmental externalities. Carbon taxes or emissions trading have therefore received much attention in public debate.

The objectives of climate policy have shifted from delivering marginal emissions reduction to facilitating low-carbon development.

This requires reassessment of whether all the assumptions required for the first fundamental theorem of welfare economics are still satisfied – for example, whether internalising the cost of carbon alone delivers efficient market outcomes. Innovation and learning-by-doing mean that the potential response is much more complicated and non-linear – described by economists as non-convexities in cost functions. Interactions between actors and technologies create network effects that result in similar non-convexities for the benefit functions. In addition, pre-existing infrastructure creates path dependency. All of these instances violate the assumptions of the welfare theorem and, therefore, pricing carbon is not sufficient to deliver efficient outcomes, but remains necessary.

The Stern Review (2006) on climate change points to three sets of instruments that are necessary to facilitate a low-carbon transition: (i) putting a price on carbon; (ii) technology policy; and (iii) targeted regulation, with transparent and shared information and measures to engage individuals and companies in low-carbon opportunities. Countries are now using a combination of these policy instruments to tackle climate change. However, any policy intervention can distort economic incentives and create costs in implementation, enforcement and compliance. Policy intervention can have distributional implications and might interfere in private-sector decision processes. So, it is essential to assess carefully the specific circumstances of sector, country and industry structures when designing the policy mix for low-carbon transformation.

Changes to policy frameworks, in particular if they directly affect relative prices of products and services, have distributional implications that shift costs and wealth between poor and rich and between rural and urban parts of society. As a result, implementation of individual climate-policy instruments can increase or reduce fuel poverty or inequality in a society. The more ambitious the objectives of climate-policy instruments, the more significant could be the distributional impacts, which affect equity issues and political

support. With careful analysis, it is possible to anticipate many of these impacts and to use complementing policy measures to balance the consequences, or to support individuals and companies during a transition.

To illustrate the type of analysis that is necessary for any policy instrument, this book explores in more detail the role of carbon pricing in the economy. Carbon pricing increases the price of processes, products and services that are carbon intensive, thus creating incentives for the use and innovation of carbon-efficient technologies, and inducing substitution of lower-carbon fuels, products and services, by industry and final consumers. The price signal feeds into individual decisions that would be difficult to target with regulation. Pricing also makes it profitable to comply with carbon-efficiency regulations, thus facilitating their implementation. Carbon prices can be delivered with a carbon tax or cap-and-trade schemes.

As much as the theoretical features are essential, the real analytical and policy challenge revolves around the process of implementing the relevant policy instruments and the design of detailed provisions.

Chapter 3 discusses the implementation of carbon pricing, using the example of cap-and-trade schemes. Early experience from the trading schemes for SO_2 and NO_X in the USA, and the subsequent European Union emissions-trading scheme (EU ETS) for CO_2 allowances, are discussed. Cap-and-trade schemes were acceptable to stakeholders, aided co-ordination across countries, and delivered an emissions price. The chapter examines experience from the EU scheme, focusing on setting the cap and allocation of allowances under the EU ETS. Free-allowance allocation to emitters was the bargain chip offered to gain industry support for the scheme. But it exposed ministries tasked with the allowance allocation to intensive lobbying. In the pilot phase, lobbying for more allocation also inflated the cap. This was subsequently addressed as Kyoto and EU targets were fixed prior to the allocation discussion.

Repeated free allocation also creates various perverse incentives that undermine the economic efficiency of the scheme. Therefore, the European Commission proposed, and the EU legislative agreed (European Commission 2009a), to require the auctioning of most allowances in the EU scheme post 2012.

After initial difficulties, support for the EU ETS is now shared across governments, industry and political groups. However, the experience of the first years also offers several insights relevant for design of climate-change policy. The implementation of a scheme that allocates allowances with an annual value of about €40 billion is not trivial.

Free allocation to emitters can also have undesired distributional impacts. In most markets, emitters will pass on carbon costs to product prices and thus to consumers. As a result, emitters profit from the free allocation, while consumers bear the costs. Schemes to compensate households for the distributional implications of carbon pricing deserve careful consideration, to ensure equity and political support. The negative public perception of large emitters benefiting from free-allowance allocation was the second reason for the move towards large-scale auctioning in Europe after 2012.

Policy instruments will ultimately be deemed successful, and should therefore be evaluated, only by the results they deliver. Most reduction in emissions is expected to be achieved through changes of investment choices and shifting finance to lower-carbon options.

Chapter 4 assesses the delivery of investment responses. Low-carbon development requires diffusion of existing and new technologies, infrastructure and business models. This requires clear, credible and long-term policies, as confirmed in Copenhagen by a statement of 186 investment institutions representing assets of $13 trillion. International discussions focus on emissions targets, initially for developed countries. The expectation is that clear commitment to such targets also allows private actors to anticipate future opportunities for low-carbon processes, products and services, as well as

constraints for carbon-intensive investment choices. Obviously, emissions targets for countries must be translated into policy instruments if they are to affect investment choices of private actors. Cap-and-trade schemes provide the opportunity directly to translate emissions targets into economic incentives for private actors. This can limit the uncertainty of policy design and implementation and thus strengthen the low-carbon investment framework. The first example of this approach – the EU ETS – has succeeded in focusing the attention of carbon-intensive industries on exposure to carbon costs and on low-carbon opportunities.

When evaluating individual projects, many investors remain concerned that the carbon-price signal is not sufficiently robust, and that carbon prices might drop in response to economic and political developments. It is therefore argued that the risk of extremely low carbon prices must be reduced, if low-carbon projects are to be facilitated. It was suggested that, for example, carbon taxes would be more predictable in the short term, and could thus increase investment certainty for investors operating with short investment horizons. In the long term, however, carbon taxes are more difficult to predict, as they are subject to continued political negotiations. Even where carbon taxes are fixed in the long term, this might increase rather than reduce exposure for low-carbon investors, who are competing in a world with uncertain fuel, commodity and technology costs.

Financial investors, including pension funds, are another group of actors that can be supported with climate policy instruments. They need to shift investment from carbon-intensive and -exposed activities to low-carbon options, so as to ensure the long-term viability of their investment portfolio. The sector is only starting to explore the carbon risk inherent in some incumbent companies, and needs better tools to asses the impact of carbon risk on future performance. In addition, all too frequently, the focus is on the risks of low-carbon investment, owing to the involvement of new technologies, business models and partnerships.

The discussion illustrates that the diversity of participants in our economies might respond differently to a policy instrument that delivers a carbon price. Hybrid cap-and-trade schemes, combining a price floor with an emissions cap, could target the needs of heterogeneous groups of investors.

The evolving focus of climate policy, from marginal reduction in emissions towards low-carbon transformation of economies, is also reflected in discussions about low-carbon investment frameworks. Investment in new technologies, production processes, products and services can succeed only with appropriate infrastructure, institutional setting and social acceptance. Government support is often required for research, development, early deployment and adjustments to regulatory frameworks, as well as administrative standards and procedures. The co-ordination of all these activities requires a shared vision of a country's low-carbon development trajectory.

For this reason, the international discussions leading up to Copenhagen increasingly emphasised the importance of low-carbon development plans for developed and developing countries. The plans characterise industrial and technological development, energy use and emissions across different sectors of the economy. They can therefore ensure that initial mitigation efforts are consistent with long-term objectives (for example, understanding the implications of efficiency improvements of coal power stations, relative to other mitigation options). They can also ensure consistency of mitigation strategies across sectors – for example, by testing whether available biomass resources are consistent with their anticipated use in steel, cement, transport, heating, industry and power sectors, and by assessing whether electricity use in transport, industry and for heat pumps is consistent with anticipated generation and network structure. In addition, the plans allow national governments to prioritise actions according to long-term relevance and lead times, and to signal a consistent overall strategy to facilitate private-sector investment.

Low-carbon development plans are therefore essential, not as a bureaucratic instrument, but as a process to create a shared vision and platform to discuss and initiate the appropriate policy actions and thus facilitate low-carbon investments. These actions might well vary across countries that differ in their social preferences, industry structures, finance sectors and institutional settings. Countries might diverge in their emphasis on short-term insurance of robust carbon prices, mid-term emissions targets translated into emissions-trading schemes, technology-support schemes and institutional design choices and administrative standards.

The discussion of domestic policy frameworks to facilitate a low-carbon development points to the various opportunities for international climate co-operation, discussed in Chapter 5. An adequate response to climate change requires action on a global scale. Otherwise it is impossible to achieve the earlier-mentioned 2 °C target and reduce emissions by at least 50–85 per cent below 2000 levels. Thus, the main driver for global climate co-operation will remain the engagement of all nations in supporting emissions reduction with their domestic efforts.

Sometimes the need to act on a global scale, to achieve the 2 °C target, is interpreted to mean that individuals and countries have no responsibility to act individually in the absence of adequate action on a global scale. This is wrong – every tonne of carbon emitted accelerates climate change and increases the risks and costs for society. The chapter discusses in more detail why domestic mitigation action does not require the justification of international co-ordination.

If international agreements are not essential to facilitate action by individuals and nations, they can nevertheless be important in enhancing the effectiveness of domestic action in developed countries and in supporting low-carbon development in developing countries. First, global co-operation can enhance the level of understanding of climate-change impact and options for tackling it, bringing together experts, policy makers and industry actors. Second, global

co-operation can increase the level of action by building confidence that action will be effective. It also contributes to the sense of responsibility for a country's own emissions and awareness of the damage emissions can inflict on domestic and foreign populations and thus enhance action to mitigate that impact. Third, international co-operation can contribute to meaningful reporting on actions that allows for rapid international learning concerning best-practice policymaking. Transparent reporting also facilitates the measurement of the performance of policy instruments while enhancing the accountability of policy makers and improving transparency for private-sector investors.

International co-operation can, furthermore, provide a platform for commitments regarding emissions targets and for specific actions. Such commitments provide time frames and quantitative reference levels that can subsequently help to overcome domestic political barriers. External commitments can also enhance the credibility of longer-term strategies for private-sector investors, reducing capital costs and enhancing the scale of low-carbon investment.

This leads to the question of how international carbon markets can support co-operation and domestic de-carbonisation efforts. Such markets can allow for trade at a national level, or, as more frequently observed, at the level of individual installations. This allows traders to identify the least-cost emissions-reduction opportunities in a bigger market, and could therefore offer the benefit of reducing costs of climate policy. A joint scheme also has some political attractions: it might reflect increasing commitment by participating countries and could create momentum to drive implementation through any political adversity.

Yet, for an effective joint scheme several risks have to be managed. First, if two countries have a joint scheme but negotiate future emissions targets separately, industry in the more-ambitious country will end up buying allowances issued by the less-ambitious country. This creates incentives to negotiate less-ambitious targets at any future negotiations. Second, emissions reduction requires a multitude of