Global Carbon Trading

A framework for reducing emissions

MARK LAZAROWICZ

Global Carbon Trading

A framework for reducing emissions

MARK LAZAROWICZ

Published by TSO (The Stationery Office) and available from:

Online
www.tsoshop.co.uk

Mail, Telephone, Fax & E-mail
TSO
PO Box 29, Norwich, NR3 1GN
Telephone orders/General enquiries: 0870 600 5522
Fax orders: 0870 600 5533
E-mail: customer.services@tso.co.uk
Textphone 0870 240 3701

TSO@Blackwell and other Accredited Agents

Customers can also order publications from:
TSO Ireland
16 Arthur Street, Belfast BT1 4GD
Tel 028 9023 8451 Fax 028 9023 5401

ISBN: 9780117064508

Printed in the UK by The Stationery Office Limited

Printed on Paper containing 100% post consumer waste and meeting FSC Recycled Certification

CONTENTS

FOREWORD

Dear Prime Minister

Since you commissioned me to produce a report on global carbon trading nine months ago, we have seen significant developments in our knowledge of climate change. There is now overwhelming evidence that climate change is happening more rapidly than scientists had previously predicted. If unabated, the costs of the associated impacts on society and the global economy caused by the changes to our environment will dwarf the current global economic downturn. Action to reduce greenhouse gas emissions is therefore urgently required. The declaration of the G8 summit in July 2009 to reduce emissions to limit global temperature rise to below 2°C is very welcome. The challenge is to put in place the international policy frameworks needed to achieve this goal.

Global carbon trading will be an important tool in reducing greenhouse gas emissions. Carbon markets have been growing rapidly worldwide. The global market doubled in size between 2007 and 2008 – by 2020 it is predicted to grow to $2-3 trillion. The EU emissions trading system (ETS) is already in its second phase, with a third phase planned. The US administration has recently stated its intention to establish a federal cap and trade system, and several are planned in other OECD countries which, in combination, could cover around a quarter of global greenhouse gas emissions.

How these systems expand and link with one another over the next five to ten years will be important for the success of climate change mitigation. At the same time, global carbon trading can play an important role in reducing emissions in the developing world by providing financial flows from rich to poor countries. This will require intermediary mechanisms for developing countries which will need to be negotiated as part of any international climate change agreement at Copenhagen in December 2009.

The overall goal of the report was to assess the strengths and limitations of current trading systems and, based on this and other evidence, to set out a strategic approach to the development of global carbon trading over the coming years. As part of this exercise, I gratefully acknowledge the valuable contributions that have been made by a wide range of experts and stakeholders.

The conclusions of our analysis are set out in this report. There are broadly four areas:

First, cap and trade is a proven system for delivering real emissions reductions rapidly and cost-effectively, where the 'polluter pays'. The US sulphur dioxide market reduced emissions by over 40% between 1990 and 2007, meeting the 2010 target three years early and at a quarter of the cost originally predicted. Evidence also shows that the EU ETS has started to lead companies to reduce emissions. Nonetheless, carbon trading will need to be used alongside other policy tools, such as the Government's recent support for the demonstration of carbon capture and storage technologies in the UK, to provide a comprehensive strategy for shifting the world to a low carbon economy.

Second, a dual-level system of carbon trading should play a central role in delivering emissions reductions. At the government level, national caps should ensure governments take responsibility for limiting emissions in line with the latest science. At the emitter level, emissions trading systems should cap emissions and trade allowances. One option for expanding carbon trading would be

to set up a single global emissions trading system with centralised governance. However, this approach would reduce sovereignty over domestic policies and would be challenging to negotiate multilaterally. Under the dual-level approach, ETSs should be expanded and linked up to form a global network. Effectively a global carbon market, this network would allow emitters to trade emissions allowances internationally without loss of sovereignty of governments to use the most appropriate tools for reducing domestic emissions. This dual-level system has the additional benefits of covering all emissions sectors (emissions from sectors unsuitable for inclusion in ETSs can be traded at government level), maximising cost effectiveness and taking account of country-specific circumstances.

Our analysis shows that, if well-designed, a dual-level system of global carbon trading could reduce the costs of emissions reductions by up to 70%. These efficiencies could potentially allow the world to reduce emissions by an additional 40-50% at the same cost while providing substantial financial flows to the developing world to support the move to a low carbon economy with sustainable growth.

Third, realising a long-term framework of global carbon trading will require a period of transition and roadmaps for: 1) expanding national targets with strengthened monitoring, reporting and verification; 2) developing a linked network of emissions trading systems (ETSs); 3) participation of developing countries through intermediary mechanisms; and 4) strong and effective international institutions. Roadmaps are set out and discussed in detail in the report.

Scaled-up mechanisms for developing countries are needed that are more effective, efficient and equitable than the current Clean Development Mechanism. The report goes into a detailed analysis of these mechanisms, which should be designed to provide substantial real emissions reductions that go beyond offsetting and deliver financial flows to the developing world.

Fourth, a well-designed global network of emissions trading will need appropriate governance, regulatory frameworks and capacity building, particularly in developing countries. Areas where governance will be particularly important include target setting, compliance and monitoring, reporting and verification. And most urgently, the international community needs to provide support to developing countries to build capacity for accessing carbon trading mechanisms, including the sharing of technical expertise, financing and support for national-level demonstration programmes.

Finally, I would like to thank Graham Floater and his team at the Office of Climate Change for their dedication and hard work in producing this report: David Makinson, Jenny Milligan, Rocio Perez Ochoa, Leila Pourarkin, Duncan Stone and Andrew Wood.

I look forward to seeing the Government take forward the recommendations of the report as part of its wider agenda working with the international community to prevent dangerous climate change and move the world to a stronger, more secure low carbon economy.

MARK LAZAROWICZ
Prime Minister's Special Representative

ACKNOWLEDGMENTS

The team in the Office of Climate Change was led by Graham Floater. The project was managed by David Makinson. Team members were Jenny Milligan, Rocio Perez-Ochoa, Leila Pourarkin, Duncan Stone and Andrew Wood.

The following individuals and organisations provided background papers that were used to inform the report: Michael Mehling and Jon Price (Climate Strategies); Marion Vieweg, Claudia Doets, Marta Torres, Sina Wartmann, Padraig Oliver, Deniz Yener, Edgar Cruz, Edwin Dalenoord, Nuria Valero Esteban, Ann Gardiner and Alyssa Gilbert (Ecofys); Steven Martin, Guy Turner and Jonathan Malsbury (New Carbon Finance); Sam Fankhauser and Cameron Hepburn (Vivid Economics).

In preparing its analysis the team has consulted widely. A series of round-tables were held in March 2009 with representatives of NGOs, academic institutions and business groups. These included: Association of Electricity Producers; BP Oil; British Airways; British Chamber of Shipping; Caisse des Depots; Cambridge University/Climate Strategies/Carbon Trust; CBI; Cemex; Climate Change Capital; Climate Exchange plc; Carbon Markets and Investors Association; Deutsche Bank; E3G; Ecosecurities; Friends of the Earth; Grantham Research Institute on Climate Change and the Environment; Greenpeace; International Emissions Trading Association; International Energy Agency; Institute for Public Policy Research; JP Morgan; McKinsey & Company/Project Catalyst; Morgan Stanley; Royal Society for the Protection of Birds; RWE npower; Shell International; The Climate Group; Tyndall Centre for Climate Change Research; US Embassy; and WWF UK.

Other individuals and organisations were also consulted. These included: Andrew Sentance (Bank of England); Bryn Harrison (Carbon Trust); Juan Carlos Castilla-Rubio (Cisco); Coos Battjes and Meindert Witteveen (Credit Suisse); the Financial Services Authority; Dimitri Zenghelis (Grantham Research Institute on Climate Change and the Environment); Barbara Buchner and Richard Baron (International Energy Agency); Jane Ellis (Organisation for Economic Cooperation and Development); and Aditi Maheshwari (World Bank).

We are very grateful to the following government departments who have provided invaluable advice and contributions throughout the project: Department of Energy and Climate Change, in particular the International Climate Change and Climate Change Economics divisions; Department for Environment, Food and Rural Affairs; HM Treasury; Department for International Development; Department for Transport; Department for Business, Innovation and Skills; Cabinet Office; and the Foreign and Commonwealth Office.

Finally, the team would like to thank Stephen Muers, Jane Ellaway, Rachel Lewis, Jo O'Driscoll, John Ferguson and Demus King for their input and support.

EXECUTIVE SUMMARY

OBJECTIVES AND SCOPE

This report was commissioned by the Prime Minister to examine the role of cap and trade systems internationally and the main challenges that will be faced as they develop. The overall goal of the report is to examine the strengths and limitations of current trading systems and to set out a strategic approach to the development of global carbon trading over the coming years. The aims of the report fall into four broad categories:

- **To provide a balanced assessment of evidence for the benefits and limitations of cap and trade** as a tool for climate change mitigation.
- **To set out a long-term framework for cap and trade systems** to help ensure that reductions in greenhouse gas emissions are delivered rapidly and cost-effectively, based on the latest science and recognising the current international climate change framework.
- **To provide a roadmap for expanding and linking cap and trade systems in developed countries and establishing intermediary mechanisms for developing countries.**
- **To assess the governance and institutional requirements** of a global carbon trading system and provide recommendations on capacity building needs.

Cap and trade systems have inherent advantages over other policy tools in delivering a guaranteed level of emissions reductions cost effectively. However, it is also important to recognise that carbon trading will not deliver all climate change policy objectives. Other policy tools such as regulation, taxation and subsidies will be needed to complement and support the objectives of carbon trading as part of a wider transition to a low carbon economy.

The report does not provide a detailed examination of issues that are already well documented, such as the operation of the EU ETS and RGGI,[1] the challenges surrounding leakage of emissions from one country to another,[2] or a catalogue of essential design features for a well-functioning ETS.[3] Auction revenue raising, secondary carbon markets and non-market finance, as well as detailed analysis of other policy tools, are substantial projects in their own right and are also outside the scope of this report. Nonetheless, the report does examine how many of these issues interact with the overall aim of developing a global system of carbon trading.

URGENT ACTION TO TACKLE CLIMATE CHANGE

Climate change is a global threat that needs urgent global action. All countries will be affected by its impacts, particularly developing countries. Current evidence suggests that to avoid the worst impacts of climate change, we should aim to **limit the global average temperature rise to**

1 Edenhofer, Flachsland, Marschinski (2007)
2 Dröge (2009)
3 Convery, De Perthuis and Ellerman (2008)

2°C. This requires the international community to undertake immediate and substantial reductions in global greenhouse gas emissions in all sectors in line with the latest science.

The environmental impacts of climate change will damage economies and prosperity throughout the world, dwarfing the current global economic downturn. Evidence shows that the costs of reducing greenhouse gas emissions will be considerably less than the costs of climate change. Nonetheless, the finance needed for adaptation, mitigation, forestry and technology will increase as the capacity of developing countries to invest in climate change related measures grows. Recent estimates suggest that around **$100 billion a year will be needed by 2020**. This will require strong and urgent international cooperation, and a combination of private and public finance. The carbon market will provide a significant proportion of finance by 2020. International public finance will also need to play a substantial role, and more advanced developing countries will be expected to fund some of their activities themselves.

A CENTRAL ROLE FOR CAP AND TRADE ALONGSIDE OTHER TOOLS

Cap and trade has been proven to cut pollutants substantially, rapidly and cost-effectively. The US market in sulphur dioxide reduced emissions by 43% between 1990 and 2007, three years ahead of schedule and at a quarter of the predicted cost. In the carbon market, evidence shows that the EU ETS has already started leading companies to reduce emissions.

Global carbon trading is growing rapidly. Emissions trading systems are already operating or planned in over 35 countries in the developed world. In 2008, the estimated value of the carbon market doubled to $126 billion. **By 2020 the carbon market could be worth up to $2-3 trillion per year.**

Modelling suggests that, under the right conditions, **global carbon trading could reduce emissions reduction costs by up to 70%. These efficiencies could potentially allow the world to reduce global emissions by an additional 40-50% at the same cost and provide substantial financial flows to the developing world** to support the move to a low carbon economy with sustainable growth.

Although **cap and trade is key to addressing the failure to put a price on carbon emissions**, it is only one of the policy tools that governments will need to use. **Taxation, subsidies and regulation will also be required, for example to support the research, development and demonstration phases of new technologies such as carbon capture and storage.** Individual countries should use the policy tools that are most appropriate for their own specific circumstances.

If global carbon trading is to deliver substantial emissions reductions, realised cost-effectively and achieved equitably across and within countries, **the current framework for international carbon trading needs reform**.

One option for expanding carbon trading would be to set up a single global emissions trading system with centralised governance. However, this approach would reduce sovereignty over domestic policies and would be challenging to negotiate multilaterally. Instead, this report recommends a **dual-level system of carbon trading**. At the government level, national targets should ensure governments take responsibility for limiting emissions. At the emitter level (for example, power stations, industrial companies), emissions trading systems should be developed for capping emissions and trading in emissions allowances. This dual-level system can cover

all emissions sectors, respects the sovereignty of governments to choose appropriate tools for reducing domestic emissions, maximises cost effectiveness and takes account of country-specific circumstances.

Under the dual-level approach, **ETSs should be expanded and linked up to form a global network**. Effectively a global carbon market, this network would allow emitters in one country to trade allowances with emitters in other countries without loss of sovereignty.

Recommendation. A dual-level system of carbon trading should play a central role in delivering emissions reductions. At the government level, national caps should ensure governments take responsibility for limiting emissions. At the emitter level, emissions trading systems should cap emissions and trade allowances.

Recommendation. A global carbon market should be developed as a network of linked ETSs rather than a single global emissions trading system.

Recommendation. Cap and trade should complement other policy tools, including regulation, taxation and subsidies, to provide comprehensive action for moving rapidly to a low carbon economy.

THE TRANSITION TOWARDS GLOBAL CARBON TRADING

Realising a long-term framework of global carbon trading will require a **period of transition and a roadmap** for: 1) expanding national targets with strengthened monitoring, reporting and verification; 2) developing a linked network of emissions trading systems (ETSs); 3) participation of developing countries through intermediary mechanisms; and 4) strong and effective international institutions. In the short and medium term, capacity building will also be needed to ensure that developing countries are well-prepared for participation.

1. National targets in developed countries

A global emissions limit based on the latest science and consistent with containing global warming below 2°C should form the basis for national targets. Sovereign governments should then use the most appropriate policy tools to meet these targets. With binding national targets, countries are more likely to implement credible domestic climate change policies including emissions trading systems (ETSs).

Currently, only around a quarter of global emissions are capped under the UNFCCC. Consequently, the number of **countries taking on national targets should be extended, with all developed countries taking on national commitments by 2013**. In developed countries, emissions from all domestic sectors – power supply, industry, forestry, agriculture, domestic transport, buildings and waste – should be included under national targets, while the international aviation and shipping sectors should be capped through sectoral targets. In appropriate sectors such as power, abatement from Carbon Capture and Storage (CCS) should count towards national emissions in greenhouse gas inventories.

National targets also need to be more stringent and in line with science. The IPCC recommends that **emissions reductions for developed countries should be 25-40% below 1990 levels by 2020**. The EU has committed to a 30% reduction by 2020 if a global deal is agreed. However, as a group, developed countries have so far committed to reductions of around only 7-9% relative to 1990 levels.

During the transition, an important challenge will be to address excessive surpluses of emissions allowances generated through loose targets under the first commitment period of Kyoto. Developed countries should commit to **cancel a substantial proportion of surplus allowances**. Other measures, such as **Green Investment Schemes**, should be considered, but only if emissions reductions are systematically measured and verified.

Recommendation. All developed countries should aim to cap their emissions by 2013.

Recommendation. All domestic sectors – power supply, industry, domestic transport, waste, agriculture and forestry – should be included under national targets.

Recommendation. International aviation and shipping sectors should each have a dedicated transnational system to cap emissions.

Recommendation. National caps should be made more stringent in line with science. The EU has stated that developed countries as a group should commit to emissions reductions of at least 25-40% by 2020.

Recommendation. Given the over-allocation of AAUs under Kyoto, developed countries should commit to cancelling a substantial proportion of their surplus AAUs.

2. A global network of linked emissions trading systems

While individual countries should use the range of policy tools that are most appropriate for their own specific circumstances, emissions trading systems (ETSs) should play a central role in developed countries and, in the future, advanced developing countries. Mandatory ETSs are currently limited to the EU ETS and certain US states. However, **ETSs are planned in other countries which could result in 17-35% of global emissions being covered by 2015**.

Emissions in sectors that respond effectively to carbon pricing, have low transaction costs and robust measurement criteria (for example power and industry), should be addressed through ETSs. Specific sectors in specific countries may not be suitable for inclusion. Trading at the government level should help reduce emissions cost-effectively in sectors where an ETS is not the most suitable tool to drive reductions.

A global network of ETSs should be developed and expanded through bilateral linking agreements. Many planned ETSs could link up with each other over the next decade if they are well designed and coordinated.

Linking all OECD countries could reduce overall costs by between 25 and 55%. Under one scenario, this could lead to one gigatonne of extra emissions reductions at the same cost.

Linking the EU ETS with a federal US system should be a priority. This would increase liquidity and stability of the EU and US systems, covering between 13 and 27% of global emissions. It would also provide leadership and momentum and reduce overall costs substantially.

Different design features are already emerging in ETS proposals in different OECD countries to reflect country-specific circumstances. However, **four major design features will need to be coordinated prior to and during linking**: 1) effective, credible and trusted mechanisms for monitoring, reporting, verification, compliance and enforcement; 2) rules for international credits; 3) banking and borrowing of emissions allowances; and 4) price intervention – which should be avoided if possible.

Providing a **notice period of several years prior to linking** ETSs would allow time to negotiate common standards and give emitters and investors time to prepare. Most importantly, **a coordinated set of actions and announcements over a notice period can help to smooth the convergence of prices in the different systems**.

Recommendation. Emissions in sectors responsive to carbon pricing with low transaction costs and robust measurement criteria, for example power and industry, should be delegated to Emissions Trading Systems. Specific sectors in specific countries may not be suitable for inclusion.

Recommendation. A network of linked ETSs should be developed through a series of bilateral agreements between developed countries over the next decade.

Recommendation. Linking the EU ETS with a federal US ETS (cap and trade system) should be a priority and, though ambitious, could be achieved by 2015.

Recommendation. Four major design features should be coordinated so that ETSs can benefit from the huge gains available from linking: MRVCE processes, entry of international credits, banking and borrowing of allowances, and the avoidance of price interventions.

Recommendation. A notice period of several years should be provided prior to linking ETSs to allow time to negotiate common standards, give emitters and investors time to prepare, and smooth the convergence of prices in different systems.

3. Intermediary mechanisms for developing countries

Most future growth in emissions is set to take place in developing countries. Recent analysis indicates that if the world is to have a chance of limiting average global temperature rise below 2˚C, it will require **developing countries as a group to deviate from business as usual emissions in the order of 15-30% by 2020**. Countries at different levels of development will be ready to access carbon markets at different rates, in accordance with the principle of common but differentiated responsibilities and respective capabilities.

Scaled-up mechanisms for developing countries are needed that are more effective, efficient and equitable than the current Clean Development Mechanism – providing substantial real emissions reductions that go beyond offsetting and deliver financial flows to the developing world.

The participation of developing countries in carbon trading mechanisms has several advantages. Trading provides flows of finance to the developing world to reduce emissions and aid sustainable development. The efficiencies from trading also mean that developed countries can take on deeper reduction targets than if their efforts were based on domestic abatement alone. However, **the use of trading to reduce emissions in developing countries should supplement rather than replace action by developed countries to decarbonise their own economies.**

Sectoral Trading offers the most effective means for developing countries to access carbon markets. Sectoral Trading provides certainty over the level of emissions reductions and can be used to delegate reductions in suitable sectors to an ETS. Modelling suggests that **more advanced developing countries engaging in Sectoral Trading in key sectors could achieve substantial abatement at low or no net cost to themselves in 2015**. Furthermore, using Sectoral Trading rather than CDM could reduce the global cost of abatement financed through carbon trading by around a half, enabling developed countries to make deeper emissions cuts.

Sectoral Crediting provides a national sectoral baseline and moves beyond offsetting by including own action activity. For some countries, this activity could be supported with finance from the international community. Sectoral Crediting could be used in developing countries not yet in a position to participate in Sectoral Trading. This would be more effective and deliver more net revenue to developing countries than the current CDM. Under one modelling scenario, **Sectoral Crediting in key sectors with substantial own action could double net revenues compared to the CDM.**

For countries without Sectoral Trading, **national-level Sectoral Crediting could be particularly suitable for providing finance to forest nations** and preventing deforestation simply being displaced from one locality to another. This should involve the participation of forest communities.

Developing countries not yet in a position to participate in government-level sectoral mechanisms should be assisted to take part in a **reformed CDM**. This should use benchmarking and a more rules-based approach where possible to increase the environmental integrity of CDM credits and minimise investor uncertainty.

The finance needed for adaptation, mitigation, forestry and technology will increase as the capacity of developing countries to invest in climate change related measures grows. Estimates suggest that around **$100 billion a year will be needed by 2020**. The carbon market will provide a significant proportion of finance by 2020. However, **international public finance will also need to play a substantial role**.

Recommendation. The international community should create government-level sectoral mechanisms including Sectoral Trading and Sectoral Crediting. Developing countries should be encouraged to participate in the mechanisms that are appropriate to their level of development.

Recommendation. Alongside carbon market finance, public funds should be used to leverage further financial support for climate change mitigation, forestry, technology and adaptation in developing countries. Low carbon development strategies should be used to coordinate mitigation action financed through carbon trading with that financed through non-market international funds.

Recommendation. The development of national-level carbon trading mechanisms in the forestry sector should involve the full participation of forest communities.

Recommendation. The Clean Development Mechanism should be reformed, using benchmarking where possible to increase environmental integrity and become more rules-based to reduce uncertainty.

4. Strong governance and institutions

The United Nations should continue to provide a framework for developed country national targets, agreed standards and verification of national-level emissions. However, **the international framework needs to be reviewed and strengthened in certain areas, such as target setting and compliance**.

Sovereign nations should maintain the freedom to use the most appropriate domestic policy tools to meet their national emissions targets. This means that at the emitter level, **the national authority should remain responsible for the effective regulation and implementation of its own ETS**, even after linking to other ETSs. Cooperation between countries to link their domestic ETSs bilaterally should also take place outside the intergovernmental negotiation processes and institutions. **A light-touch joint committee consisting of representatives of national authorities could coordinate between linked ETSs** and negotiate with new entrants.

New institutional functions will be needed for new sectoral mechanisms for more advanced developing countries to link into the global trading network. For developing countries not in a position to participate in government-level sectoral mechanisms, the CDM should be reformed and streamlined. In the short term, **the secretariat of a reformed CDM should be strengthened** with more permanent staff and scope to validate uncontroversial proposals more rapidly.

While sectoral mechanisms are still being developed, **bilateral credit agreements between buyer and seller countries** could trial sectoral methodologies and approaches. Sectoral baselines and finance could be agreed by countries on a bilateral basis outside any intergovernmental process. However, such agreements would need to consider the ownership and fungibility of such trial credits.

Non-market finance will be important for capacity-building, demonstration activities, R&D, technology transfer and adaptation as well as realising additional climate change mitigation. **A high level international body should facilitate coordination of market and non-market finance and assess its effect on the delivery of quantifiable emissions reductions through low carbon development strategies**. The design and governance of forestry funds need to be based on equitable participation by developing and developed country governments, and should be carried out in consultation with indigenous groups and other forest communities.

Recommendation. At emitter level, the appropriate national authorities should continue to be responsible for the effective regulation and implementation of national (or regional) Emissions Trading Systems, even after linking.

Recommendation. A light-touch joint committee consisting of national representatives of linked Emissions Trading Systems should coordinate between Emissions Trading Systems and negotiate with new entrants.

Recommendation. Baselines for government-level Sectoral Crediting should be determined with the advice of a technical body and the agreement of buyer and seller nations.

Recommendation. Bilateral credit agreements between buyer and seller countries outside the intergovernmental process should be trialled while sectoral mechanisms are being developed.

Recommendation. The CDM secretariat should be strengthened with more permanent staff and more scope to validate projects that are uncontroversial.

CAPACITY BUILDING: IMMEDIATE ACTION

A wide range of capacity building initiatives has been undertaken to date to prepare countries for participation in carbon trading. **The international community needs to build on existing initiatives urgently to demonstrate and realise the potential of carbon trading mechanisms** as a policy tool to abate emissions. Capacity building for preparing countries to participate in carbon trading should focus on three main requirements: **1) measuring, monitoring and verification of emissions both at national and business levels, 2) policy and legal reform and 3) institutional reform**. Further capacity building will be required in specific sectors (for example, reform of land rights for the forestry sector) along with wider support for development. These requirements will be country-specific.

One estimate suggests that the **costs of capacity building could be up to $5 billion over the next decade to enable developing countries to participate in sectoral mechanisms and a reformed CDM**.

This cost estimate does not include the **costs of implementation and wider sector-specific capacity building, which would substantially increase costs**.

Non-market funding for capacity building will be essential in the short term as carbon market finance will be limited at early stages of development. International public funds should be coordinated effectively, avoiding a proliferation of competing mechanisms and prioritising capacity building efforts.

Recommendation. The international community should provide urgent support to developing countries to build capacity for accessing carbon trading mechanisms. This support should include the sharing of technical expertise, financial support and support for demonstration activities.

Recommendation. International funds should build on existing initiatives such as the GEF and World Bank funds. However these should be coordinated effectively to avoid a proliferation of competing mechanisms.

1 INTRODUCTION

KEY MESSAGES

Preventing dangerous climate change is essential for global security and prosperity. All countries will be affected by the impacts of climate change, particularly developing countries.

Current evidence suggests that to avoid the worst impacts of climate change, we should aim to limit the rise in global average temperature to 2°C.

The international community will need to use the full range of policy tools at its disposal to bring about immediate and substantial reductions in carbon dioxide and other greenhouse gas emissions. These tools should be environmentally effective, economically efficient and equitable between and within countries.

The costs of not acting to tackle climate change are far greater than the costs of action. Nonetheless, the amount of finance needed for adaptation, mitigation, forestry and technology will increase post-2012 when developing countries' capacity to invest in climate change related measures will increase. Recent estimates put the need at around $100bn a year by 2020.

Cap and trade is a powerful tool for reducing emissions. Binding caps at national and emitter levels is effective because it results in quantified emissions reductions; trading emissions allowances is efficient because it reduces the costs of abatement; and cap and trade systems can be designed to be equitable by setting caps and responsibilities that respect the principle of common but differentiated responsibilities.

Countries should use other policy tools alongside cap and trade as appropriate for their circumstances.

This report sets out a framework for developing and linking cap and trade systems for developed countries and transitional mechanisms for developing countries which, alongside other policy tools, could enable the international community to stabilise greenhouse gas emissions cost effectively and equitably.

1.1 IMPACTS OF CLIMATE CHANGE

Preventing dangerous climate change is essential for global security and prosperity. All countries will be affected by the impacts of climate change, particularly developing countries.

Climate change is one of the greatest threats that the world faces. On a path of high greenhouse gas emissions, with the world taking no action, the global average temperature is projected to

rise by 2.4-6.4°C by the end of this century.[1] This would have very serious consequences, both environmentally and economically.

Even if the international community takes action to limit the temperature increase towards the lower end of the IPCC projection – 2-3°C – many parts of the world are still likely to experience severe environmental impacts: rising sea levels and flooding of low-lying areas, a greater frequency of intense storms and hurricanes, and water shortages caused by the melting of glaciers and snows (around a sixth of the world's population rely on rivers fed by glaciers for their drinking water). The area of land affected by drought will also increase further,[2] causing crop failures and millions of environmental refugees. Since the 1970s, the proportion of very dry land around the world has doubled.[3]

These environmental impacts will affect economies and prosperity throughout the world. The Stern Review in 2006 estimated that the costs of not acting to tackle climate change could be equivalent to 5-20% of global GDP per annum, compared to costs of around 1% of GDP to achieve stabilisation of emissions. In other words, the costs of inaction are far greater than the costs of action.[4] And the costs of inaction could rise further: recent scientific evidence suggests that the economic and environmental impacts of climate change could be considerably greater and more rapid than previously thought.[5]

All countries will be affected, but particularly developing countries. A recent report has estimated that developing countries already bear over nine-tenths of the climate change burden, with 98% of those seriously affected, 99% of deaths from weather-related disasters, and over 90% of total economic losses.[6] In contrast, the 50 Least Developed Countries contribute less than 1% of the global greenhouse gas emissions which are contributing to climate change.[7]

Climate change presents a challenge to global security, and may increasingly become a driver of insecurity by exacerbating existing tensions around the world. The environmental and economic problems it will cause could lead to new geo-political disputes.[8] Climate change also poses the largest global health threat of the 21st century. Although vector-borne diseases such as malaria will expand their reach, the indirect effects of climate change on water, food security, extreme climatic events and population migration are likely to have the biggest impact on global health.[9]

1.2 SOURCES OF ANTHROPOGENIC GREENHOUSE GAS EMISSIONS

The Intergovernmental Panel on Climate Change (IPCC) has identified a range of gases that could contribute to global warming (see Box 1.1). In terms of anthropogenic emissions, carbon dioxide is the most important as it is produced in large quantities and remains in the atmosphere for long periods. Other important greenhouse gases include methane and nitrous oxide. Nine broad sectors account for anthropogenic emissions of greenhouse gases: power/energy supply, industry, forestry, agriculture, buildings, waste, aviation, shipping and surface transport (see Figure 1.1).

1 IPCC (2007) AR4
2 Stern (2009)
3 IPCC (2007) AR4 Working Group II
4 Stern (2006)
5 Stern (2009)
6 Global Humanitarian Forum (2009)
7 Ibid
8 DECC (2009a)
9 The Lancet/University College London Institute for Global Health Joint Commission, May 2009

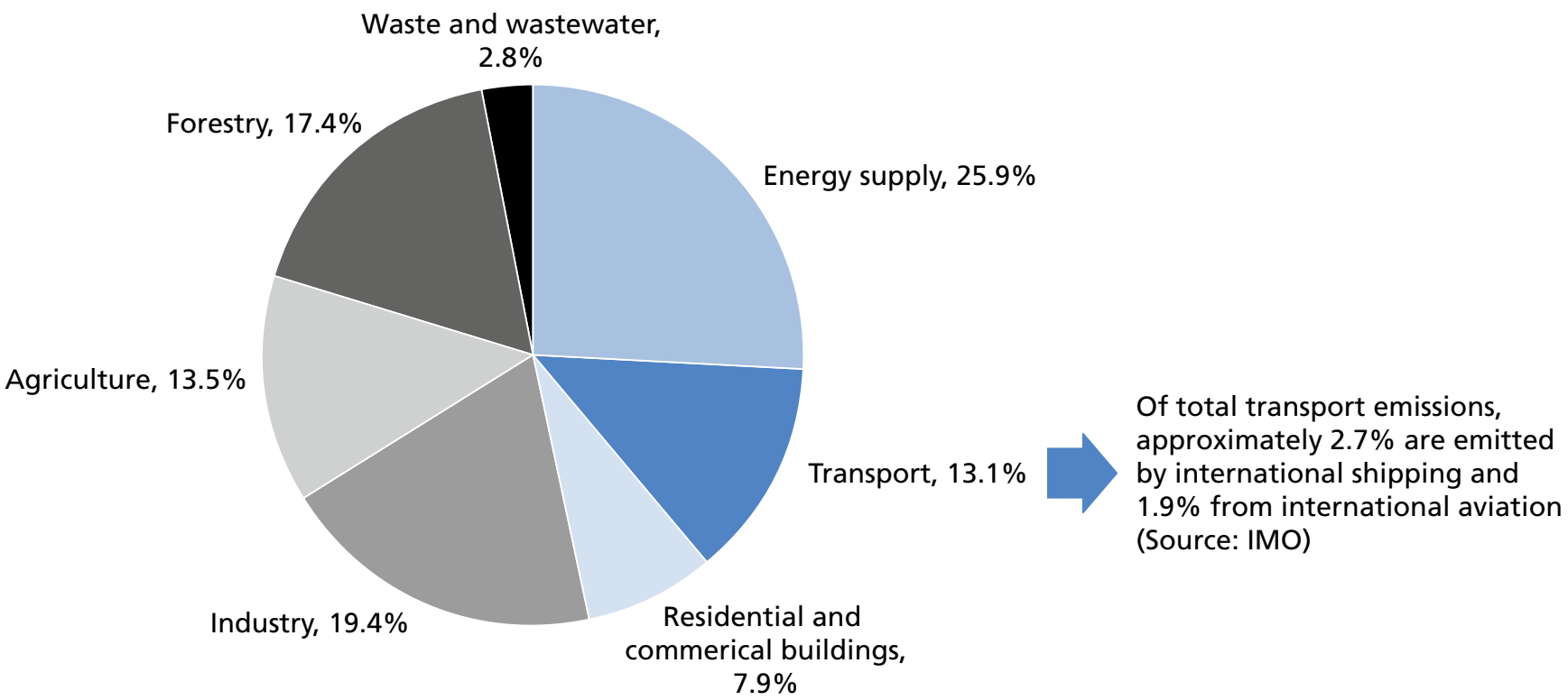
Box 1.1: Greenhouse gases

Greenhouse gases trap the sun's heat as it is radiated back from the earth and cause global warming, which in turn leads to climate change. A proportion of greenhouse gases are produced anthropogenically.

Carbon dioxide is the most important greenhouse gas with respect to global warming. It is produced in large quantities, particularly through the burning of fossil fuels and deforestation, and remains in the atmosphere for long periods of time. In addition, the Intergovernmental Panel on Climate Change lists several other anthropogenic greenhouse gases which also contribute to global warming. These are methane, nitrous oxide, PFCs, HFCs and SF6 (under the Kyoto Protocol) and CFCs (under the Montreal Protocol). These gases are incorporated into a combined measure of atmospheric concentration called CO_2 equivalent or CO_2e. While the current atmospheric concentration of CO_2 is 387 parts per million, the CO_2e concentration is over 430 ppm.

Worldwide, the power sector accounts for 26% of emissions, with the majority of this being electricity generation from coal, gas and oil. Industry is the second largest sector at 19%, with the largest contributors being steel, cement, aluminium and pulp production. Forestry is the third largest sector, accounting for around 17% of emissions, with deforestation accounting for more annual emissions than the entire transport sector, which accounts for around 13% of emissions. A short analysis of each of the nine sectors is provided in Annex A at the end of this report.

Figure 1.1: Sources of anthropogenic greenhouse gas emissions



Source: IPCC (2007) AR4

1.3 CLIMATE CHANGE MITIGATION

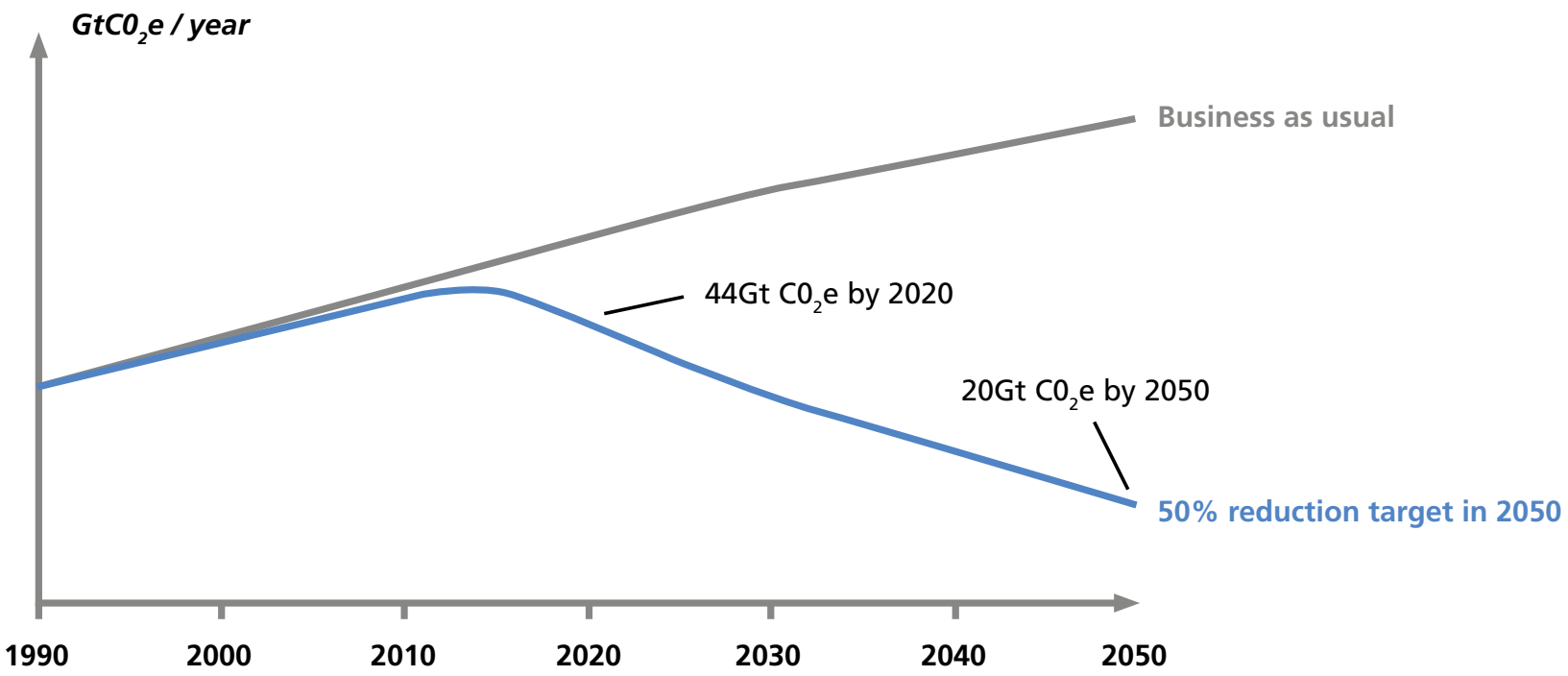
Current evidence suggests that to avoid the worst impacts of climate change, we should aim to limit the global average temperature rise to 2°C.

The international community will need to use the full range of policy tools at its disposal to bring about immediate and substantial reductions in carbon dioxide and other greenhouse gas emissions. These tools should be environmentally effective, economically efficient and equitable between and within countries.

The costs of not acting to tackle climate change are far greater than the costs of action. Nonetheless, the amount of finance needed for adaptation, mitigation, forestry and technology will increase post-2012 when developing countries' capacity to invest in climate change related measures will increase. Recent estimates put the need at around $100bn a year by 2020.

Current evidence suggests that to avoid the worst impacts of climate change, we should aim to limit the global average temperature rise to 2°C.[10] This requires the international community to undertake immediate and substantial reductions in annual global greenhouse gas emissions in all sectors in line with science (see Figure 1.2). One trajectory that is consistent with this goal suggests that global emissions should be reduced to around 44 $GtCO_2e$ by 2020.[11] This would involve emissions peaking and falling between now and then – global emissions were 45 $GtCO_2e$ in 2000 and 49 $GtCO_2e$ in 2004.[12] Reducing emissions effectively will require appropriate targets. For example, the IPCC recommends that developed country emissions should be reduced by 25-40% by 2020 (relative to 1990 levels) and by 80-95% by 2050[13], while developing country emissions should be reduced by 15-30% below their projected baselines by 2020.[14]

Figure 1.2: A trajectory compatible with limiting global average temperature increase to 2°C



Source: GLOCAF (2009). An explanation of this trajectory is provided in Annex B

As well as acting urgently, the international community will need to ensure that emissions reductions are effective, economically efficient and equitable.[15] Effectiveness means that real and lasting emissions reductions are achieved; economic efficiency ensures that those reductions are achieved at least cost; and equity reflects the principle of common but differentiated responsibilities, ensuring that emissions reductions are distributed fairly and contribute to sustainable economic growth.

10 IPCC (2007) AR4
11 Commission (2009); McKinsey (2009)
12 IPCC (2007)
13 IPCC (2007) AR4 Working Group III, Box 13.7
14 den Elzen and Höhne (2008)
15 Stern (2008)

The finance needed for adaptation, mitigation, forestry and technology will increase post-2012, when developing countries will have greater capacity to invest in low carbon development and climate change related measures. Recent estimates put the figure at around $100bn a year by 2020.[16] The UK Government expects the private sector to be the main source of finance, with a reformed carbon market providing a significant proportion of incremental finance. International public finance will also need to play a substantial role, particularly for adaptation and, before it can enter the carbon market, forestry. Developing countries are also expected to fund some of their activities themselves.

Governments have a range of policy tools available to them to meet their emissions reduction goals including cap and trade, taxation, subsidies, regulation and voluntary agreements. Cap and trade is capable of delivering emissions reductions effectively, efficiently and equitably, and should play a central role in emissions reduction strategies. By putting a price on emissions, it can provide clear signals against which consumers, producers and investors can make decisions. However, it will not be sufficient to tackle emissions reductions on its own – a mixture of policy tools will be needed. Individual countries should choose the policy tools that are most appropriate for their own specific circumstances to tackle emissions reductions within national boundaries. The rest of this chapter examines the strengths and limitations of these various policy tools.

1.4 CAP AND TRADE

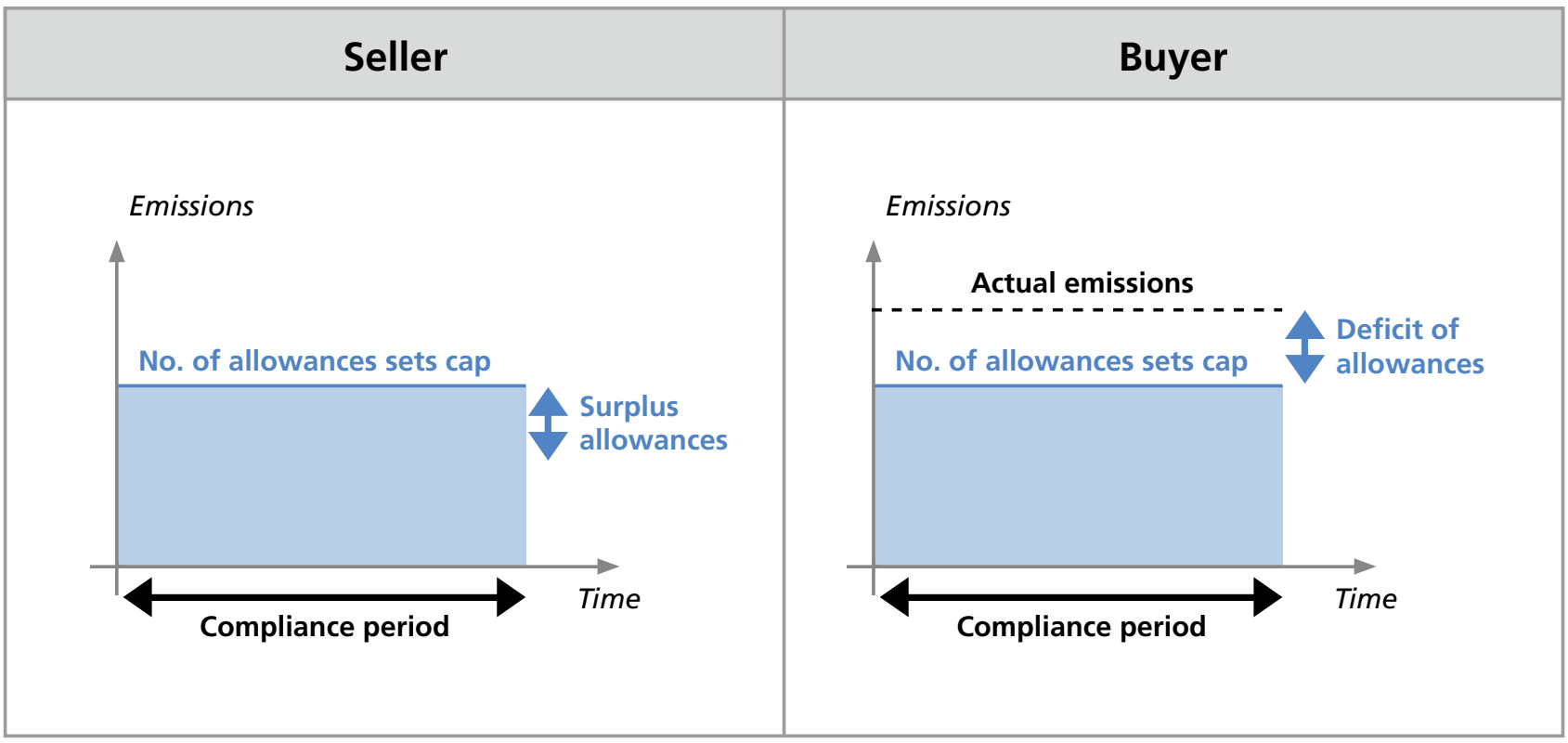
Cap and trade is a powerful tool for reducing emissions. Binding caps at national and emitter levels is effective because it results in quantified emissions reductions; trading emissions allowances is efficient because it reduces the costs of abatement; and cap and trade systems can be designed to be equitable by setting caps and responsibilities that respect the principle of common but differentiated responsibilities.

Cap and trade is a powerful tool for reducing emissions and one which is set to grow substantially over the coming decade. In 2008, the total value of the carbon market was $126bn,[17] having doubled in size since 2007. By 2020 it could be worth up to $2-3 trillion per year.[18]

Under cap and trade, a cap is set on emissions. Allowances are provided, either through purchase or allocation, to emitters covered by the cap. These emitters are required to submit allowances equal to the amount of greenhouse gases emitted over a predetermined period. The difference between expected emissions and the cap creates a price for the allowances. Emitters who can reduce emissions for less than the price of an allowance will do so. If, however, abatement costs more than the price of an allowance, it makes sense to purchase the allowance. The transfer of allowances is the 'trade'. The relative difficulty of abatement or scarcity of allowances sets the price of carbon. In theory, those that can reduce emissions most cheaply will do so, achieving the reduction at the lowest possible cost.

16 DECC (2009a). See also EC Economic and Financial Committee report, 10466/09, 2 June 2009, p3
17 World Bank (2009). The total value transacted was $126 billion in both the primary and secondary markets.
18 Point Carbon (2008). The estimated value of the carbon market is €2 trillion which equates to around $2-3 trillion.

Figure 1.3: How cap and trade mechanisms work



1.4.1 Advantages of cap and trade

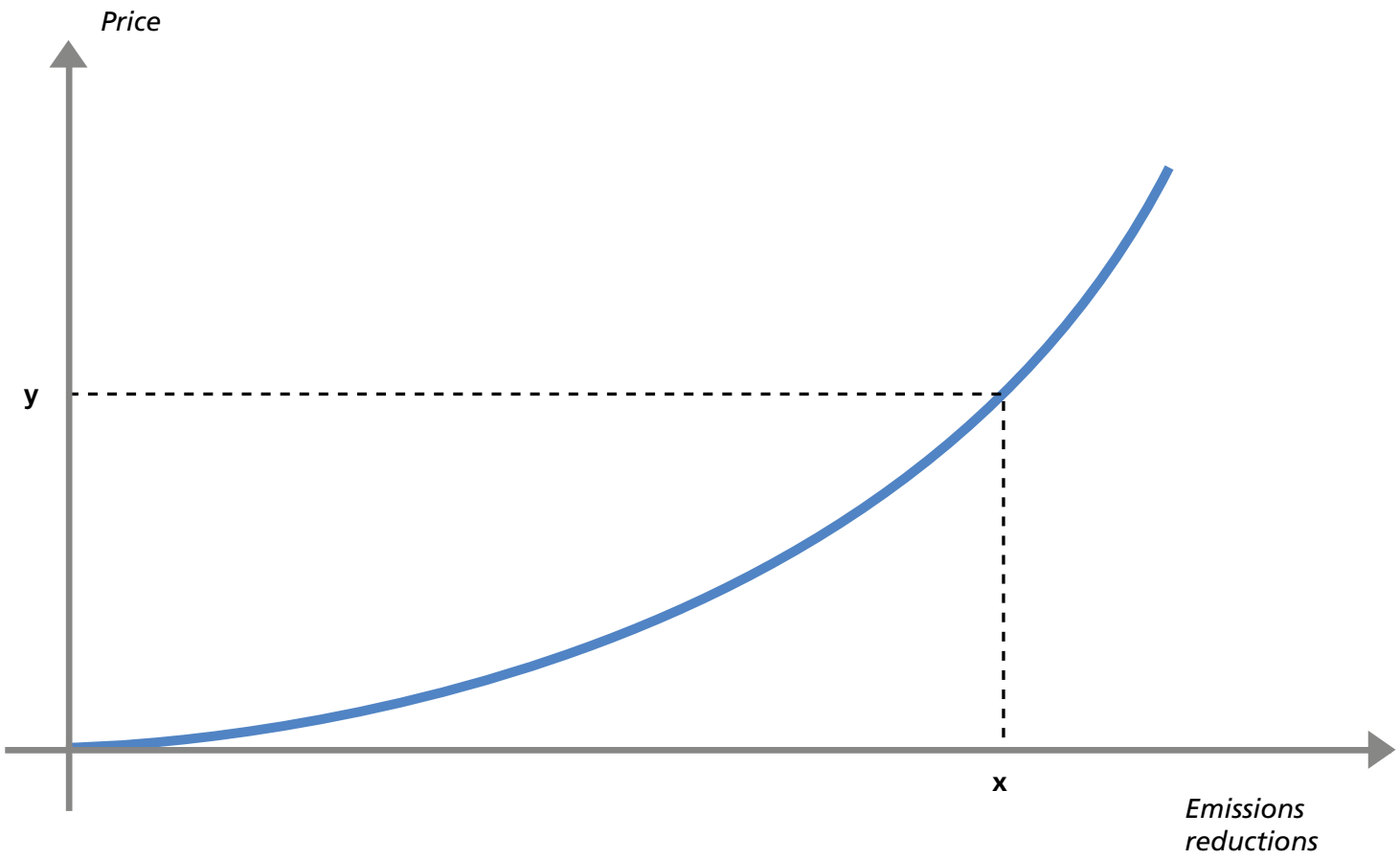
Cap and trade has a number of advantages over other policies. First, it delivers quantifiable emissions reductions by setting a cap. Other policy tools such as taxation cannot guarantee a certain level of emissions reductions. Second, trading allows for more cost-effective abatement. Modelling suggests that global carbon trading could reduce the cost of emissions reductions by up to 70% in 2020 compared with domestic abatement alone (see Chapter 3). Third, cap and trade is flexible – it prescribes no specific action or price. Fourth, it is progressive: there are significant low-cost abatement opportunities in the developing world, and the participation of developing countries in carbon markets will result in substantial financial flows to these countries (see Chapter 6).

The cap and trade system has a number of other strengths:

- Using a market-based approach that is linked to the broader economic situation enables carbon to find the 'right' price (see Box 1.2). For example, recent price falls in the EU ETS are not a sign that the system is failing to operate effectively. On the contrary, it is sensible that the recent economic downturn, leading to a decrease in economic output, should be reflected in a lower price for emission allowances whilst leaving the environmental impact (the cap) unchanged. In fact, there is evidence to suggest that, in recent months, the supply of EU allowances exceeded total emissions as demand and activity slumped. Yet the price did not fall to zero as might be expected in the absence of scarcity, the reason being that EU ETS certificates can be held or banked in Phase II. As a result, investors have not sold their surplus allowances but, in the expectation of better market conditions when global demand recovers, have retained them.
- National cap and trade systems can be linked with each other to good effect (see Chapter 5), while developing countries can be linked in to carbon markets through a range of mechanisms (see Chapter 6). The larger and broader the market, the greater the liquidity and the lower the overall cost of abatement.
- A trading system offers both compliance and policy flexibility, both of which are important for business. Compliance flexibility is delivered through the ability to 'make or buy', ie, to implement a project and make reductions, or to buy allowances from the market. Cap and trade delivers a profit incentive to companies that discover more effective ways of reducing emissions; policy flexibility comes through the mechanism for the distribution of allowances.

Box 1.2: Marginal abatement costs and the carbon price

Different options for reducing carbon emissions carry different costs. The 'marginal abatement cost' defines the cost of abating one further tonne of carbon which becomes increasingly expensive as cheaper options for abatement are used up. An illustrative marginal abatement cost (MAC) curve is shown below.



A cap and trade system caps emissions, guaranteeing emissions reductions (for instance, at x in the diagram above). The price of an allowance traded in the market should then be the same as the marginal abatement cost at this level (y). This is because the carbon price produces the incentive for abatement up to this level, but no further. By producing this price signal, the market ensures that cheap abatement opportunities are taken first, and that emissions abatement occurs in an efficient manner.

Cap and trade is already proven as an effective tool in practice. Under the 1990 US Clean Air Act Amendments, the Acid Rain Program was established, which led to the creation of emissions trading markets for SOx (sulphur dioxide) and NOx (nitrogen oxides). Due to the large scale and high profile of the Acid Rain Program, its relative success was the largest contribution to the change in attitude towards emissions trading in the 1990s.[19] Overall, the SOx trading system has been highly successful in achieving its stated goals. Detail of these is provided in Annex C. Between 1990 and 2007, SO_2 emissions decreased by 43%, and the 2010 emissions target was reached three years early. The EPA also estimates that by 2010 the overall compliance costs to businesses and consumers will be $1-2bn per year, one quarter of the original cost predictions.[20]

The EU ETS provides further evidence for the effectiveness of cap and trade. A survey undertaken by the National Audit Office shows that the EU ETS is influencing company investment decisions and achieving emissions reductions. Around 64% of companies reported that the ETS has led directly to emissions reductions from their operations, while 34% of respondents said that reducing emissions was now taken more seriously as a boardroom issue.[21]

19 Tietenberg (2006)
20 Ellerman (2003)
21 NAO (2009)

1.4.2 Limitations of cap and trade

The evidence shows that ETSs are a powerful tool for reducing emissions with certain clear advantages over other policy tools. However, ETSs have some limitations and should therefore be implemented alongside other policy tools:

- ETSs will not always provide the long-term, certain price signals required to incentivise innovation and investment in specific new technologies that have a high cost today but potentially lower costs in the future, for example carbon capture and storage. Government grants can provide funding to finance the research, development and demonstration phases of new technologies.[22]
- Other policy instruments such as regulation are also likely to be more effective than an ETS at delivering the necessary infrastructure to unlock the potential of low carbon technologies in an economy. An example of this might be the need for a smart energy grid, which is an important part of developing renewable energies.
- ETSs usually cover businesses (such as power companies) that emit greenhouse gases as they meet demand for goods and services from their end users. Even where businesses pass the cost of carbon on to end users (for example through higher electricity prices), this may not reduce consumption behaviour significantly. For example, consumers may lack information on their energy bills and usage. Where the price signal does not change behaviour significantly, specific policies will be needed to target consumer behaviour directly.
- Certain sectors may be unsuitable for inclusion in ETSs if the concentration of emitters in the system is relatively diffuse and emissions measurements lead to high transaction costs. This will depend on country-specific circumstances (see Chapter 3).

1.5 OTHER POLICY TOOLS

Countries should use other policy tools alongside cap and trade as appropriate for their circumstances.

1.5.1 Taxation

With taxation, governments decide on a price for the emission of a greenhouse gas such as a tonne of carbon, whether from a power plant, a factory or an aeroplane. Taxation provides certainty over the price of carbon, because it is fixed at a level set by government. However, there cannot be certainty over the amount of emissions reduction because the relationship between the price of a good and demand cannot be predicted reliably – it is difficult for governments to determine the exact level of taxation needed to deliver a certain level of emissions reductions. This is a major drawback compared to cap and trade, given that the primary goal of climate change policy is to limit greenhouse gas emissions to a specific level.

Another drawback of taxation is the challenge of harmonising taxes across countries. Although taxation is a relatively simple policy tool, agreeing an international regime of taxation for carbon and other greenhouse gases would be difficult given the complexity of such negotiations and the sensitivity of sovereign governments over ceding powers to a supra-national authority with the ability to change national taxation rates and thus affect economic prospects. This was seen in the 1990s, when EU Member States failed to reach agreement on a pan-European carbon tax.

22 Office of Climate Change (2008)

A taxation regime requires a baseline to be set, monitoring and verification of emissions to be carried out, and the resulting revenue to be distributed appropriately. A crediting system would also have to be set up for projects that eliminate emissions; and this would require project oversight, measurement and verification, and an institution to oversee compliance. These elements are similar to those needed under a cap and trade regime.

Nevertheless, despite the drawbacks of taxation, it is a useful complementary tool to cap and trade to ensure that changes in behaviour occur early and rapidly and for providing coverage of sectors of the economy not suited to cap and trade.

1.5.2 Subsidies

Where possible, the private sector should be left to finance new technologies. However, if market failures exist, and carbon prices are still relatively low, governments can use subsidies to support low carbon technologies (particularly in the early stages of development) and behaviours. This is a mechanism that governments already use to address environmental externalities. Examples of subsidies include capital grants from the UK Government for low carbon technologies such as offshore wind power, wave and tidal energy and low carbon vehicles, as well as public funding for the demonstration and development of carbon capture and storage.[23] It is however a challenge for government to time and price subsidies in a way that maximises their effectiveness.

1.5.3 Regulation

There are instances when behaviour cannot be altered effectively by changing the price of a good, and it may be necessary for governments to regulate to achieve the required effect. Regulation can guarantee the environmental outcome, create substantial new markets, and has a role where consumers or businesses do not respond to price signals, such as installing energy efficiency measures, building regulations and car standards, such as those recently proposed in the US.[24] Regulation can also be cheaper than price instruments in many of these cases. In the EU, there are now regulations in place to keep average vehicle emissions to 130gCO_2 per kilometre by 2015.[25]

Applied widely, this would be a blunt instrument which would limit all sources of emissions regardless of how important and valuable the activities that created these emissions were, and regardless of the cost of abatement. But if used in a targeted manner then regulation can, and does, deliver effective changes in production and behaviour relatively rapidly and effectively. As such, it should be used as part of an overarching policy framework to tackle climate change.

1.5.4 Other policy mechanisms

A range of other policy mechanisms are available to help reduce emissions:

- **Voluntary agreements** exist between government authorities and private parties with the aim of achieving environmental objectives beyond those stipulated in regulated obligations.
- **Information instruments** provide for the public disclosure of environmental information. Examples include product labelling and rating systems.
- **Research and development** in new low carbon technologies is essential if we are to tackle climate change. Government funding and investment can create innovative approaches to greenhouse gas abatement which would not necessarily be stimulated by a carbon price.

23 DECC (2009b)
24 Associated Press (2009)
25 European Parliament (2009)

- **Government procurement**, often backed by standards and regulations, can spur large scale and profitable innovation by creating substantial new markets (for example in electricity generation and distribution, schools, hospitals, buildings and transport systems).

Although none of these policy tools is sufficiently effective to deliver the necessary emissions reductions in isolation, they are useful components of an overall policy approach. Cap is trade is an essential part of this.

1.6 SCOPE OF THE REPORT

This report sets out a framework for developing and linking cap and trade systems for developed countries and transitional mechanisms for developing countries which, alongside other policy tools, could enable the international community to stabilise greenhouse gas emissions cost effectively and equitably.

This report examines the role of cap and trade systems internationally and some of the issues that will be faced as they develop. It aims to set out a strategic approach to the development of global carbon trading which, along with other policy tools, should play a central role in tackling climate change. The report also sets out the importance of careful design during transition and the need for practical roadmaps for governments and policy makers to maximise the benefits of cap and trade, together with the institutional reform and capacity building that will be needed to deliver this transition over the coming years.

The report does not provide a detailed examination of issues that are already well documented, such as the operation of the EU ETS and RGGI,[26] the challenges surrounding leakage of emissions from one country to another,[27] or a catalogue of essential design features for a well-functioning ETS.[28] Auction revenue raising, secondary carbon markets and non-market finance, as well as detailed analysis of the other policy tools, are substantial projects in their own right and are outside the scope of this report. Nonetheless, the report does examine how many of these issues interact with the overall aim of developing a global system of carbon trading.

Chapter 2 of this report provides an assessment of the current framework for global carbon trading. In Chapter 3, we set out our long-term vision for a dual system of cap and trade, including targets at the national level and a linked network of emissions trading systems at the emitter level. Chapters 4-6 examine the transition that will be necessary over the next 10 to 20 years to achieve that vision, at national and emitter level, in both developed and developing countries. Chapter 7 sets out what institutional framework and governance will be required during this period of transition, while Chapter 8 sets out a plan for the capacity building that will be needed, particularly in developing countries.

26 Edenhofer, Flachsland and Marschinski (2007)
27 Dröge (2009)
28 Convery, De Perthuis and Ellerman (2008)

2 THE CURRENT FRAMEWORK

KEY MESSAGES

The UN Framework Convention on Climate Change and the Kyoto Protocol have provided an important framework for international emissions reductions, including legally-binding targets for developed countries.

Three flexible mechanisms provide opportunities for governments and emitters to trade national allowances and project-based credits through international emissions trading, the Clean Development Mechanism and Joint Implementation.

The EU Emissions Trading System and the Regional Greenhouse Gas Initiative in US states have provided blueprints for how governments can effectively devolve emissions reduction effort to businesses and other emitters.

Voluntary carbon markets have also provided a testing ground for new approaches to carbon market mechanisms.

Current carbon market instruments provide valuable lessons for developing and expanding carbon trading in the future. For example, weak targets reduce and delay environmental effectiveness, some project-based credits have been limited in their effectiveness, efficiency and equity, and trading could be more transparent.

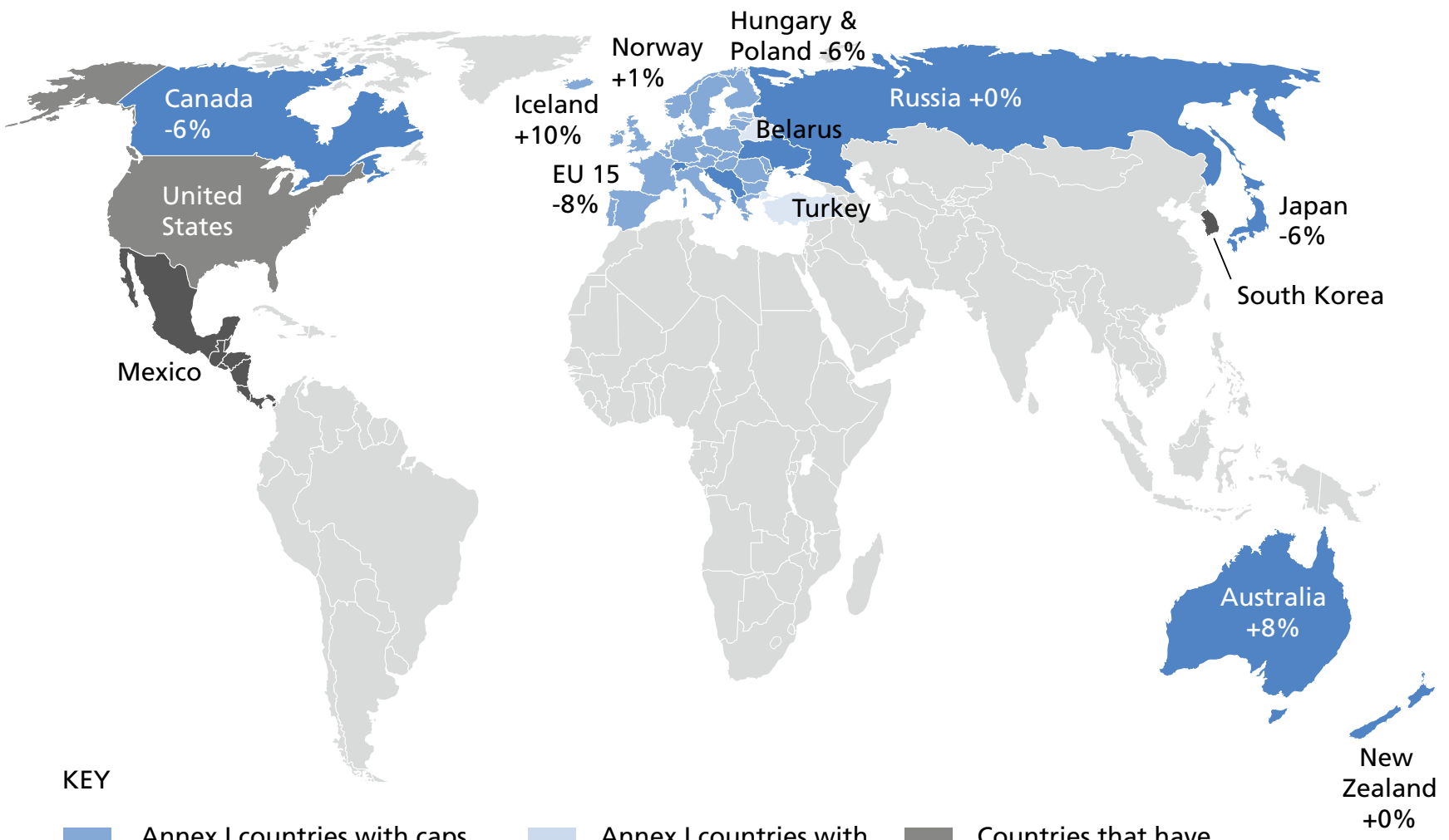
2.1 TARGETS AND TRADING UNDER THE CURRENT FRAMEWORK

2.1.1 National targets under the UNFCCC framework

The UN Framework Convention on Climate Change and the Kyoto Protocol have provided an important framework for international emissions reductions, including legally-binding targets for developed countries.

The UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol agreed under the UNFCCC have provided an important framework for international emissions reductions. The Kyoto Protocol commits Annex I countries to individual, legally-binding emissions reduction targets (see Figure 2.1). For each tonne of CO_2e that a country can emit within its target, one Assigned Amount Unit (AAU) is allocated.

Figure 2.1: Countries capped under the UNFCCC Kyoto Protocol



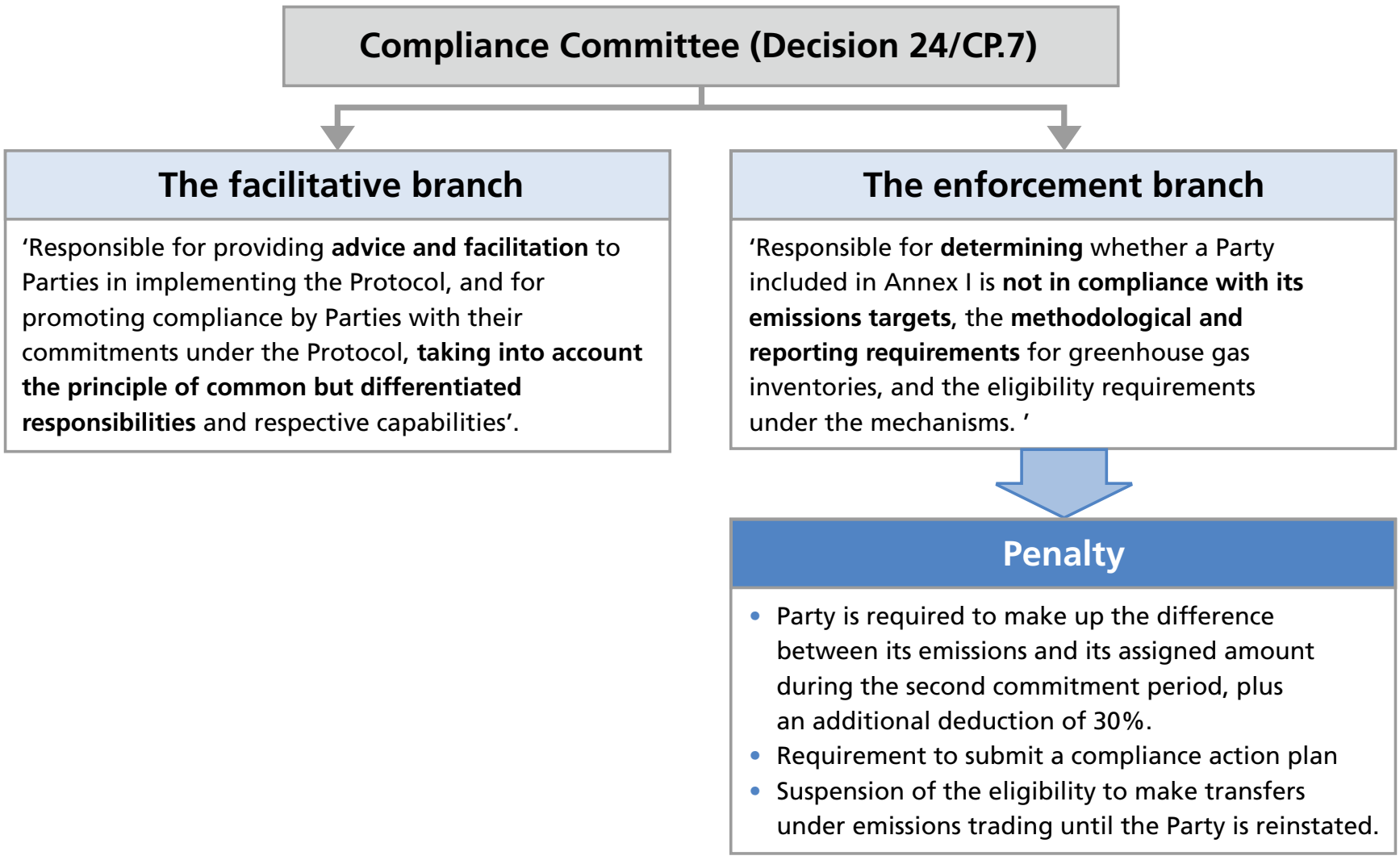
Source: UN (1992)

Annex I countries report their total emissions through national inventories and retire sufficient AAUs to cover their emissions target at the end of each commitment period (the first commitment period is 2008-2012 for the Kyoto Protocol). To date, all Annex I countries[1] have produced national inventories annually since 2003,[2] although some, including the Russian Federation, Ukraine, Lithuania and Liechtenstein, started later.

The UNFCCC coordinates the verification of emissions and AAU holdings to establish compliance. Once review and compliance procedures have been completed for all Parties, there is a period of 100 days called the 'true-up period' which provides countries with the opportunity to undertake and finalise the transactions necessary to achieve compliance. If a country emits more than its allowance in the compliance period – taking account of any international transfers under the flexible mechanisms (see below) – it must make up the difference in the next compliance period, plus an additional deduction of 30% (see Figure 2.2). However, these enforcement procedures will only be tested at the end of the compliance period, with the exception of EU Member States, which are legally required to retire AAUs annually.

1 41 of them: 40 countries plus EU aggregate submission
2 Comprising Common Reporting Format tables and National Inventory Reports

Figure 2.2: UNFCCC international compliance and enforcement mechanisms



Source: UNFCCC (1998)

2.1.2 Carbon trading under the UNFCCC framework

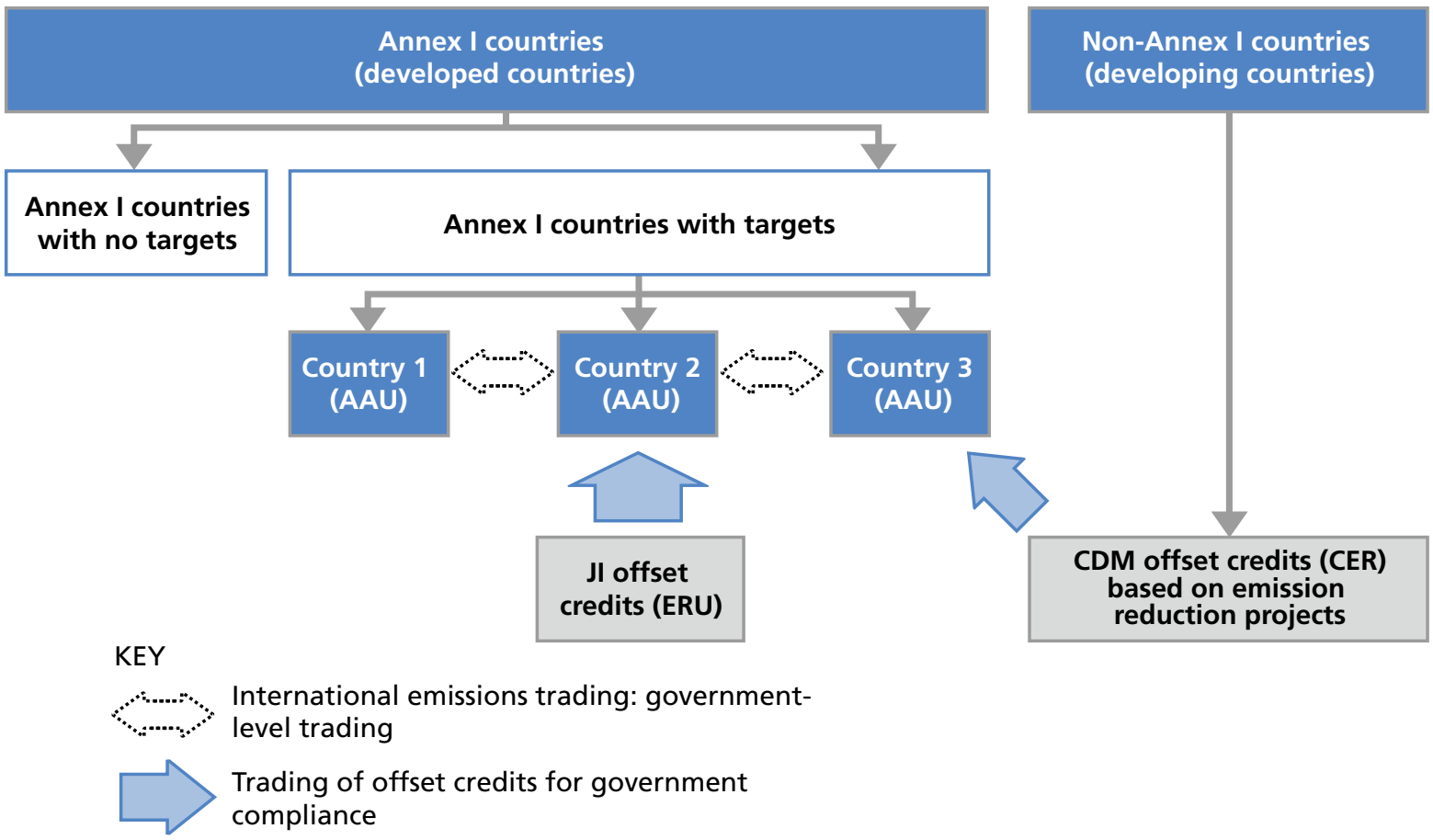
Three flexible mechanisms provide opportunities for governments and emitters to trade national allowances and project-based credits through international emissions trading, the Clean Development Mechanism and Joint Implementation.

Countries can make use of three carbon market mechanisms, called flexible mechanisms, to comply with their obligations under the Kyoto Protocol. These are international emissions trading[3] (often referred to as IET), the Clean Development Mechanism (CDM), and Joint Implementation (JI) (see Figure 2.3). With these three carbon market mechanisms in place, countries have a wide range of carbon units (including AAUs, Certified Emissions Reductions and Emissions Reduction Units), each equivalent to one tonne of CO_2e, that they can use for compliance.[4]

3 Article 17 of the Kyoto Protocol

4 Because carbon can also be removed from the atmosphere through land use and forestry activities, a third type of carbon credit has been created, called a Removal Unit (RMU). As some Annex I countries have chosen to only issue RMUs at the end of the compliance period, during the true-up period there is therefore a limited scope for trading.

Figure 2.3: The UNFCCC carbon trading mechanisms



Source: OCC (2009)

International emissions trading allows trading of AAUs between Annex I countries, and covers around a quarter of world greenhouse gas emissions. This mechanism is top-down, since it was established by an overarching global convention – the UNFCCC – and involves government-to-government trading. As the first commitment period of international emissions trading only started in 2008, it is still too early to draw any conclusions on its efficiency. However, whilst trades between countries are starting to take place, the UK has decided to cancel any surplus AAUs rather than trade them, in order to bring down overall emissions and to encourage others to do the same.

The CDM[5] allows Annex I countries capped under Kyoto to fund carbon reduction projects in non-Annex I countries and earn carbon credits against a pre-defined baseline. These carbon credits are called Certified Emissions Reductions (CERs) and are equivalent to one tonne of CO_2e abated through a CDM project. CERs can be used for compliance instead of AAUs, which means that AAUs and CERs are interchangeable (also referred to as fungible). CERs do not result in additional emissions reductions as they are purchased by Annex I countries to offset against an increase in emissions beyond the cap. They are also used, within limits, by companies to meet their compliance obligations in regional cap and trade systems (EU ETS and RGGI). Currently, the CDM is the mechanism used to link developing countries to existing carbon markets (see Box 2.1 for more details about the CDM).

5 According to Article 12 of the Kyoto Protocol, the purpose of the CDM is two-fold: 1) 'To assist Parties not included in Annex I in achieving sustainable development' and 2) 'To assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments', ie, cost-effective abatement

Box 2.1: CDM facts and figures (as of 3 July 2009)

Since 2005, 311 million CERs have been issued (equivalent to 311 $MtCO_2e$) from the 1702 projects registered under the CDM. This number is expected to reach over 1620 million CERs (1.6 $GtCO_2e$) by the end of 2012. In addition, 193 projects have requested registration, which should add an additional supply of 20 million CERs by 2012, reaching a total of over 1640 million CERs.

The majority of CDM projects have developed in only a small number of countries: 60% of registered projects are located in China (34%) and India (26%). This is mainly due to the existence of cheap abatement opportunities in these countries[6] as well as the large size of the projects, which has generated economies of scale (lower transaction costs).

Less than 1% of CDM projects occur in Least Developed Countries. Abatement opportunities in these countries are concentrated in agriculture, afforestation and reforestation. Agriculture and afforestation are under-represented in the CDM with less than 6% of total registered projects, while LULUCF is excluded.

CDM registered projects are dominated by those that are energy-related – over 60% of the total – including renewables and energy efficiency. Project developers who invest in CDM projects and implement them are mainly located in developed countries.

Source: UNFCCC website: http://cdm.unfccc.int/index.html

Finally, JI allows Annex I countries capped under Kyoto to implement emissions reduction projects in other Annex I countries.[7] Carbon credits generated through JI projects, called Emissions Reduction Units (ERUs), are converted from AAUs, are equivalent to one tonne of CO_2e and can be used for compliance. In a similar way to the CDM, JI projects do not result in additional emissions reductions beyond the level of the national target. JI has made slow progress, with only around 200 projects registered to date (75 $MtCO_2e$).[8]

2.1.3 Emissions trading systems

The EU Emissions Trading System and the Regional Greenhouse Gas Initiative in US states have provided blueprints for how governments can effectively devolve emissions reduction effort to businesses and other emitters.

Once countries commit to national emissions targets, they need to ensure that these targets are met through the adoption of national mitigation policies (see Chapter 1). One option is to implement a carbon market nationally or regionally by setting emission caps consistent with international obligations and devolving the liability down to the emitter level. This means that emissions from businesses are capped and individual companies can trade allowances on a carbon market to ensure they have sufficient allowances to match their actual emissions. This enables each company to determine whether to emit and purchase allowances, or whether to abate.

6 Glocaf (2009)
7 Article 6 of the Kyoto Protocol
8 Key reasons for this slow take-off include Russia taking time to implement JI projects and start crediting ERUs, and the fact that JI is excluded from EU ETS sectors, which reduces the scope of opportunities. To date, almost half of JI projects take place in Russia, representing two thirds of ERU volumes

In 2003, the EU agreed to create the EU Emissions Trading System (ETS),[9] bringing together all EU countries within one carbon market (see Box 2.2). The creation of the EU ETS was partly incentivised by the Kyoto Protocol. Chapter 5 discusses the design of ETSs in more detail.

Since 2005, the EU ETS has demonstrated a number of successes including:

- putting measuring, reporting and verification guidelines in place, which has produced accurate emissions data;
- establishing national registries (which contain accounts of where units are held in the name of the government or in the name of legal entities authorised by the government to hold and trade units) as well as a Community Transaction Log, recently linked to the UNFCCC International Transaction Log (transaction logs verify transactions proposed by registries); and
- encouraging businesses to factor carbon trading into business operations – and consider it at Board level – by taking part in the ETS.

In addition, verified emissions from the EU ETS decreased by around 3% in 2008.[10] Although the economic downturn played an important role in this decrease, analysis conducted recently has concluded that only 30% of the emissions reduction could be attributed to recessionary impacts and as much as 40% could be attributed to the incentives created by the EU ETS (other factors include a rise in renewable energy generation and nuclear availability).[11] It is worth noting that although electricity generation in the EU was up 0.3% in 2008, emissions from this sector decreased by 2%.[12]

This decrease in emissions led to a fall in EU ETS allowance (EUA) prices in early 2009,[13] which indicates that the market mechanisms of supply and demand are operating as they should. In addition, because caps will be tighter in Phase III and businesses can bank surplus EUAs for future use, EUA prices have held up despite strong downward pressures.

9 Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community
10 Based on verified emissions reported to the Community Independent Transaction Log (CITL)
11 New Carbon Finance (2009)
12 Ibid
13 EUA prices went briefly below €10/tCO_2 in February 2009

Box 2.2: The EU Emissions Trading System

The EU ETS is a mandatory trading system covering installations in all EU Member States. It currently covers around half of Europe's CO_2 emissions (equivalent to 42% of all Europe's greenhouse gas emissions). The EU ETS is also the largest and most liquid ETS to date, with transaction volumes growing by almost ten times between 2005 and 2008 (3 $GtCO_2e$ exchanged in 2008).[14] The units traded are EU allowances (EUAs), with one EUA equivalent to one tonne of CO_2e. In addition to EUAs, operators may convert CDM and JI credits for use in the system. The use of these credits is subject to quantitative restrictions.

The sectors currently covered are electricity generation (power stations) and other large stationary emission sources (industry) – for example, iron, steel, cement and lime. This amounts to approximately 12,000 installations, the top 7% of which account for 60% of emissions covered. Installations are required to measure and report their emissions and at the end of the year surrender allowances to cover their reported and verified emissions.

The EU ETS has operated in phases:

- **Phase I (2005-2007)** constituted a 'learning by doing' phase. Only CO_2 emissions were covered, with the option to voluntarily opt-in other greenhouse gases. Each Member State made allocations to businesses through a National Allocation Plan (NAP) agreed with the European Commission, and the combined total of these allocations constituted the EU level cap. The use of generous business as usual emissions projections led to lenient caps. This resulted in more allocations being made than were needed to fulfil obligations under the system. This, combined with the inability to bank allowances between Phase I and Phase II, led to a collapse of the EUA price, reaching €0.02/tCO_2 at the end of Phase I.[15]
- **Phase II (2008-2012)** took account of the problems identified in Phase I to improve the efficiency of the system. The EU was much tougher in ensuring that Member States' NAPs delivered a tighter cap, projected to reduce EU emissions by 6% on 2005 levels by 2012, with the auctioning of around 3% of allowances. In addition, three non-EU countries – Norway, Iceland and Liechtenstein – were included in the EU ETS.
- **Phase III (2013 onwards)** was agreed in December 2008. A centralised EU cap will be set rather than the cap being the sum of the Member States' NAPs. More sectors (including aviation) and more gases will be included. The cap will decline linearly, aiming for a total reduction of around 21% of emissions below 2005 levels by 2020. Auctioning of allowances will play a far greater role – at least 60% of allowances will be auctioned by 2020. Unlimited banking will be allowed between Phases II and III. If an international agreement is concluded and the EU accepts an overall reduction target greater than 20%, the cap will be tightened to deliver emissions reductions within the ETS that are consistent with the overall EU target. Access to CDM and JI credits will be limited to no more than 50% of the abatement effort compared to 2005 emissions levels over the period 2008 and 2020.

14 World Bank (2009)
15 Caisse des Depots et Consignation (2008)

In the US, a regional ETS has been operating since 2008: the Regional Greenhouse Gas Initiative (RGGI). RGGI caps emissions from power companies and covers around 95% of the power sector (207 $MtCO_2$)[16] in 10 US states.[17] RGGI has been a useful testing ground for developing new monitoring, reporting and verification standards, IT systems such as registries, and more generally for bringing business-to-business carbon trading to the US. The US administration has now committed to a federal ETS (or cap and trade system). Other ETSs have been proposed in Australia, New Zealand, Japan and Canada (see Chapter 5).

The EU ETS and international emissions trading under Kyoto are generally viewed as two distinct carbon markets. Although Phase I of the EU ETS started before the first Kyoto commitment period, Phase II is timed to coincide with the Kyoto commitment period. This means that since 2008, the EU ETS and Kyoto international emissions trading have been linked.[18] The EU ETS has also been linked to the CDM and JI since 2005. Currently, CDM and JI credits can be traded within the EU ETS up to a limit, following the principle of 'supplementarity'.[19]

2.1.4 The emergence of voluntary carbon markets

Voluntary carbon markets have also provided a testing ground for new approaches to carbon market mechanisms.

Voluntary carbon transactions are transactions that are not required by any international treaty or regulation. The development of voluntary carbon markets has been influenced by regulated carbon markets and has been driven mainly by initiatives in the US. These voluntary markets have either taken the form of cap and trade or offset credit mechanisms and in most cases have tended to be less stringent than regulated markets in terms of target baseline and measuring, reporting and verification (MRV) requirements.

The Chicago Climate Exchange (CCX) was created in 2003 and is currently the largest voluntary cap and trade system, with over 300 members[20] (as a comparison, the EU ETS covers over 12,000 installations). Businesses make a voluntary but legally binding commitment and trade Carbon Financial Instruments (CFI) contracts, which can be either allowances or offset credits.[21] Two features of the CCX are important for the purposes of this report. First, unlike the EU ETS, the CCX allows the use of forestry credits and has experienced a great deal of trade in agriculture-based offset credits (31% of CCX projects).[22] The second important feature is the fact that between 2003 and 2006, there has been a one-way link between the CCX and the EU ETS, with CCX members able to use EUAs for compliance. It is estimated that around 1000 EUAs were transferred from the EU ETS to the CCX in 2006.

Voluntary offset credits that occur outside the scope of the CCX are generally referred to as Voluntary Emissions Reductions (VERs). VERs have had mixed success. They are mainly traded on a bilateral basis with limited transparency as to the origin of credits. This creates risks of double-counting and a lack of additionality (ie, emissions reductions could be paid for which would have

16 RGGI used short tonnes of CO_2 whereas the EU ETS and Kyoto use metric tonnes. This means that RGGI covered 188 million short tonnes of CO_2 in 2009, equivalent to 207 million metric tonnes of CO_2

17 The 10 US states covered are: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont

18 In practice, this means that each EUA is backed by one AAU in order to avoid any double-counting

19 The principle of supplementarity is that emissions reductions bought in from developing countries should be supplemental to emissions reductions achieved within developed countries, to ensure that developed countries undertake abatement

20 http://www.chicagoclimatex.com/

21 All six Kyoto greenhouse gases are covered by the CCX. The commodity traded on CCX is the Carbon Financial Instrument (CFI) contract, each of which represents 100 metric tons of CO_2e

22 http://www.chicagoclimatex.com/

occurred anyway).[23] This is not to say that all VERs are poor quality credits – an increasing number of offsets adhere to the emerging voluntary offset standards, such as the Gold Standard.[24, 25]

Drawbacks of VERs include the proliferation of standards, a lack of transparency regarding the methodologies used in emissions assessments, and a lack of independent validation and verification. Some of the leading VER standards are based on 'lighter touch' versions of the CDM validation and verification procedures which – in light of criticism of the CDM – raises questions of how such standards can ensure that their processes are sufficiently robust.

Finally, it is important to note that VERs have been a fertile ground for the development of forestry credits. An estimated 36% of VERs (3.5 $MtCO_2$) issued in 2006 came from forestry projects, of which 67% originated in North America.[26] Although voluntary markets provide a useful testing ground for new methodologies, they should not divert attention away from efforts to improve the Kyoto mechanisms.

2.2 LESSONS LEARNED FROM CURRENT CARBON MARKETS

Current carbon market instruments provide valuable lessons for developing and expanding carbon trading in the future. For example, weak targets reduce and delay environmental effectiveness, some project-based credits have been limited in their effectiveness, efficiency and equity, and trading could be more transparent.

The development of Kyoto markets and regional ETSs has demonstrated the political feasibility of carbon trading. As the first multilateral agreement on climate change, the Kyoto Protocol has shown that an international consensus can be reached on carbon trading with the engagement of both developed and developing countries. Similarly, the EU ETS has shown how important the design of a system is for ensuring environmental effectiveness (for example defining clear MRV standards), economic efficiency (for example provisions for banking and borrowing of allowances) and equity (for example agreement of appropriate allocation of allowances).

The current system has also identified pitfalls to avoid. The following sections focus on three key lessons that can be learned from current systems: 1) weak targets, which delay environmental effectiveness, 2) project-based international credits, some of which are limited in their effectiveness, efficiency and equity and 3) trading, which could benefit from greater transparency.

2.2.1 Weak targets

The Kyoto Protocol can be considered as a learning phase, with national targets set without full knowledge of countries' actual and projected emissions. As a result, some countries have caps that are now significantly above their actual emissions. Overall surpluses of AAUs are expected to total around 7-10 $GtCO_2e$ in the period 2008-2012,[27] and Russia alone is expected to have a surplus of around 3.5-5 $GtCO_2e$.[28] If countries with surpluses choose to sell their entire surplus within the compliance period, they could potentially trigger a flood of allowances onto the international emissions market and a collapse of the AAU price. This is unlikely to happen as long

23 Ricardo et al (2007)
24 The Gold Standard has been developed by the World Wildlife Fund (WWF) to combine climate change and sustainable development benefits. The Gold Standard Foundation registers emissions reduction projects that contribute to sustainable development and certifies their carbon credits for sale on both compliance and voluntary offset markets. Source: http://www.cdmgoldstandard.org/
25 None of these standards are currently recognised by the UK Government
26 Ricardo et al (2007)
27 Discussions with the World Bank. See also World Bank (2009)
28 Ibid

as countries are confident that they can bank their AAUs for future periods, and to date the price of AAUs does not appear to have been affected by this over-allocation.[29] However, if countries are able to bank surpluses, this could lock in a lack of ambition in the system in future periods, with countries relying on using surpluses from past periods rather than making the necessary emissions reductions in future periods. It is still unclear how the international community will deal with these challenges in a post-2012 agreement. Chapter 4 sets out some of the options that could be considered.

Similarly, during Phase I of the EU ETS, when EU Member States were setting emission targets for the first time, they had to take into account political acceptability and acknowledge that there was a lack of accurate emissions data on which to base their calculations. The result was loose targets and over-allocation. Recognising the limitations of the availability of emissions data, the EU ensured that Phase I was closed with no ability to bank allowances into Phase II. This meant that when the oversupply was revealed in 2006, the allowance price dropped (see Box 2.2). However, the EU has been able to learn the lessons from Phase I, which was relatively experimental in its time, and develop more robust design features in Phases II and III.

2.2.2 International credits

Governments and businesses in developed countries can use offset credits from developing countries to meet a proportion of their abatement effort. CDM offset credits have been successful in engaging developing countries and their business sectors in climate change mitigation. They have demonstrated that a multilateral mechanism can work – the CDM market is the second largest carbon market after the EU ETS – and they have helped shape offset standards internationally. However, the CDM has also revealed problems inherent in offset credits, including environmental effectiveness, economic efficiency and equity concerns.

First, the environmental integrity of offset credits has been questioned. In the case of the CDM, projects are validated only if the project can demonstrate that it is additional, which means that the abatement would not have happened without the CDM. The risk is that if a project is not fully additional, offset credits will not be delivering the emissions abatement that is assumed. This undermines the environmental effectiveness of the system. Several sources have suggested that many CDM projects may be non-additional and would have occurred without the existence of CDM credits.[30]

A second concern is the transfer of 'rents' (or windfall profits) to project developers and developing countries resulting from CDM projects. Large rents are created when the cost of abatement is substantially below the actual price of carbon, which can occur in a market with a single price for carbon. The most commonly cited examples are HFC projects, where factories producing refrigerants emit the powerful greenhouse gas HFC-23. This gas can be abated at less than $\$0.5/tCO_2e$; significantly lower than the CER price.[31] Consequently, some have argued that HFC gases could have been abated more efficiently through mechanisms other than carbon markets.[32] Other CDM credits can also produce rents, though generally substantially lower than those for HFC projects. In these cases, it can be argued that the risks taken in investing in CDM projects (such as delivery risk, technology risk) need to be rewarded through a risk premium in the form of rents (see Chapter 6).

---

29 AAUs are traded over-the-counter only. AAU prices in 2009 were €8-10 per AAU. Source: World Bank (2009)
30 Including IEA/OECD, Oko-Institut, WWF estimates that around 20% of CDM projects are not additional. (http://assets.panda.org/downloads/cdm_report_wwf_background_paper.pdf/)
31 AEA (2009)
32 Victor and Wara (2008)

Finally, equity concerns have stemmed from the geographical distribution of CDM projects and their impact on sustainable development. Less than 1% of CDM projects have occurred in Least Developed Countries (Box 2.1). Moreover, some have argued that the most cost-effective projects have delivered limited additional social and environmental benefits.[33] Consequently, when considering the future of the CDM, the international community needs to determine more effective ways of delivering emissions reductions and providing significant development benefits for LDCs (see Chapter 6).

As well as concerns over offset credits, there are also important challenges surrounding the linking of CDM credits with ETSs in the developed world. On the one hand, developed countries need to demonstrate that they are taking significant action domestically and this can be guaranteed by setting import limits (supplementarity limits) on offset credits. On the other hand, credits have the advantage of reducing abatement costs while transferring substantial flows of finance to poorer countries. Used in this way, import limits appear to be an inefficient market intervention. The inclusion of offset credits into ETSs clearly involves some challenging trade-offs which will require careful design (see Chapter 5).

2.2.3 Transparency of trading

The efficiency of cap and trade systems depends on the ability of market participants to access relevant information. They need to know that they can find a buyer or seller, and they need to know the market price in order to make informed decisions about whether to abate or whether to trade in allowances. Transparency is therefore important in cap and trade systems.

Trading information has not been fully transparent in the current systems. Under the UNFCCC, AAU transactions are negotiated bilaterally between countries, and there is no obligation to reveal either the price or the volume traded, or even that a trade occurred. Similarly, at the ETS level, transactions can occur either on exchange markets or over-the-counter. In contrast to over-the-counter trades, exchange trades provide a transparent market price and volume, which helps participants to plan their trading and investment strategy more efficiently.

In addition, the lack of certainty over the future of the Kyoto Protocol and the longevity of ETSs as a policy tool to mitigate climate change has also had a negative impact, reducing participants' ability to make informed long-term investment decisions. Greater clarity on long-term national targets, together with the banking of allowances across commitment periods, should help to reduce price volatility.

33 Oko-Institut (2007)

3 LONG-TERM FRAMEWORK FOR CARBON TRADING

KEY MESSAGES

Global carbon trading should play a central role in delivering emissions reductions, realised cost effectively and achieved equitably between and within countries. This vision should be achieved through a dual-level system in which both governments and emitters participate.

At the government level, developed country governments should commit to national emissions reduction targets consistent with the goal of avoiding dangerous climate change.

At the emitter level, an emissions trading system should be one of the main policy tools used to meet national targets, alongside other domestic policies. This provides a carbon price signal which rewards low carbon businesses and technologies and reduces abatement costs through domestic carbon trading.

ETSs should be linked to form a global network of carbon trading. Linking ETSs can increase their liquidity and stability, and further reduce the cost of emissions reductions through international carbon trading.

Not all sectors in all countries will be suitable for inclusion in ETSs. Consequently, governments are likely to wish to continue to trade emissions allowances with each other in the long term to achieve their commitments as cost effectively as possible.

This dual-level system has potential advantages over a single-level system. It can cover all emissions sectors, respects the sovereignty of governments to choose instruments for reducing domestic emissions, increases cost-effectiveness and takes account of country-specific circumstances.

Global carbon trading could reduce global abatement costs by up to 70% in 2020 compared with countries and emitters meeting all their targets domestically. These efficiencies from carbon trading could allow governments to reduce global emissions by an additional 40-50%. Carbon trading can also provide significant financial benefits to developing countries through the sale of credits and surplus allowances.

Realising this long-term vision will be challenging. It will require a period of transition and a roadmap for: 1) the expansion and strengthening of national commitments; 2) developing a linked network of ETSs; 3) the participation of developing countries through intermediary mechanisms; and 4) strong and effective international institutions.

In the short and medium term, capacity building will be needed to ensure that developing country governments and other actors are well-prepared for participation in global carbon markets.

3.1 DUAL-LEVEL SYSTEM OF NATIONAL TARGETS AND ETSS

Global carbon trading should play a central role in delivering emissions reductions, realised cost effectively and achieved equitably between and within countries. This vision should be achieved through a dual-level system in which both governments and emitters participate.

The long-term goal of international climate change policy is a limit on the rise in global average temperature to below 2˚C.[1] This should be delivered through a global limit on greenhouse gas emissions based on science, realised cost effectively and achieved equitably across and within countries. Global carbon trading should play a central role in any framework to achieve these goals, alongside other policy tools.

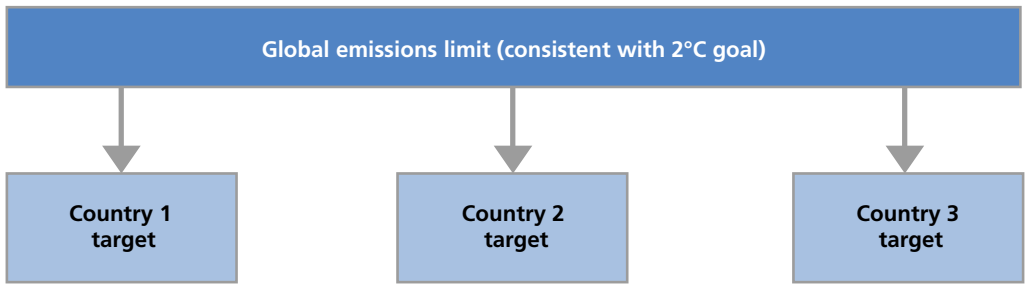
This vision should be achieved with a dual-level system in which both governments and emitters participate. Two levels of actor currently participate in carbon market mechanisms: 1) governments and 2) businesses and other emitters. While it would be theoretically possible for one international institution to directly regulate emitters through one global emissions trading system (ETS), in practice governments are likely to retain responsibility for committing to targets as well as sovereignty in choosing policy instruments for meeting them. Consequently, it is likely that the two points of obligation will continue to exist in global carbon markets. However, the more a country devolves responsibility for implementing its national target through an ETS (particularly one linked to other ETSs), the less the government will need to participate in global carbon trading.

3.1.1 National targets

At the government level, developed country governments should commit to national emissions reductions consistent with the goal of avoiding dangerous climate change.

The foundation for most carbon market activity is the emissions reduction targets committed to by governments. For most developed country governments, these national targets are agreed internationally under the United Nations. One country commits to reduce or limit its emissions commensurate with its responsibilities, capabilities and national circumstances in return for other countries making equivalent commitments. These national targets should reflect a global limit on greenhouse gas emissions based on science and consistent with the objective of limiting global warming to below 2˚C (see Figure 3.1). A comprehensive global limit on greenhouse gas emissions is necessary in order to provide a link between climate science and policy, give certainty of global environmental outcome and reduce global abatement costs.

Figure 3.1: Illustration of governments sharing responsibility for a global emissions limit



1 G8 Leaders' Declaration: Responsible Leadership for a Sustainable Future, 8 July 2009

The broader the coverage of sectors under national targets the more constrained global emissions will be. We therefore recommend that all domestic emissions sectors – power supply, industry, domestic transport, waste, buildings, agriculture and forestry – should be included under national caps (see Chapter 4 and Annex A for a discussion of domestic sectors as well as international aviation and shipping).

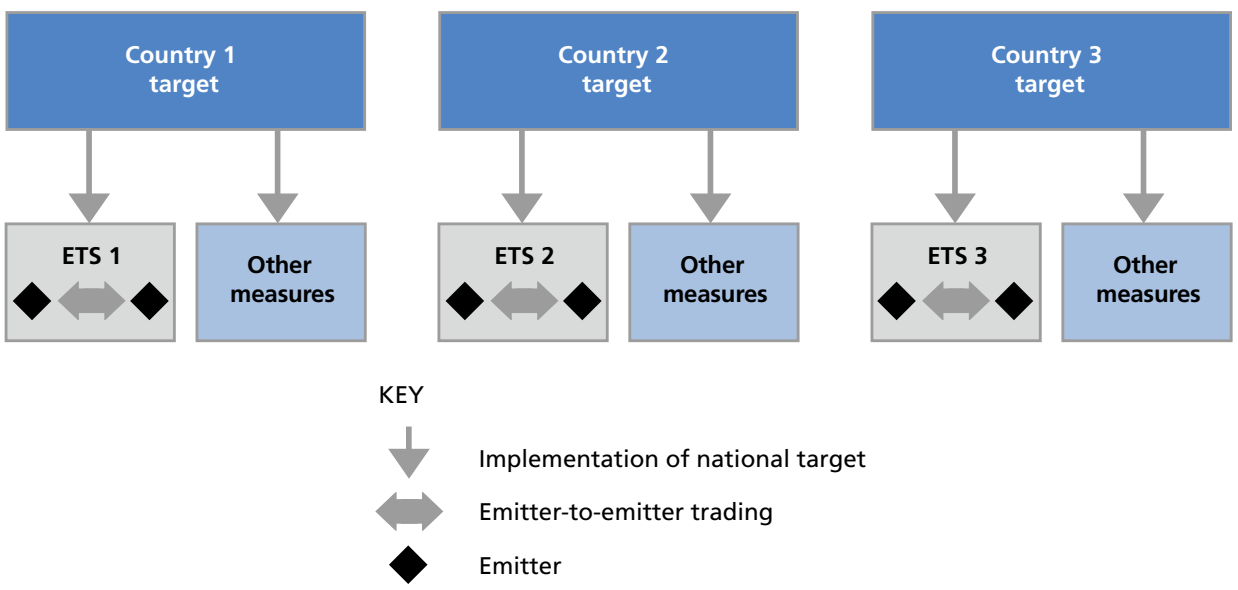
3.1.2 ETSs and other policy tools

At the emitter level, an emissions trading system should be one of the main policy tools used to meet national targets, alongside other domestic policies. This provides a carbon price signal which rewards low carbon businesses and technologies and reduces abatement costs through domestic carbon trading.

Once governments commit to national targets and are allocated emissions allowances, they must consider how best to reduce their emissions below the level of their allowances. Sovereign governments can choose between a number of different policy tools, including taxation, regulation, subsidies and an ETS (Figure 3.2). Countries will want to use a range of these domestic policy tools side by side, depending on country-specific circumstances. However, as set out in Chapter 1, an ETS should be one of the central policy tools used.

When countries with national targets create an ETS for certain sectors, they in effect devolve a proportion of their allowances to emitters.[2] These emitters are then responsible for ensuring they have sufficient allowances to cover all of their emissions. In this way a government gives responsibility to those who control emissions. The UN is not involved in creating or regulating ETSs.

Figure 3.2: Illustration of governments using policy instruments to meet their national targets



A number of choices need to be made when designing ETSs (such choices are also relevant in the design of government caps and international emissions trading under the Kyoto Protocol). Table 3.1 summarises some of the main design features to be considered. Some options are more effective, efficient and equitable than others. Table 3.1 sets out the leading options for each design feature and the supporting rationale.

2 In practice the allowances allocated to emitters need not come from the pool of allowances allocated to the government by the UN. A government can create its own type of allowance for its ETS.

Table 3.1: Design features for cap and trade mechanisms[3]

DESIGN FEATURE	LEADING OPTION	RATIONALE
Compliance period length	3-10 years	Too short a period provides little policy certainty and insufficient time to bring down emissions. It can increase volatility and limit longer-term price signals. Too long a period gives insufficient opportunity to reset caps in light of experience and take any necessary enforcement action. Indicating a range of potential emissions caps for future commitment periods can overcome some of the drawbacks of short commitment periods.
Allocation methodology	Auctioning	Minimises windfall profits to emitters
Banking rules	Banking permitted	Increases the depth and liquidity of the market, reducing price volatility if investors expect greater policy-induced scarcity of allowances in the future. Further, it frontloads abatement action by creating incentives for emitters to take early action to reduce emissions. Banking also creates a private sector group with a vested interest in stringent targets for future commitment periods. However, if significant over-allocation has occurred then banking can act to lock in 'hot air' over successive commitment periods.
Borrowing rules	Borrowing excluded between commitment periods	To ensure that targets are met – borrowing would allow emitters to put off action. They would also have a vested interest in weak targets in successive commitment periods. Further, there would be significant transaction costs for governments to assess the credit worthiness and solvency of emitters.
Price management	Price ceilings and floors should be avoided	Price ceilings could threaten environmental integrity by jeopardising compliance with emissions caps. Price floors could increase the cost of reaching a given target, which risks imposing a liability on the public balance sheet. Both interventions would create additional complexity for linking ETSs.
Liability	Effective enforcement of binding targets	To ensure the environmental integrity of the system.

3 For ETS design features see the background paper to this report: Fankhauser and Hepburn (2009)

Not all sectors in all countries will be suitable for inclusion in ETSs. When considering which sectors to include within an ETS there are several factors a government will need to take into account (see Table 3.2 and Annex A). These include:

1) **The likely effect of the carbon price signal on emitters.** To be efficient in reducing emissions overall, the market for carbon should be designed to include a wide range of participants whose abatement costs differ. The extent to which sectors are sensitive to carbon prices will affect their incentives to change behaviour and reduce emissions. Price sensitivity may be relatively low in some sectors and in particular countries for a number of reasons. For example, landlords have little incentive to insulate rented accommodation if the energy bills are paid for by tenants. Regulation is an alternative means of ensuring emissions reductions within a sector, though costs may differ compared with using a market mechanism.

2) **The concentration of emitters within the sector.** If there is a large number of small emitters in a sector, there are likely to be high transaction costs in setting caps, allocating allowances (if full auctioning is not initially adopted), monitoring performance and regulating trading. If the transaction costs are higher than the efficiency gains of trading, then the sector will probably be unsuitable for inclusion in an ETS. The concentration of emitters in a sector will differ from country to country. For example, in some countries, large areas of agricultural land are owned by a few large landowners, while in other countries land may be owned by hundreds of thousands of small farmers.

3) **The measuring and monitoring of emissions of emitters within the sector.** If the transaction costs of measuring and monitoring emissions accurately are higher than the efficiency gains of trading, then the sector is probably unsuitable for inclusion in an ETS. For example, it is more challenging to measure agricultural emissions than to measure power sector emissions. This is because of the diverse range and sources of greenhouse gases in the agricultural sector, as well as the large geographical area over which emissions are spread.

The importance of these factors in each sector will be heavily dependent on the point of obligation being considered. In the road transport sector, for example, the fuel which gives rise to greenhouse gas emissions on combustion is first extracted from the ground by an oil company, refined by a refinery, imported by a fuel importer, sold at petrol stations and combusted by vehicle owners. As there are far fewer fuel importers than there are car owners, choosing this point in the supply-demand chain as the point of obligation would lead to lower transaction costs.

Table 3.2: Important factors when considering inclusion of sectors in an ETS

SECTOR	POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
		Sensitivity to price signal	Concentration of emitters	Measuring emissions accurately
Power	Plant	Sensitive, although dampened to some extent by large subsidies to global fossil fuel industries	Concentrated	Low cost
Industry	Plant	Sensitive	Concentrated in heavy industry sub-sector; diffuse in light industry sub-sector	Low cost for heavy industry
Aviation	Fuel supplier/ operator	Sensitive	Concentrated if fuel suppler point of obligation chosen; less concentrated for operator point of obligation	Low cost (assuming good availability of fuel use data)
Shipping	Fuel supplier/ operator	Insensitive at lower carbon prices due to small contribution of shipping costs to total price of goods	Concentrated if fuel supplier point of obligation is chosen; diffuse for operator point of obligation	Low cost (assuming good availability of fuel use data)
Surface transport	Fuel supplier	Sensitive in the longer term with a sustained price signal. Shorter-term sensitivity requires a relatively high carbon price	Concentrated	Low cost
Buildings	Fuel supplier (but downstream measures may also be necessary)	Sensitive, apart for in the rented sector due to the principal-agent problem and also for some energy-efficiency measures (due to high capital cost requirements)	Concentrated at fuel supplier point of obligation; very diffuse at building-level point of obligation	Low cost at fuel supplier point of obligation
Waste	Plant	Sensitive	Concentrated	Complex and high cost
Forestry	Landholder	Sensitive (assuming sufficient private freehold or leasehold ownership)	Diffuse in some countries, more concentrated in others	Complex. Costs increase when emitters are diffuse
Agriculture	Hybrid (chemical or food processors; possible opt-in for large farms)	Relatively insensitive because extensive subsidies in the sector dampen the price signal	Diffuse	Complex MRV, leading to potentially high transaction costs

See Annex A for more details on each of the nine sectors.

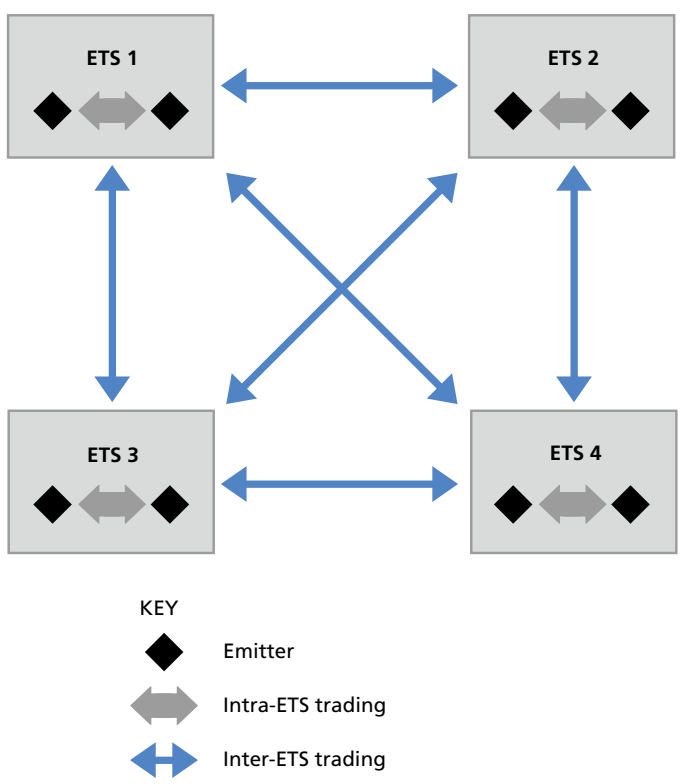
3.1.3 Linking emissions trading systems

ETSs should be linked to form a global network of carbon trading. Linking ETSs can increase their liquidity and stability, and further reduce the cost of emissions reductions through international carbon trading.

One option for expanding carbon trading would be to set up a single global emissions trading system with centralised governance. However, this approach has a number of disadvantages. It would reduce sovereignty over domestic policies and would be challenging to negotiate multilaterally. Instead, this report recommends a dual-level approach. The government level provides a framework for countries to sign up to and meet emissions targets, and to allow trade between countries in respect of sectors that cannot be delegated to ETSs cost effectively. Governments should then be responsible for domestic policy tools, including the operation of a domestic ETS at the emitter level.

Once a government has devolved a proportion of its emissions allowances to emitters through an ETS, further benefits can be gained by linking up this ETS with those in other countries (Figure 3.3). This allows emitters in one country to trade allowances with emitters in other countries. The increased number of participants (and therefore trading) within the linked market brings greater liquidity and price stability. Most importantly, linking ETSs to enable international trade in allowances can dramatically reduce the overall abatement costs, enabling governments and emitters to take on more stringent targets as a result of the cost savings. See Chapter 5 for a quantification of the cost savings from linking ETSs.

Figure 3.3: Illustration of a linked network of ETSs



The choice of design features for an ETS (some of which are set out in Table 3.1) can have a large bearing on how easily ETSs can be linked together. These and other ETS design features, and their potential impact on the prospect of linking, are considered in Chapter 5 and a background paper to this report.[4]

4 Fankhauser and Hepburn (2009)

3.1.4 Government-level emissions trading

Not all sectors in all countries will be suitable for inclusion in ETSs. Consequently, governments are likely to wish to continue to trade emissions allowances with each other in the long term to achieve their commitments as cost effectively as possible.

A government is unlikely to rely solely on an ETS to reduce its emissions. One reason for this is that an ETS is less suitable for use in some sectors than others (see Section 3.1.2). Another reason is that while an ETS can deliver an environmental outcome cost effectively in the short term, its carbon price may not be sufficiently high to incentivise research, development and deployment of technologies such as carbon capture and storage or nuclear fusion which, while perhaps costly or unproven in the short term, may be the most effective and efficient means of tackling climate change in the longer term (see Chapter 1). Other types of policy instrument are also likely to be more effective than an ETS at delivering the necessary structural changes in an economy to unlock the potential of low carbon technologies. An example of this is the need for a smart energy grid, which is an important part of developing renewable energies.

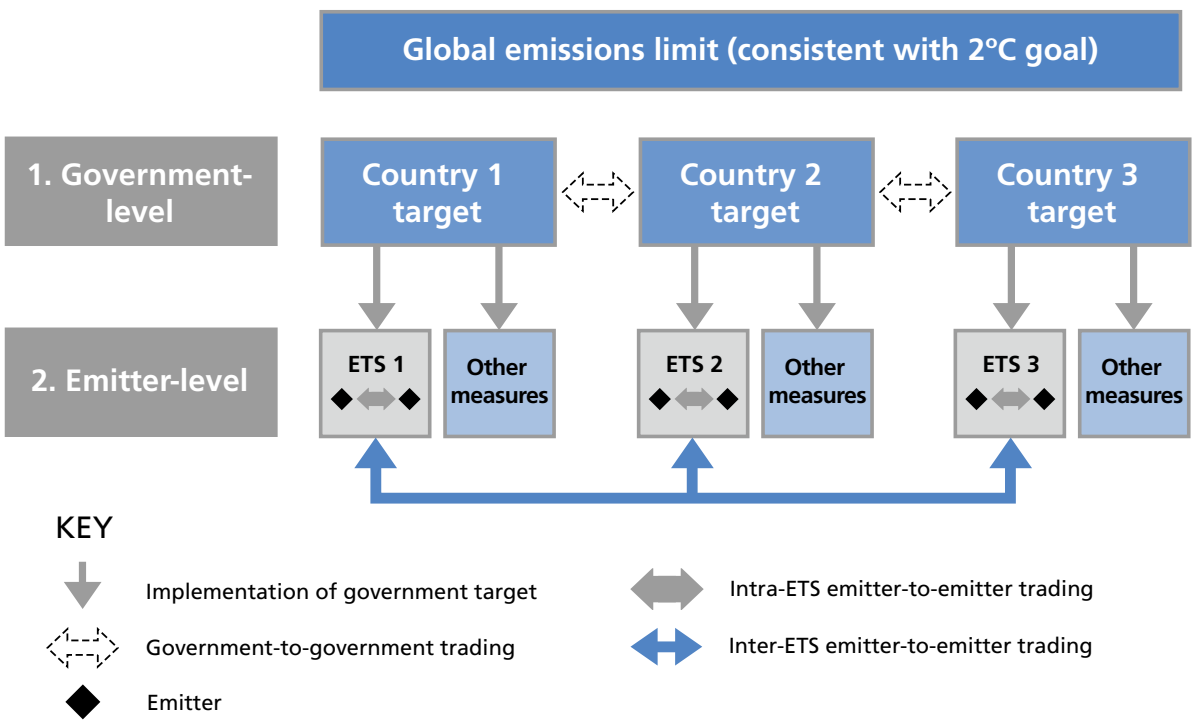
Consequently, most governments are likely to choose a portfolio of policy instruments to bring down their emissions and so meet their national targets, with an ETS forming the backbone to this policy mix. This is already the case for EU Member States, who not only participate in the EU ETS but also levy carbon taxes, subsidise low carbon technologies and regulate high carbon products and processes. This portfolio of policies is used not only with respect to the 60% of emissions in the EU's non-traded sector, but also in respect of the traded sector.

The use of policy tools other than ETSs to implement national targets will mean that governments may wish to continue to trade emissions allowances with each other in the long term. This will enable the advantages of trading to apply across all sectors, not just those included under an ETS. This can further reduce abatement costs for countries, enabling them to adopt more stringent targets as a result. This leads to the dual-level system of carbon trading illustrated in Figure 3.4.

Trading of government allowances is already permitted under Article 17 of the Kyoto Protocol and is known as international emissions trading (IET). It is governed by the United Nations. The previous chapter shows how an excessive number of allowances were allocated to governments in respect of the Kyoto Protocol's first commitment period. This has led to reluctance among some countries to buy or sell government allowances in the short term. The UK government has decided to cancel the surplus AAUs corresponding to the difference between its Kyoto target and more challenging domestic carbon budgets in order to meet a more stringent national target.[5] In order for government-to-government trading of allowances to fulfil its potential to help limit costs in the longer term, government targets should be substantially more stringent in future commitment periods.

5 Climate Change Act 2008

Figure 3.4: A dual system of cap and trade



3.2 BENEFITS OF GLOBAL CARBON TRADING

3.2.1 The benefits of a dual-level system

This dual-level system has potential advantages over a single-level system. It can cover all emissions sectors, respects the sovereignty of governments to choose instruments for reducing domestic emissions, increases cost-effectiveness and takes account of country-specific circumstances.

A dual system of cap and trade would be more effective and efficient than a single-level system. If trading existed only at the government level, the small number of actors involved would give rise to a fairly illiquid market with a weak carbon price signal. Further, sole responsibility for choosing mitigation measures would rest with government, when it is in fact the emitters directly responsible for greenhouse gas emissions that are best placed to reduce them most efficiently.

On the other hand, if trading occurred only at the emitter level, through ETSs, the carbon market would not cover all emissions sectors (see Section 3.1.2). Consequently, some sectors would escape caps and some low-cost abatement opportunities would be unavailable for trading, leading to an increase in global abatement costs. We have also seen that ETSs alone are unlikely to bring about the low carbon technologies of the future that we need.

In summary, a dual-level system can cover all emissions sectors, respects the sovereignty of governments to choose instruments for reducing domestic emissions, increases cost-effectiveness and takes account of country-specific circumstances. Nonetheless, the more allowances devolved to the emitter level through an ETS (particularly one linked to other ETSs), the more effective and efficient the system will be, and the less that governments will need to participate in global carbon trading.

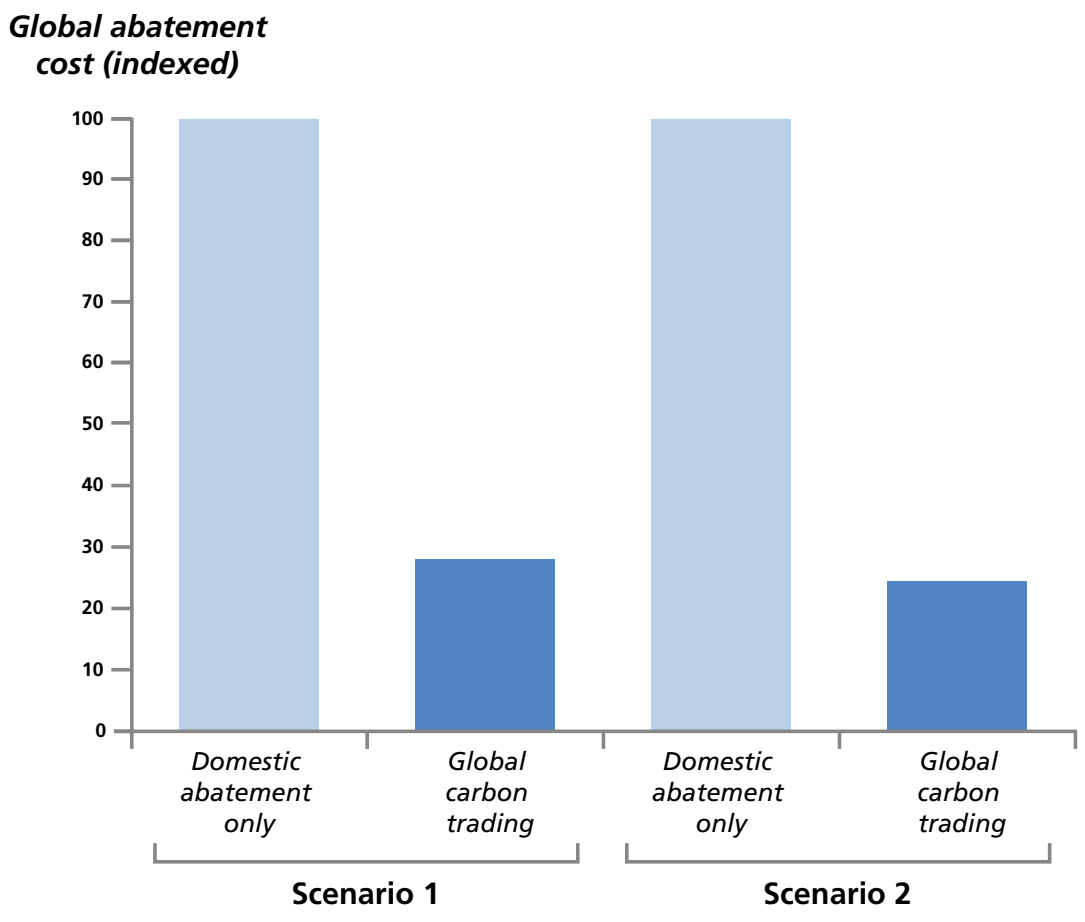
The dual system of cap and trade set out in this report differs from the current framework in several key respects: the number of countries and sectors that participate; the stringency of targets; the design of the mechanisms' component features; the number of ETSs; the amount of linkage (and therefore trading) between different ETSs; and how these carbon market mechanisms are governed.

3.2.2 Modelling the benefits of global carbon trading

Global carbon trading could reduce global abatement costs by up to 70% in 2020 compared with countries and emitters meeting all their targets domestically. These efficiencies from carbon trading could allow governments to reduce global emissions by an additional 40-50%. Carbon trading can also provide significant financial benefits to developing countries through the sale of credits and surplus allowances.

Modelling for this report suggests that international trading of allowances and credits by emitters and governments could reduce global abatement costs by up to 70% in 2020, compared with a scenario where governments and business and other emitters in ETSs could only meet their targets through domestic abatement (see Figure 3.5).[6] Previous modelling by the European Commission has suggested that carbon trading could reduce global abatement costs by around 30-50% in 2020.[7]

Figure 3.5: Global abatement costs – global carbon trading versus domestic abatement only



Source: GLOCAF modelling for this report

All these results show that the trading element of a cap and trade mechanism is a very important factor in minimising global abatement costs. This in turn is important if the world is going to be able to limit global warming to around 2˚C, because the efficiencies resulting from global carbon trading can be used by developed and advanced developing country governments to take on more ambitious targets earlier than would have been the case with less extensive trading. The scenarios modelled above for 2020 suggest that the efficiencies resulting from global carbon

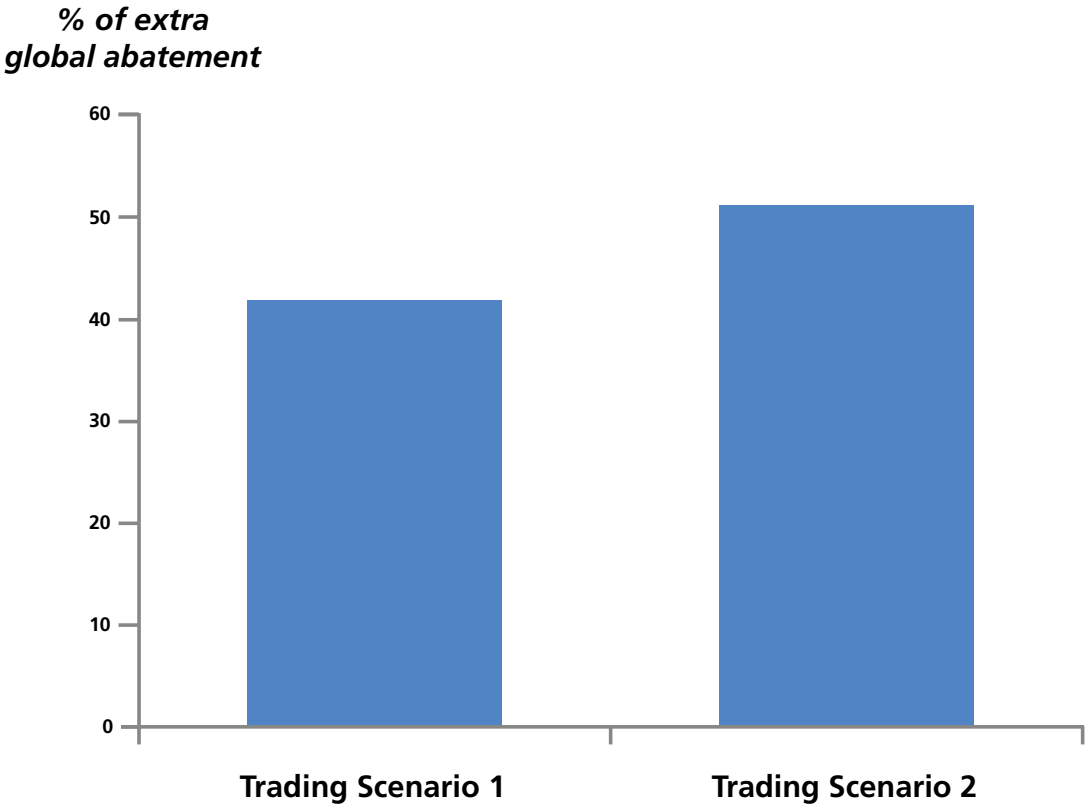
6 GLOCAF modelling (see Annex D). Two scenarios were used. In the first scenario, Annex I countries as a whole reduced emissions to 25% below 1990 levels by 2020, and developing countries as a whole reduced emissions by 18% relative to BAU. The second scenario was a very low ambition scenario and used for sensitivity analysis. In this scenario Annex I countries as a whole reduced emissions by only 13% below 1990 levels and developing countries did not participate in sectoral mechanisms, only in CDM. The costs of domestic abatement only in Scenario 1 were around two and a half times greater than in Scenario 2. Consequently, the gross savings from global carbon trading were much greater in Scenario 1.

7 Russ et al (2009)

trading could allow governments to reduce global emissions by an additional 40-50% at no extra cost compared to a scenario with domestic abatement alone (see Figure 3.6).[8]

As well as being effective and efficient, cap and trade systems can be designed to be equitable through fair distribution of national targets, commensurate with countries' responsibilities, capabilities and national circumstances. Global carbon trading can also provide significant financial benefits to developing countries through the sale of credits and surplus allowances (see Chapter 6).

Figure 3.6: Additional abatement available through global carbon trading



Source: GLOCAF modelling for this report

3.3 TRANSITION TO THE LONG-TERM FRAMEWORK

Realising this long-term framework will be challenging. It will require a period of transition and a roadmap for: 1) the expansion and strengthening of national commitments; 2) developing a linked network of ETSs; 3) the participation of developing countries through intermediary mechanisms; and 4) strong and effective international institutions.

In the short and medium term, capacity building will be needed to ensure that developing country governments and other actors are well-prepared for participation in global carbon markets.

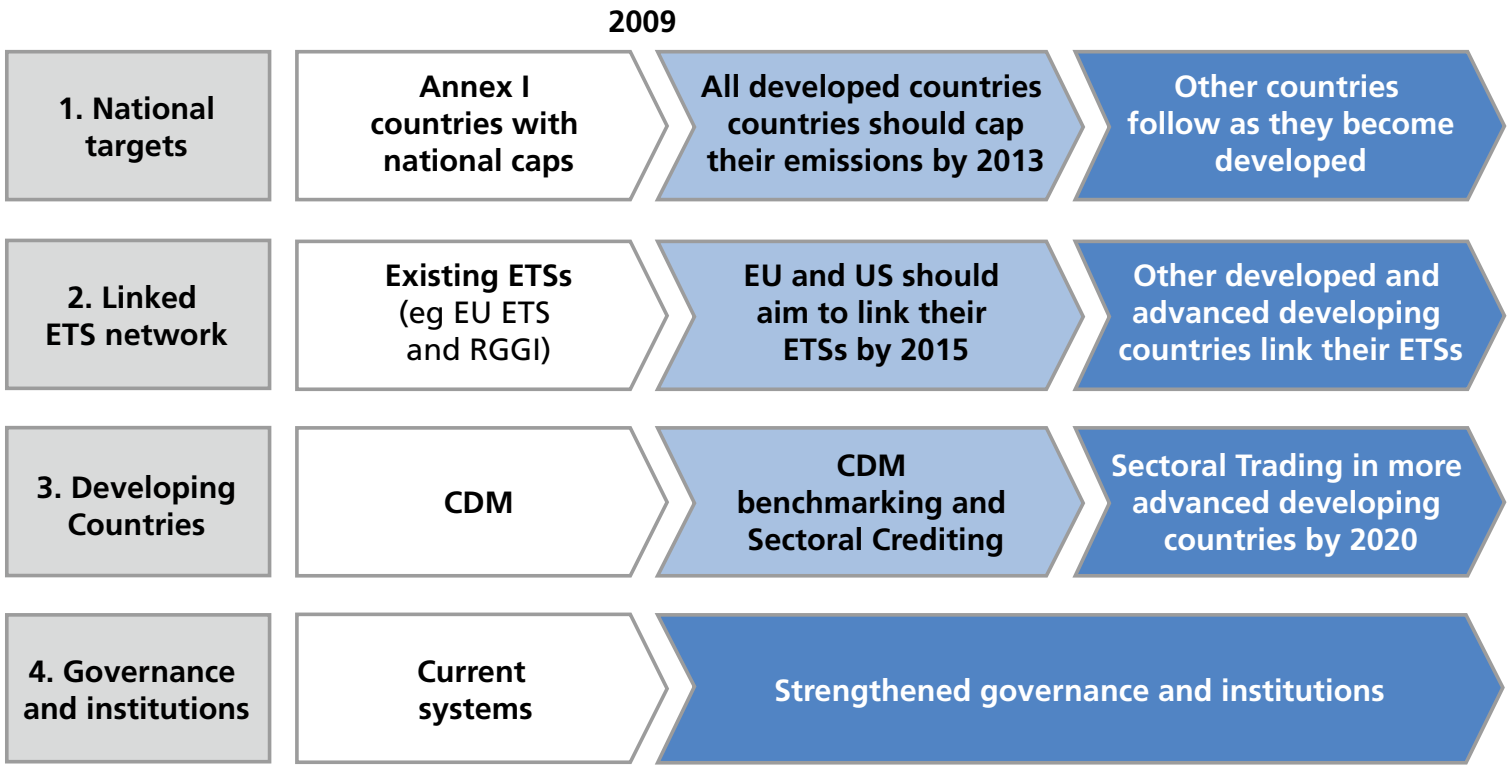
Reaching the long-term framework described in this chapter will be challenging. A clear direction is required for the transition, which will need to cover four broad elements: 1) expanding and strengthening national targets; 2) creating and linking ETSs; 3) enhancing developing countries' access to carbon trading; and 4) developing strong governance and institutions.

This roadmap includes several important milestones (see Figure 3.7). First, all developed countries should aim to cap their emissions by 2013. Developed countries will need to reduce their emissions by at least 25-40% below 1990 levels by 2020 (see Chapter 4), and developing countries as a

8 GLOCAF modelling (see Annex D). The same two scenarios were used here as for the global abatement costs modelling set out in Figure 3.5. For reasons set out in footnote 6 above, the gross amount of extra abatement set out in Figure 3.6 was much greater for Trading Scenario 1 than for Trading Scenario 2.

group will need to deviate by 15-30% below business as usual emissions. Second, the EU and US should aim to link their ETSs by 2015 (see Chapter 5). Third, new sectoral carbon trading systems will need to be established by 2020 at the latest to allow the more economically advanced developing countries to access finance and reduce emissions cost-effectively in their power sectors, and potentially in some other sectors that use a lot of energy such as cement, aluminium and iron and steel (see Chapter 6). Achieving these milestones will require the strengthening of international institutions, which is considered in Chapter 7 of this report. And in the short and medium term, capacity building will be needed to prepare developing countries and other actors for participation in global carbon markets (see Chapter 8).

Figure 3.7: Roadmap for the development and expansion of global carbon trading



3.4 RECOMMENDATIONS

- A dual level system of carbon trading should play a central role in delivering emissions reductions. At the government level, national caps should ensure governments take responsibility for limiting emissions. At the emitter level, emissions trading systems should cap emissions and trade allowances.
- A global carbon market should be developed as a network of linked ETSs rather than a single global emissions trading system.
- Cap and trade should complement other policy tools, including regulation, taxation and subsidies, to provide a comprehensive approach for moving rapidly to a low carbon economy.

4 NATIONAL TARGETS IN DEVELOPED COUNTRIES

KEY MESSAGES

Broader coverage of national targets is necessary, capping emissions from all developed countries by 2013.

Commitments to national targets by developed countries should cover emissions from all domestic sectors, including power supply, industry, forestry, agriculture, domestic transport, buildings and waste.

Sequestration of CO_2 through carbon capture and storage of emissions, for example from power and industry sectors, should be recognised as a mitigation action and accounted for in national inventories.

The international aviation and shipping sectors should each be capped through dedicated transnational systems.

National targets need to be more stringent and in line with science. The IPCC recommends emissions reductions for developed countries of 25-40% below 1990 levels by 2020.

During the transition, an important challenge will be to deal with excessive surpluses (of AAUs) generated as a result of loose targets. Given the over-allocation of AAUs under Kyoto, developed countries should commit to cancelling a substantial proportion of their surplus AAUs.

The UK Government has decided to cancel the surplus AAUs corresponding to the difference between its Kyoto target and domestic goals in order to meet a more stringent national target.

4.1 EXTENDING COVERAGE OF NATIONAL TARGETS

4.1.1 Developed countries with national targets

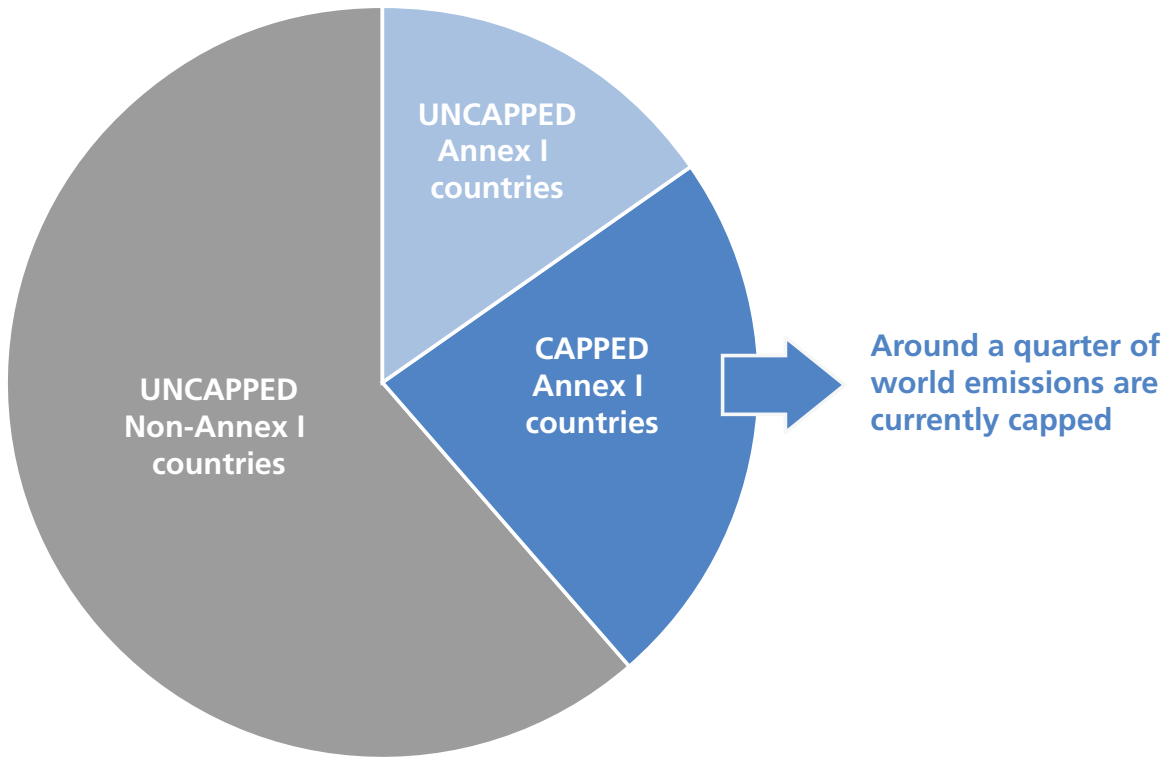
Broader coverage of national targets is necessary, capping emissions from all developed countries by 2013.

As discussed in previous chapters, a global limit based on the most up to date science should form the basis for national targets. Sovereign governments should then be free to choose which policies they put in place to meet these targets. With binding national targets, countries are more likely to implement credible domestic climate change policies,[1] such as emissions trading systems (ETSs).

1 Some notable examples exist. EU ETS targets go further than internationally negotiated targets for Europe, due to European political pressure to reduce emissions. However this pressure arguably only exists in a small number of developed countries, so in aggregate a global agreement is likely to reduce emissions by more.

Currently, caps on Annex I countries cover less than half of global emissions. Furthermore, not all Annex I countries have ratified the Kyoto Protocol, which means that only around a quarter of global emissions are currently capped under the UNFCCC (see Figure 4.1).[2] The number of countries taking on national targets should therefore be extended: this report recommends that all developed countries should take on national targets by 2013 as part of a global deal post-2012.

Figure 4.1: Coverage of caps under current global carbon market (2008-2012)



Note: Based on 2005 emissions, 28% of world emissions were capped under international emissions trading. 2010 estimates suggest that the proportion of non-Annex I countries' emissions will increase between 2005 and 2010, leading to a decrease of the proportion of capped emissions to 23%.

Source: 2010 emission data from GLOCAF (see Annex D)

4.1.2 Sectoral coverage at national level

Commitments to national targets by developed countries should cover emissions from all domestic sectors, including power supply, industry, forestry, agriculture, domestic transport, buildings and waste.

Sequestration of CO_2 through carbon capture and storage of emissions, for example from power and industry sectors, should be recognised as a mitigation action and accounted for in national inventories.

The international aviation and shipping sectors should each be capped through dedicated transnational systems.

In order to prevent dangerous climate change, action will be needed to reduce emissions from all sectors. Consequently, all domestic sectors – power supply, industry, forestry, agriculture, domestic transport (including domestic aviation), buildings and waste – should be included under national caps (see Annex A). Emissions from international sectors such as international aviation and shipping also need to be addressed. Accurate measurement of emissions from all sectors will be important. Common standards should be agreed and adopted by all countries, as the current range of national monitoring methods may pose a risk to the consistency of targets.[3] Strengthening

2 2010 emissions data from GLOCAF (see Annex D)
3 See for example 2006 IPCC Guidelines for National Greenhouse Gas Inventories

of measuring, reporting and verification (MRV) mechanisms of emissions in some sectors will also be needed. Annex A sets out various characteristics of the major emitting sectors and areas where improvements could be made. Some particular issues for specific sectors include:

- **Carbon capture and storage (CCS) in power and industry sectors.** CCS is expected to provide a significant abatement option in the power and industry sectors, as many countries are likely to continue to rely on fossil fuel use. Captured and stored CO_2 is already counted in national inventories (for example, Norway's Sleipner storage reservoir) and CCS will be a valid abatement option in Phase III of the EU ETS. This report therefore recommends that abatement from CCS should count towards national inventories and targets, to incentivise its future development. CCS should be included in developed country ETSs (see Chapter 5) and in developing countries emissions reductions policies (see Chapter 6). As discussed in Chapter 1, the demonstration and development of CCS will require a range of policy tools, including government grants. A number of projects to demonstrate CCS at large (near-commercial) scale are already under development.
- **Agriculture.** Emissions from agriculture are problematic because of high levels of uncertainty in measuring emissions. Although methodologies have improved, additional research could reduce uncertainties in areas such as measuring carbon emissions from soil. This is an important issue for countries with extensive land areas, where aggregate carbon flux from soil can form a significant share of total emissions. To reduce uncertainties, the use of comparable measurement methodologies across time along with yearly data collection is the best option.
- **Waste.** The uncertainties around methane production rates in the waste sector need to be reduced. In addition improvements need to be made in the collection of emissions data, especially in the wastewater sub-sector.
- **Forestry.** Emissions from the forestry sector can be estimated accurately and transparently at the national level, aided by satellite images.[4] Annex I countries are currently required to account for carbon stock changes resulting from the effect of changes in land use. Carbon stock changes from forestation, reforestation and deforestation since 1990 must be accounted for. In addition, countries can currently opt to account for carbon stock changes resulting from pre-1990 'forest management' activities. Accounting for carbon stock changes is currently problematic, given the challenge of distinguishing between anthropogenic and non-anthropogenic (particularly natural sink) effects. The IPCC has proposed methodologies to better distinguish between the two, and further work is ongoing. It is important that the international community improves this aspect of forestry emissions accounting. Furthermore, all countries should follow the 2006 IPPC guidelines in compiling national emissions inventories.
- **International aviation and shipping.** Emissions from the international aviation and shipping sectors should be addressed with dedicated transnational caps for a number of reasons. Firstly, emissions from these sectors occur largely within international territory, which makes it difficult to follow the accounting principles of the UNFCCC that provide that each country should be responsible for emissions occurring within its own territory.[5] Secondly, consistent treatment of entities within each sector will help to avoid the transfer of business between entities that are covered in a global system to entities that are not covered by a partial system. For instance, this might occur through a shift of passengers/freight from Annex I airlines to non-Annex I airlines operating the same routes (in a system addressing emissions from Annex I airlines only). Thirdly, shipping is particularly vulnerable to the problem of 'reflagging' whereby a ship can be rapidly re-registered under the flag of a party not covered by a partial scheme. And lastly,

4 Eliasch (2008)
5 Haites (2008)

transnational mechanisms will ensure institutional consistency with the current framework, in which civil aviation and shipping are overseen by specialised UN agencies (International Civil Aviation Organization and International Maritime Organization).

4.2 STRINGENT TARGETS

4.2.1 More ambitious targets

National targets need to be more stringent and in line with science. The IPCC recommends that emissions reductions for developed countries should be 25-40% below 1990 levels by 2020.

As well as having a greater coverage across countries, legally-binding national targets need to be more stringent and in line with science. This needs to be a central aim of international negotiations. The IPCC recommends that emissions for developed countries should be reduced by 25-40% below 1990 levels by 2020 and by 80-95% by 2050.[6] Some developed countries have already committed to this level of abatement. The EU has committed to a 30% reduction by 2020 if a global deal is agreed. However, other developed countries have made no commitment, or commitments that fall below the level needed. Overall, as a group, developed countries have committed to reductions of around 7-9% relative to 1990 levels. Clearly, countries need to go substantially further if a global limit on emissions is to be achieved in line with science. In addition, the IPCC has stated that emissions will need to be reduced by developing countries as a group by 15-30% below business as usual emissions by 2020[7] (see Chapter 6).

4.2.2 Dealing with loose targets of the past

During the transition, an important challenge will be to deal with excessive surpluses (of AAUs) generated as a result of loose targets. Given the over-allocation of AAUs under Kyoto, developed countries should commit to cancelling a substantial proportion of their surplus AAUs.

The UK Government has decided to cancel the surplus AAUs corresponding to the difference between its Kyoto target and domestic goals in order to meet a more stringent national target.

Legally-binding caps on Annex I countries under Kyoto are projected to result in reductions of emissions of 4.7% per year on average or a reduction of around 0.6 $GtCO_2e$ per year relative to 1990 levels between 2008 and 2012.[8] However, some Annex I countries have targets that are significantly above their actual emissions and this results in excessive surpluses of AAUs. The overall surplus of AAUs is expected to be between 7 and 10 $GtCO_2e$ over the period 2008-12[9] (see Figure 4.2). An important challenge will be to deal with this surplus in the short to medium term.

One way of dealing with excessive surpluses of AAUs would be to amend Article 3(13) of the Kyoto Protocol which allows for banking of allowances.[10] Agreement could be sought that banking be either restricted or prohibited for a defined period of time.

---

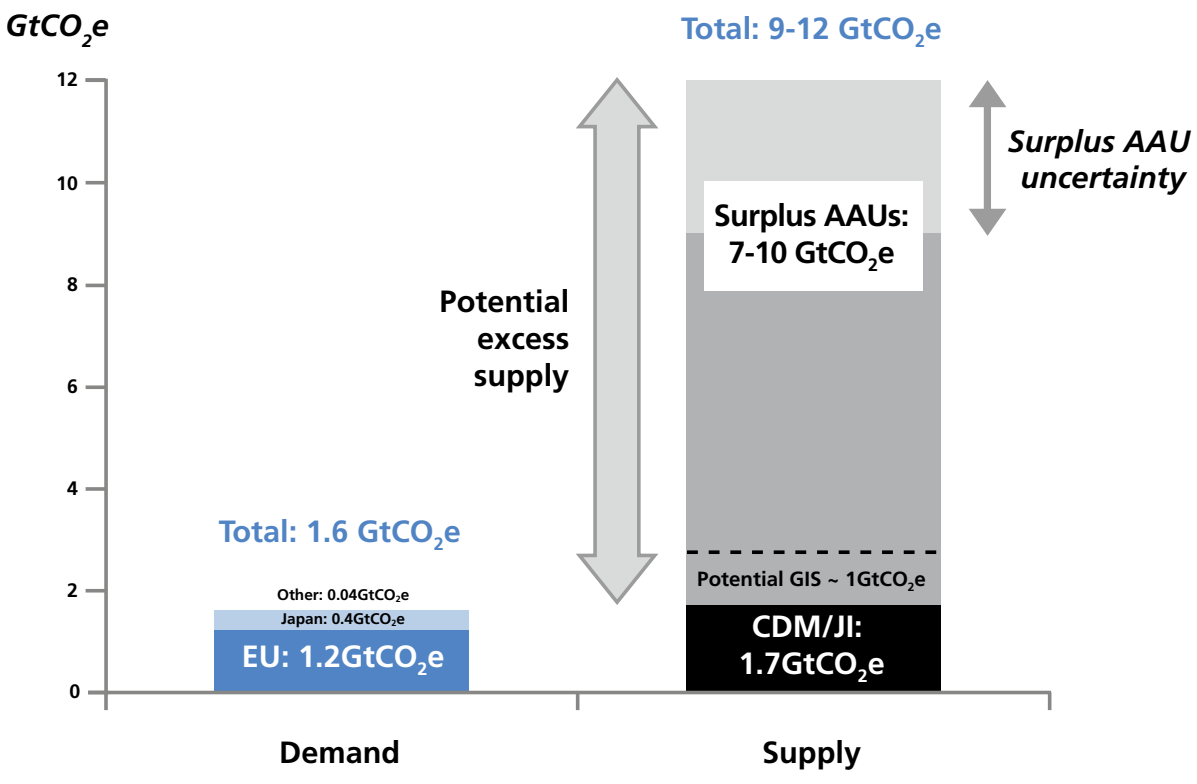
6 IPCC (2007) AR4 Box 13.7, p776
7 den Elzen and Höhne (2009); European Commission (2009); DECC (2009)
8 UNFCCC (2008) Table 4, p10
9 World Bank (2009)
10 Article 3(13) of the Kyoto Protocol states that 'If the emissions of a Party included in Annex I in a commitment period are less than its assigned amount under this Article, this difference shall, on request of that Party, be added to the assigned amount for that Party for subsequent commitment periods.'

A second option would be for countries to voluntarily cancel any surpluses of allowances to demonstrate a commitment to reducing emissions. For example, the UK Government has decided to cancel the surplus AAUs corresponding to the difference between its Kyoto target and domestic goals in order to meet a more stringent national target.

A third option would be for buyer countries to limit the number of AAUs that they buy. As an alternative, countries could buy credits from developing countries.

Lastly, countries with excessive surpluses could sell AAUs while providing the buyer with an assurance that the proceeds will contribute to agreed low carbon projects and programmes through Green Investment Schemes (GIS).[11] GIS can improve the credibility of surplus AAU trades, but only if it is systematically measured and verified, in the way that Joint Implementation credits are tracked. The World Bank estimates that the potential for GIS AAUs is around 1 $GtCO_2e$ by 2012.[12] As a result, because buyers may wish to buy GIS AAUs and because interest in AAU trading may remain limited as long as post-2012 rules are unclear, the total AAUs surplus is unlikely to enter the market.

Figure 4.2: Supply and demand of allowances and credits over the compliance period 2008-2012



Source: World Bank (2009) and Point Carbon (2009)

4.3 RECOMMENDATIONS

- All developed countries should aim to cap their emissions by 2013.
- All domestic sectors – power supply, industry, domestic transport, waste, agriculture and forestry – should be included under national targets.
- International aviation and shipping sectors should each have a dedicated transnational system to cap emissions.
- National caps should be made more stringent in line with science. The EU has stated that developed countries as a group should commit to emissions reductions of at least 25-40% by 2020.
- Given the over-allocation of AAUs under Kyoto, developed countries should commit to cancelling a substantial proportion of their surplus AAUs.

11 World Bank (2009) p56
12 World Bank (2009)

5 EMISSIONS TRADING

KEY MESSAGES

Mandatory emissions trading systems (ETSs) are currently limited to the EU ETS and certain US states. However, ETSs are planned in other countries which could result in the coverage of 17-35% of global emissions by 2015.

Linking ETSs would provide substantial benefits. It would aid international cooperation on emissions reductions by aligning the interests of different nations, reduce price volatility and address competitiveness concerns.

Modelling shows that linking two ETSs bilaterally could potentially reduce short-term costs across the two systems by 30-50%. Linking all OECD countries could reduce overall costs by between 25-55%. Under one scenario, this could lead to one gigatonne of extra emissions reductions at the same cost.

A network of ETSs should develop as systems expand and link through bilateral agreements. If well designed and coordinated, many planned ETSs could link up with each other over the next decade.

Linking the EU ETS with a federal US system should be a priority. Linking by 2015 would be ambitious but achievable. This would increase liquidity and stability of both the EU ETS and a new US emissions market, and result in the coverage of between 13 and 27% of global emissions. It would also provide leadership and momentum as well as long-term cost reductions.

Different design features are already emerging in ETS proposals in different OECD countries to reflect country-specific circumstances. However, four major design features will need to be coordinated so that ETSs can benefit from the huge gains available from linking.

1) **ETSs should ensure that monitoring, reporting, verification, compliance and enforcement mechanisms are effective, credible and trusted by other ETS authorities.**
2) **Coordinating import limits on international credits entering ETSs can ensure the proper functioning of the linked markets.**
3) **Unlimited banking and limited borrowing of emission allowances should be allowed in all systems so that linking does not undermine their integrity.**
4) **Price floors and ceilings in ETSs should be avoided.**

A notice period of several years should be provided prior to linking ETSs to allow time to negotiate common standards, give emitters and investors time to prepare, and smooth the convergence of prices in different systems.

Trading at the government level should help reduce emissions cost effectively in sectors where an ETS is not the most suitable tool to drive reductions.

5.1 COVERAGE OF EMISSIONS TRADING SYSTEMS

Mandatory emissions trading systems are currently limited to the EU ETS and certain US states. However, ETSs are planned in other countries which could result in the coverage of 17 to 35% of global emissions by 2015.

Countries need to determine the most appropriate domestic policy tools to meet their targets. As set out in Chapter 3, countries will wish to use a range of policy tools depending on country-specific circumstances. One of these tools, and one that should play a central role in many countries, is an emissions trading system (ETS). An ETS provides a carbon price that rewards low carbon businesses and technologies, and reduces abatement costs through domestic carbon trading. This chapter examines the benefits of linking ETSs internationally and sets out how an effective network of linked ETSs could grow around the world over the next decade. The coordination of ETS design features will be important during this transitional process to ensure that linking is successful. The chapter also sets out the circumstances under which trading should take place at the government level as part of a dual-level system of carbon trading.

Many ETSs have been proposed, but the only mandatory systems already operating are the European Union Emissions Trading Scheme (EU ETS) and the Regional Greenhouse Gas Initiative (RGGI) in the US. The EU ETS, set up in 2005, currently covers power and heavy industry sectors which make up around 40% of the EU's total greenhouse gas emissions.[1] The RGGI, set up in 2008, covers the power sector of ten eastern US states. These systems together cover around 6% of global emissions.[2] Furthermore, at the time of writing, the US ETS proposed in the Waxman-Markey Bill would cover around 80% of US emissions.[3]

Increasing the number of countries with ETSs and including more greenhouse gases is the first step towards an ETS network. Thereafter systems should be linked to allow more liquid and efficient global carbon trading between emitters in different countries and systems.

Most countries in the OECD have proposed emissions trading systems to reduce their emissions (see Figure 5.1 and Annex E). Recently, the new US administration has stated its intention to create a federal ETS. If systems were set up in North America (US, Canada and Mexico), Japan and Oceania (Australia and New Zealand) in addition to the EU ETS, coverage of global emissions could be between 17 and 35% by 2015. The lower figure assumes that the ETSs would cover half of the regions' emissions. The higher figure assumes that the ETSs would cover emissions from all sectors.[4]

---

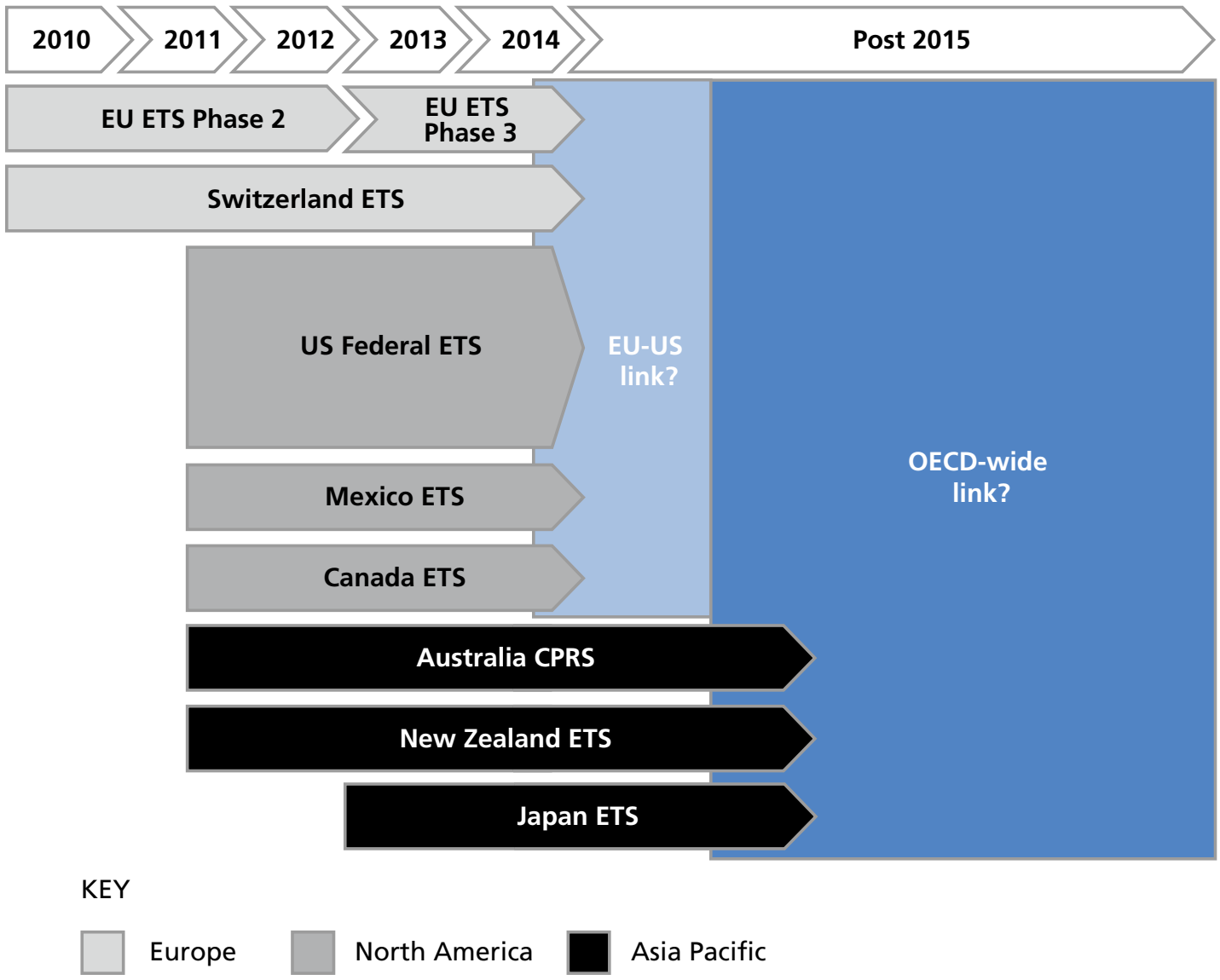
1 Pew Centre (2009)

2 In 2009 the RGGI covered 188 million short tons of carbon dioxide (RGGI, 2009) or about 207 million metric tonnes ($MtCO_2e$) whilst the EU ETS covered the equivalent of about 2 billion metric tonnes ($GtCO_2e$) in 2008. This would total around 2.2 $GtCO_2e$, which would be equivalent to around 6% of the total emitted globally in 2005 (using emission data from POLES, DIMA and IMAGE, see Annex D).

3 Pew Centre (2009)

4 Emissions data from POLES, DIMA and IMAGE (see Annex D)

Figure 5.1: Growth of national and regional emissions trading systems



5.2 A NETWORK OF LINKED ETSs

5.2.1 Benefits and cost savings from linking

Linking ETSs would provide substantial benefits. It would aid international cooperation on emissions reductions by aligning the interests of different nations, reduce price volatility and address competitiveness concerns.

Modelling shows that linking two ETSs bilaterally could reduce costs across the two trading systems by 30-50%. Linking all OECD countries could reduce overall costs by 25-55%. Under one scenario, this could lead to one gigatonne of extra emissions reductions at the same cost.

As Chapter 3 set out, international trading can substantially reduce the costs of meeting a global limit on emissions consistent with limiting global average temperature rise to below 2˚C.[5] Linking ETSs internationally should also deliver several additional benefits:

- aiding cooperation between nations by aligning their interests through similar responses, making positive international negotiations more likely;
- strengthening the market, making it deeper, more liquid and more stable, and thereby making it more robust as a policy response to climate change;[6]

5 Fankhauser and Hepburn (2009)
6 Edenhofer, Flachsland and Marschinki (2007)

- making the price signal to investors more predictable, as a larger system with many countries and emitters is more likely to continue longer term, and less likely to experience large price volatility that does not reflect market fundamentals;
- reducing competitiveness concerns for industries within the ETSs.[7]

Scenarios modelled for this report suggest that linking two OECD ETSs could reduce the overall cost of complying with their targets by between 30 and 50%,[8] as the participants in one ETS would be able to pay for cheaper abatement in the other ETS rather than more expensive abatement within their own (see Figure 5.2). Using the same assumptions as used for linking bilaterally, linking all OECD countries could reduce overall costs by between 25 and 55% (see Figure 5.3).

Figure 5.2: Two scenarios of the cost savings from linking two OECD ETSs

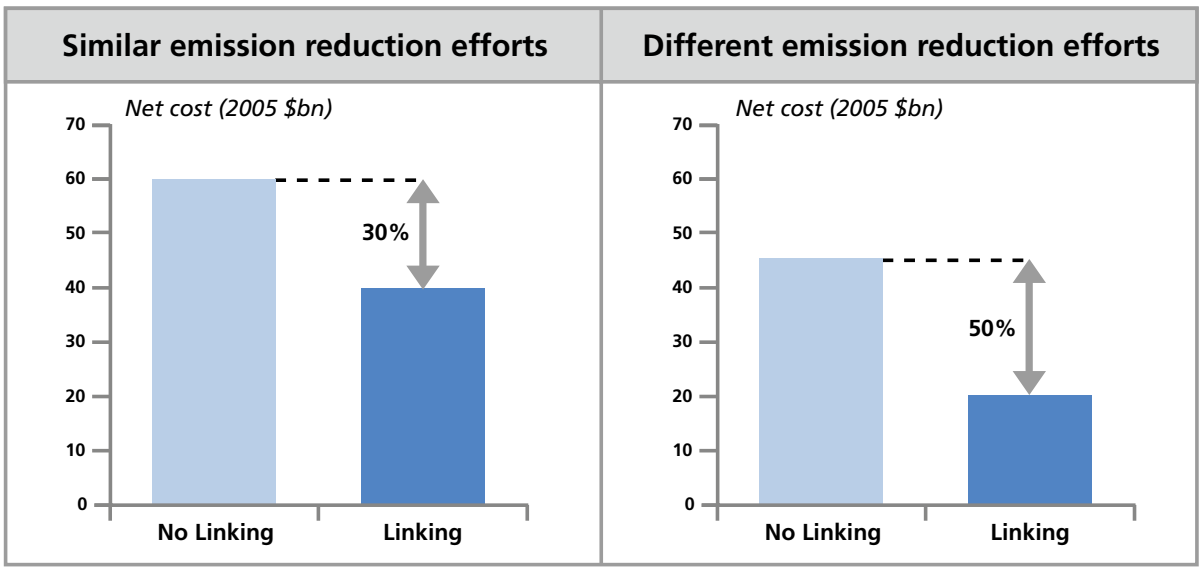
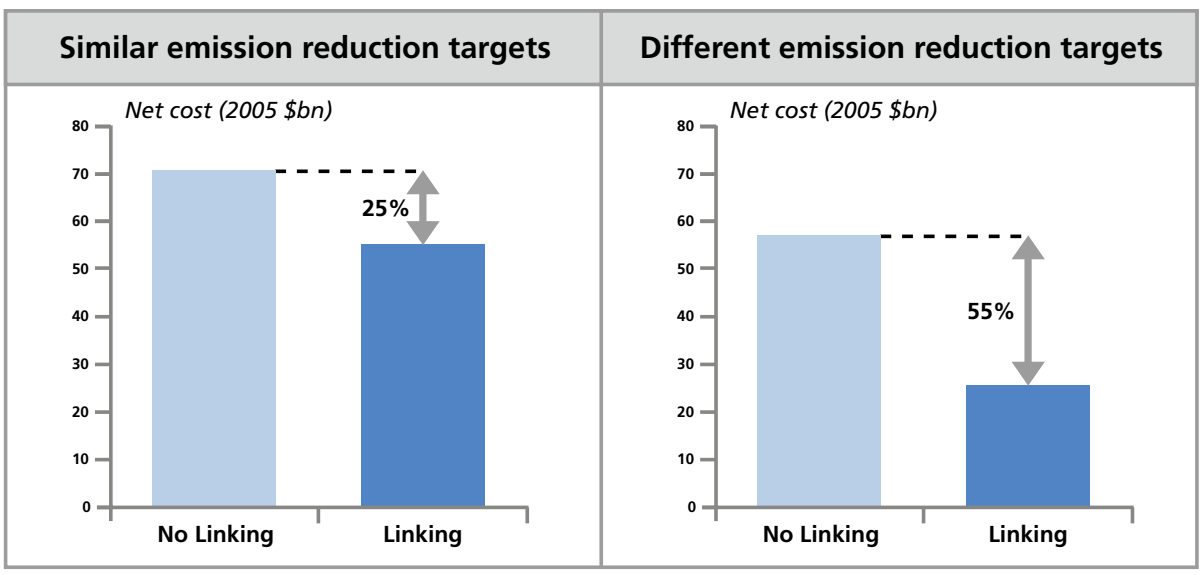


Figure 5.3: Two scenarios of the cost savings from linking all OECD ETSs



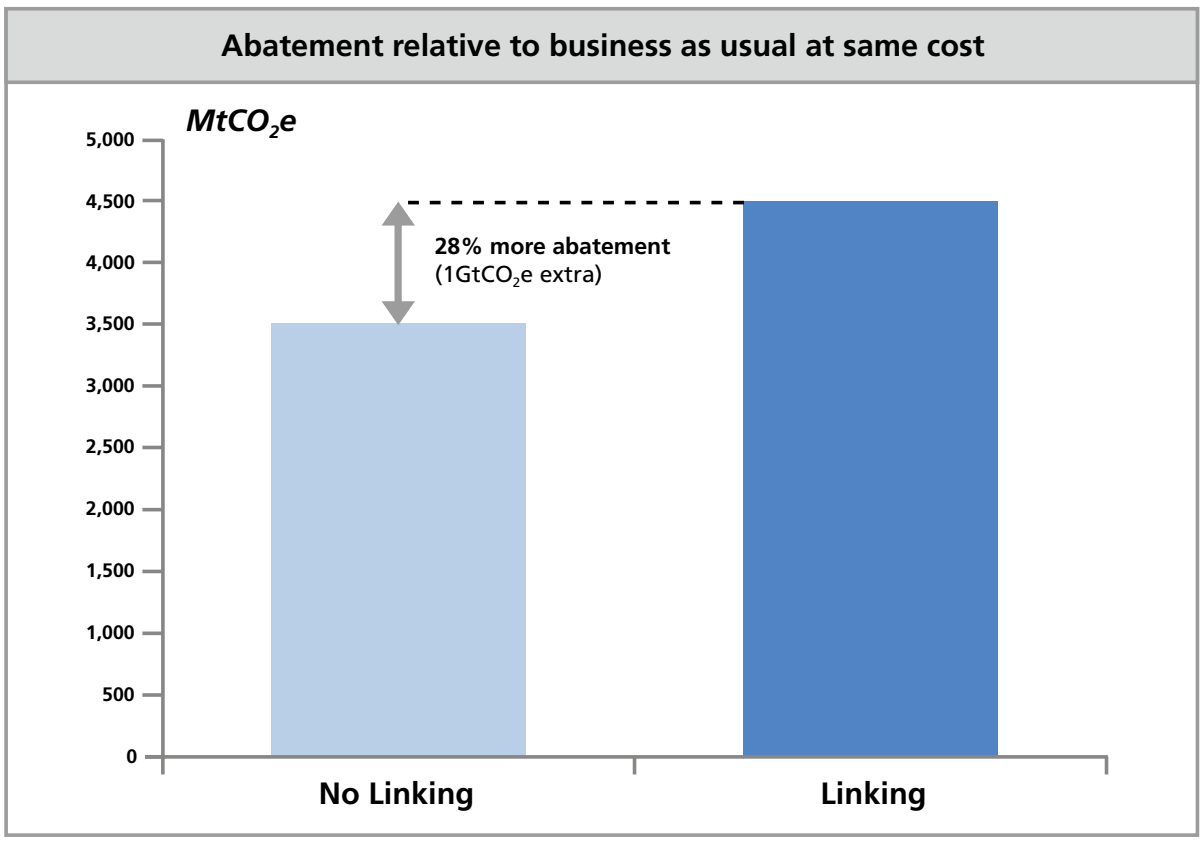
Under one scenario, linking OECD ETSs could lead to one gigatonne of extra emission abatement (or 28% additional abatement) with respect to BAU projections, at the same cost incurred when systems are not linked (see Figure 5.4).[9]

7 Climate Strategies (2008)

8 GLOCAF modelling (see Annex D).The lower end of the cost savings range (30%) assumes that countries with ETSs have the same emissions reduction targets with respect to 1990 levels. The higher end of the range (50%) assumes that one system has a target 30% higher than the other system compared to 1990 levels. For simplicity, the ETSs are assumed to cover 100% of the countries' emissions.

9 GLOCAF modelling (see Annex D). It assumed that the limits on import of credits from countries with no binding targets are held constant.

Figure 5.4: An illustrative scenario of extra emissions reductions achieved at the same cost through linking OECD ETSs



While the short-term cost savings from linking are potentially very high, they will depend heavily on a range of factors, including the costs of abatement in each system, the targets set, credit limits and coverage of sectors. The more these factors differ in each of the ETSs, the higher the immediate cost savings when linking.

Perhaps more importantly, in addition to any immediate cost savings due to the process of linking, a linked system would benefit from lower long-term costs of abatement than the individual systems would be able to achieve independently. This is due not only to the greater flexibility to access abatement opportunities, but also to the increase in liquidity and a reduction of regulatory-induced volatility in the larger, stronger market.[10]

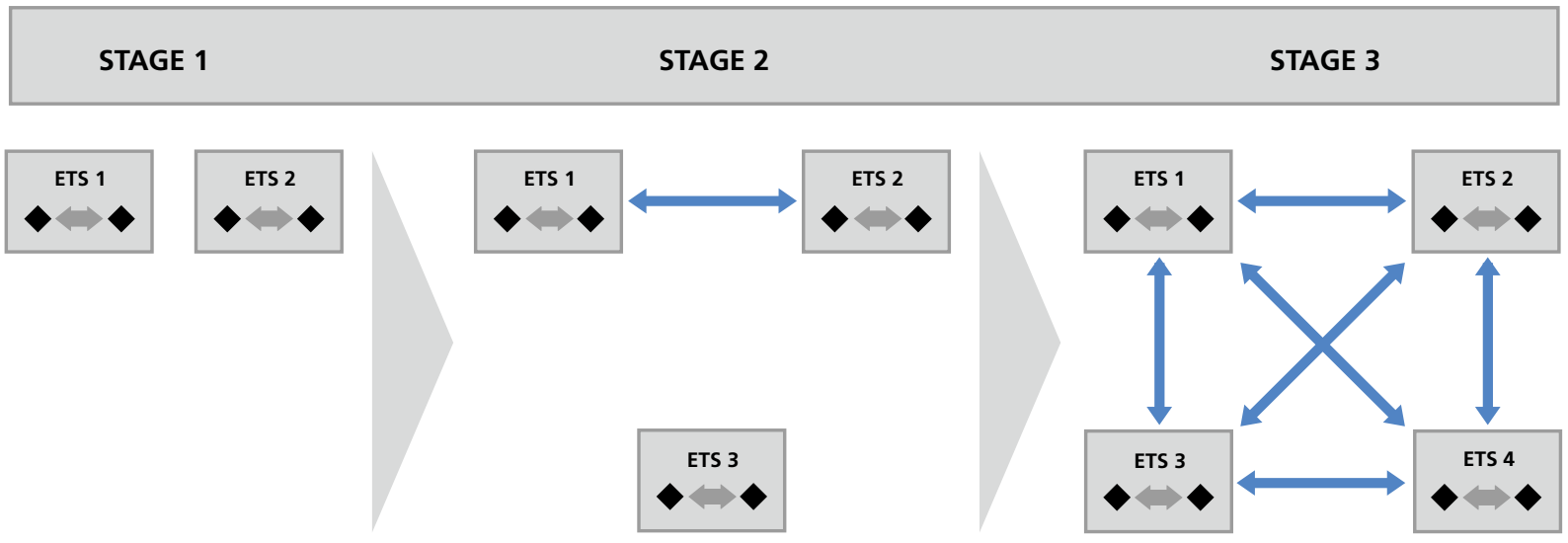
5.2.2 Development of an ETS network

A network of ETSs should develop as systems expand and link through bilateral agreements. If well designed and coordinated, many planned ETSs could link up with each other over the next decade.

While the potential gains from linking are very high, an ETS network will need a period of transition to evolve, during which ETS authorities should coordinate and plan bilateral links with one another. The first stage will be for national and regional authorities to set up domestic ETSs (Figure 5.5). In the second stage, established ETSs can start to link through bilateral agreements. In stage 3, these bilateral links will evolve into a linked network of ETSs.

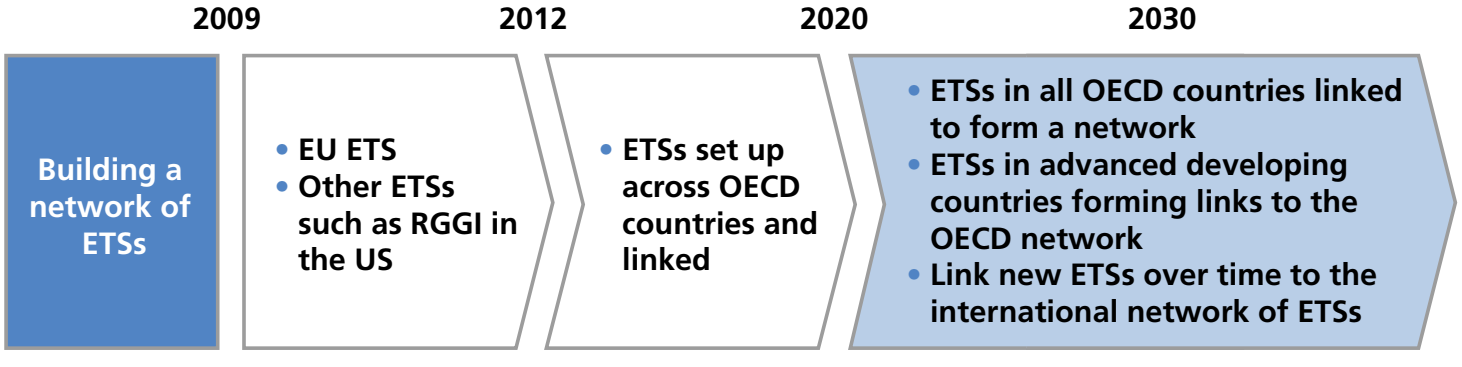
10 Fankhauser and Hepburn (2009)

Figure 5.5: Evolution of a network of ETSs



Over the next decade, ETSs are planned across the OECD. These should be linked progressively with one other (Figure 5.6). This would essentially form a developed country-wide emissions trading system, which would not only reduce the costs of abatement across the OECD, but could also form the essential demand for carbon abatement in the developing world (see Chapter 6 for more on linking with developing countries). Advanced developing countries in a position to set up their own ETSs should also have the opportunity to link with ETSs in OECD countries.

Figure 5.6: ETSs are likely to be set up and linked over the next decade



5.2.3 Linking the EU and US

Linking the EU ETS with a federal US system should be a priority. Linking by 2015 would be ambitious but achievable. This would increase liquidity and stability of both the EU ETS and a new US emissions market, and result in the coverage of between 13 and 27% of global emissions. It would also provide leadership and momentum, as well as long-term cost reductions.

A federal cap and trade system in the US along the lines of the recent Waxman-Markey Bill could cover around 80% of US emissions, the equivalent of approximately 6 $GtCO_2e$ in 2015.[11] A US system would play an important role in international trading because of its size (emissions from the US represented about 17% of global emissions in 2005[12]). If the EU ETS and federal US

11 Emission data from POLES, DIMA and IMAGE (see Annex D)
12 Ibid

systems were linked, the combined system could form the backbone of international trading, covering between 13 and 27%[13] of global emissions by 2015.

Linking the EU ETS with a federal US system should be a priority. Linking by 2015 would be ambitious, and much will depend on how rapidly the US sets up its own system. However, it is achievable. Lessons learned from the EU ETS and RGGI can help policy makers if they decide to link transatlantically. Furthermore, depending on the targets and levels of credit imports of each system, linking the systems together at a relatively early stage could provide immediate cost savings, lower costs of abatement in the longer term, and increased liquidity and less volatile prices in a larger, stronger market in the future.

5.2.4 Linking ETSs across the OECD

A linked EU-US emissions trading system would provide leadership and momentum, providing an impetus for other OECD countries to either link together or to merge their ETSs into regional systems which themselves could link in the same way as the EU ETS. If Mexico and Canada set up their own systems and linked to the US and EU, the resulting EU-North American linked system could cover between 15 and 30%[14] of global emissions by 2015.

An OECD-wide carbon market should be extended by 2020 to economically more advanced developing countries through linking to sectoral crediting and trading mechanisms as soon as these countries are ready to adopt no-lose or binding targets (see Chapter 6 for detailed analysis of developing countries' participation).

5.2.5 International emissions from aviation and shipping

As set out in Chapter 4, the international aviation and shipping sectors should each contribute to emissions reductions using transnational sectoral mechanisms. In the case of aviation, this could build on the system that is in place in the EU, where emissions from flights arriving at and departing from EU airports will be included in the EU ETS from 2012. An alternative approach is proposed in the Waxman-Markey Bill for the US – see Box 5.1. Any transnational mechanism should link to the global network of ETSs. There are also discussions on an agreement to limit EU shipping emissions, which could take the form of an ETS or another mechanism for capping emissions.[15] See also Annex A for a brief discussion of these sectors.

13 Ibid. The lower figure assumes the ETSs would cover 50% of the regions' emissions as is approximately the case in the EU ETS. The higher figure assumes the ETSs would cover 100% of the regions' emissions.
14 Ibid. The lower figure assumes the ETSs would cover 50% of the regions' emissions as is approximately the case in the EU ETS. The higher figure assumes the ETSs would cover 100% of the regions' emissions.
15 European Parliament and Council Directive (2009)

Box 5.1: Reducing international aviation and shipping emissions – some approaches

The inclusion of aviation in the EU ETS became law in November 2008. As a result, from 2012, emissions from aircraft arriving at and departing from EU airports will be capped at 97% of 'historic emissions' (an average of emissions from 2004 to 2006) and the cap will be reduced to 95% of that level from 2013 and subject to review thereafter. With respect to shipping, the revised EU directive does not specify which type of mechanism is preferred, but makes clear that these emissions should be included in reduction targets.

The draft Waxman-Markey Bill in the US indirectly proposes capping emissions from aviation as well as shipping by making fuel suppliers responsible for emissions produced by end-users of their fuels. This means that if the bill is passed in its current form, emissions from aviation and shipping within the US will be subject to an indirect cap. The bill also proposes a low carbon standard for all transport fuels. A transatlantic system of linked ETSs based on a post-2012 EU ETS and the Waxman-Markey Bill would cover around half of all global aviation emissions.[16]

In addition, the Australian Government has recently proposed that governments meeting in Copenhagen in December work towards global emission-reduction targets for the international aviation and shipping sectors, with a view to achieving sectoral agreements for each.

5.3 OVERCOMING CHALLENGES TO LINKING ETSs

Different design features are already emerging in ETS proposals in different OECD countries to reflect country-specific circumstances. However, four major design features will need to be coordinated so that ETSs can benefit from the huge gains available from linking.

As discussed in previous chapters, sovereign governments will wish to retain the right to decide on the most appropriate tools to reduce emissions within their country. As an effective domestic tool for reducing emissions, most OECD nations are planning to set up and implement ETSs. These ETSs are likely to be designed to address the specific economic, social and environmental concerns of each country. As a result, the existing and proposed systems in different OECD countries will exhibit different design features which reflect these country-specific concerns.

Extensive literature evaluates the pros and cons of different design features of ETSs,[17] and this report does not seek to make recommendations on how to design an ETS. However, as the potential benefits of linking are so great, ETSs also need to be designed to avoid locking in features that might form significant challenges to linking. In the following sections we examine ETS design features which will need to be coordinated prior to linking. While in theory linking is as simple as allowing businesses to purchase allowances from another ETS to be used for compliance within their own ETS, coordination will be needed in four key design areas:[18]

- regulations for monitoring, reporting, verification, compliance and enforcement (MRVCE);
- international and domestic credits rules;
- banking and borrowing rules;
- price intervention.

16 Emission data from GLOCAF (see Annex D)
17 Stern (2006), Garnaut (2008)
18 Edenhofer, Flachsland and Marschinski (2007); Jaffe and Stavins (2007); OCC analysis; Fankhauser and Hepburn (2009)

For each of these, the best solution is to coordinate before linking to ensure that the different designs of the ETSs are sufficiently compatible to link without compromising one another.

5.3.1 Monitoring, reporting, verification, compliance and enforcement

1) ETSs should ensure that monitoring, reporting, verification, compliance and enforcement mechanisms are effective, credible and trusted by other ETS authorities.

The most important feature of an ETS is capping emissions, and for this to hold, monitoring, reporting, verification, compliance and enforcement (MRVCE) need to be robust and trusted.[19] If MRVCE are lax and environmental integrity is compromised, then authorities in another ETS are unlikely to link so as not to compromise the credibility of their own system.

Different MRV methodologies could become a barrier to linking when they impact on the underlying assumption that one allowance still represents a tonne of carbon dioxide equivalent. For instance, if the global warming potentials of greenhouse gases are estimated differently from one country to the next, the homogeneity of one allowance is at risk. The Clean Development Mechanism (CDM) uses values from the IPCC Second Assessment Report, RGGI uses Third Assessment Report values, while the post-2012 EU ETS and the Waxman-Markey Bill's ETS will use Fourth Assessment Report values.[20] Even a slight difference in these values can lead to substantial differences in emissions measurements.

Similarly, compliance and enforcement regimes need to be credible in ETSs that are linked. For example, if a business in one ETS could negotiate to pay a non-compliance penalty without complying over the next period, the environmental integrity of the cap is undermined, and total emissions will increase as a result. As a result, enforcement of penalties should ideally be automatic and non-negotiable in each of the ETSs that link.

MRVCE standards do not have to be exactly the same, but it is important that they result in comparable accuracy and reliability in order that systems do not compromise each other's environmental integrity through linking. MRVCE standards should be transparent and coordinated before linking.

5.3.2 International credit rules

2) Coordinating import limits on international credits entering ETSs can ensure the proper functioning of the linked markets.

International credits are currently generated by projects in uncapped sectors or regions in the developing world as part of the CDM and other carbon mechanisms (see Chapter 2). Most proposed ETSs allow these credits to be imported and used for compliance to a limited extent. This links ETSs to the CDM and other carbon mechanisms globally, providing more abatement opportunities for participants, and therefore reducing the costs of compliance. Accepting credits from outside the system for compliance in one ETS will, in effect, also mean that they will be imported into a linked system. ETSs with different rules on the credits allowed to enter (sometimes called 'supplementarity' or import rules) cannot link without the rules transferring across in the following three areas:

---

19 Stern (2006)

20 Ecofys (2009); European Parliament and Council Directive (2009); Waxman, Markey (2009). For example, the value for SF_6 (Sulphur Hexafluoride) in the IPCC Second Assessment Report is 23,900 as opposed to 22,200 in the Third Assessment Report. That means that for 100MtSF_6 emitted, one system will account for 2.22 GtCO_2e whereas another will account for 2.39 GtCO_2e (an 8% difference).

- **Types of credit allowed.** If one system accepts a type of credit that a linked system does not, then the credits could be transferred across (imported into the first ETS and swapped for allowances which could be traded into the second ETS). For instance, the Waxman-Markey Bill proposes allowing credits from domestic forestry projects to be used for compliance in a US federal system. If the EU ETS linked to such a system, then the EU would also effectively be allowing the import of such credits. Even though the forestry credits themselves could not be used for compliance in the EU ETS, they could be used by US firms to comply with their obligations instead of a US unit, and this US unit could be exported to the EU ETS.
- **Unlimited credit imports.** If one system has no limits at all on credits of a certain type, then this could act as a conduit for the export of these credits into a linked system. The linked system could then not uphold any limits it places on the import of these credits. For instance, the Australian Carbon Pollution Reduction Scheme (CPRS) proposes unrestricted use of CDM credits (CERs). If it were to link with the EU ETS, CERs up to the level of the Australian cap could be exported to the EU ETS via the Australian CPRS, and Australian companies would comply only with CDM credits.[21]
- **Different offset limits.** If two systems each with a different rule on the use of credits were to link, then the overall limit of the joint system would be the weighted average of the limits in the two separate systems. For instance, if two equal-sized systems imposed different limits of 10% and 30%, the resulting larger ETS would have a limit of 20%.

For each of these three scenarios, if the authorities governing an ETS were in principle tied to limiting offset imports in a certain way, then linking with a system that has different rules would be more challenging. This is more likely to be the case where different credits are allowed, where unlimited credits are allowed or where there is a large difference between credit limits. Credit regulations do not need to be harmonised precisely to link systems. Nonetheless, in order to avoid this potential barrier to linking, ETS authorities should ensure that credit import rules are coordinated to levels that are acceptable by both authorities before linking. This includes the types of credits that are allowed and limits that are placed on the use of credits for compliance.

If coordination does not occur before linking, then the caps placed on each ETS could be undermined by the import of credits on linking. This would put the environmental outcome at risk if the caps set were based on a certain limit on imports. As a consequence, authorities should consider the coordination of tighter targets in parallel where necessary.

5.3.3 Banking and borrowing rules

3) Unlimited banking and limited borrowing of emission allowances should be allowed in all systems so that linking does not undermine their integrity.

Banking allows participants in a system to use an allowance from a previous year or phase, and borrowing allows the use of an allowance from the future, for compliance now (see Box 5.2). This can smooth the effort required for compliance, making abatement more flexible so that it can happen when it is cheapest, thereby reducing costs and avoiding price shocks that are not due to fundamentals.[22]

If it is in the interest of participants to use these rules, then arbitrage will ensure that the rules transfer between linked systems. For instance, if the EU and the US ETSs were fully linked so that allowances were fungible, then any EU allowance for a certain period could be used in the US

21 New Carbon Finance (2009)
22 Fankhauser and Hepburn (2009)

system for the same period of compliance, and vice-versa. As a hypothetical example, if the EU system were to allow banking or borrowing but the US did not, then allowances from the future or past in the EU could be used for compliance in the current period, leaving current allowances free to export for use in the US system. This essentially would form a mechanism for US participants to bank or borrow US allowances by trading them with EU allowances.[23] In this case, the restrictions on banking and borrowing would lose effect.

With unrestricted banking and borrowing, the length of compliance periods is no longer important for trading (two five-year phases with unrestricted banking and borrowing is the same as one ten-year phase[24]). Indeed, proposed systems feature different ways of dealing with the timing of emissions systems, from strict phases with tight restrictions on trading between phases to no phases at all but featuring rolling commitment periods. If we see a phase as being the period within which banking and borrowing is allowed (such as the EU ETS phases), then on linking phases tend to disappear unless they feature exactly the same timing. This is because participants can trade allowances between systems, circumventing the phase end in their own system by carrying over or borrowing allowances in the linked system.

Box 5.2 Banking, borrowing and linking

New Carbon Finance

New Carbon Finance (2009) modelled the impact of different banking and borrowing rules on linking the EU ETS to proposed systems in the US and Australia. The results of this analysis can be found in a background paper commissioned for this report. Major conclusions included:

- Minimising ambiguity around market rules and structure for market participants is vital to ensuring the credibility of ETSs.
- Where ETSs are linked but have different rules this can produce unintended market outcomes.
- Some design elements matter more than others when linking ETSs. The modelling highlights the importance of compliance years, banking rules, price intervention and international credit rules.

Although borrowing rules should matter to linked markets in theory, differing borrowing rules are unlikely to have a large impact in practice because if systems are correctly designed, borrowing will only happen in exceptional circumstances.

Fankhauser and Hepburn

Fankhauser and Hepburn (2009) analysed the flexibility of carbon markets to spread emissions reductions across space and over time, making carbon markets a cost-effective instrument for emissions control. The results of this analysis can be found in a background paper commissioned for this report.

Their analysis found that the main design features that create barriers to linking of systems are the rules on banking and borrowing and the presence of price control mechanisms. Systems with borrowing risk their environmental effectiveness if an operator borrows allowances and goes bankrupt before these are repaid. Linking one system with banking to another system without banking effectively creates a banking option for the system without banking.

23 New Carbon Finance (2009)
24 Fankhauser and Hepburn (2009)

As different banking and borrowing rules can transfer across systems, this could form a significant challenge to linking if systems featured very different approaches. Currently, banking and borrowing rules in existing and proposed ETSs do not differ greatly, so this may not form a significant challenge in practice.[25] Nevertheless, authorities should include banking and borrowing as a criterion for coordination to avoid unforeseen consequences. There seems to be a consensus that unlimited banking will feature in most systems, so attempting to limit banking will be fruitless as participants could bank through other linked schemes.[26] Borrowing could jeopardise emissions reductions, so most ETSs limit borrowing. Although substantial borrowing is unlikely as caps become tighter, some firms could borrow via linked systems.[27] This means that ETSs should probably limit borrowing to around 5-10% of the required abatement so that the integrity of the caps in the linked ETSs is not compromised.

5.3.4 Price intervention

4) Price floors and ceilings in ETSs should be avoided.

As set out in Chapter 3, there are sound reasons for avoiding the use of price floors and ceilings within an ETS. For example, a price floor that is established through an unlimited commitment from government to buy back allowances from the market would be achieved at the risk of imposing a liability on the public balance sheet. Furthermore, the presence of floors and ceilings in one system can act as a barrier to linking with a system without price interventions. For example, a price floor in one ETS can transfer to a linked ETS without a price floor. In this case the government authority overseeing the ETS which has the price floor would face a liability equivalent to both ETSs. In the most extreme scenario, this would result in a vast transfer of wealth from one country to another. Similar challenges would be faced with the use of a price ceiling. For these reasons, price floors and ceilings should be avoided.

Even where price intervention does not guarantee a certain price floor or ceiling, any intervention to affect the price would impact on both linked systems. Setting reserve prices in auctions can be used by governments wanting to support carbon prices to ensure that participants continue to have an incentive to reduce emissions. Governments can create an allowance reserve to ensure prices do not rise too high. Both mechanisms can be used to minimise volatility and to increase the dynamic efficiency of the market in the absence of long commitment periods and banking or borrowing.[28]

Setting reserve prices in auctions is not an inherent reason for why systems could not link. However the two systems would need to have similar (although not necessarily identical) auction reserve prices. This coordination would avoid the potential wealth transfer from the system with a reserve price to the system without a reserve price if the linked market prices fell below the reserve. Coordination would also be needed for allowance reserves to avoid similar potential wealth transfers.

Price intervention does not feature in the EU ETS, but has been proposed in one form or another in the Australian CPRS and in the US Waxman-Markey Bill.[29] Consequently, authorities in these different regions will need to plan and coordinate thoroughly over the coming years prior to linking. Once linked, the market will be deeper and more liquid, and will provide greater long-term

25 New Carbon Finance (2009)
26 There may be a case for limiting banking where loose caps have lead to a surplus of allowances. If this occurs in an initial 'testing' phase, then it may be appropriate to limit banking into the next phase. However, this is a second-best solution and ensuring caps are ambitious enough is the primary way to ensure that there is not a surplus of allowances.
27 New Carbon Finance (2009)
28 Fankhauser and Hepburn (2009)
29 Australian Government (2008); Waxman, Markey (2009)

predictability. This should lead to more price stability, reducing the case for price interventions still further in the future.[30]

5.3.5 Further design features

As well as the key design features set out above, two other design features should be coordinated if possible before linking occurs:

- sectoral coverage;
- allocation methods and auction design for allowances.

Where two ETSs cover different sectors, linking is possible and beneficial. However, some of the benefits of linking may be lost as there may still be competitiveness impacts, and a narrower coverage means that cost savings are potentially lower and some benefits of increased liquidity and lower price volatility may be lost. Distributional impacts may also be more prevalent. For instance, if one ETS that excluded certain industries linked with another ETS which included these industries, the allowance price in the latter could increase as a result. This would raise competitiveness issues between the two countries within the sector.

Allocation methodology need not form an absolute barrier to linking as trading should not be inhibited and a single carbon price would emerge across linked systems. However, allocating allowances in certain ways has distributional impacts as these allowances have a value. For instance, if one system auctions all allowances and links to another system where allowances are given to participants for free, then the participants in the latter system will benefit from the market value of these allowances. This could potentially be seen as unfair, especially where firms in both systems are competitors.[31] Where ETSs do auction allowances, auctions should be designed in such a way so as to smooth the effect on the market by supplying allowances into the market in a predictable and regular way. The timing and number of allowances sold should be coordinated between auctioning bodies and between linked ETSs, to avoid creating unnecessary volatility.

5.3.6 Planning and coordination

A notice period of several years should be provided prior to linking ETSs to allow time to negotiate common standards, give emitters and investors time to prepare, and smooth the convergence of prices in different systems.

Implementing the EU ETS has been a steep learning curve for participants as they get used to the rules, but it has also provided a period of time in which to build up credibility of the system. During this period, lessons have been learned about the most effective ways of operating an ETS and how to share efforts of different participants fairly. Lessons have also been learned about the causes of price volatility which could be reduced in the future; in particular, that volatility has resulted not from market fundamentals, but from having an immature market with relatively weak caps, together with less than full information about supply and demand.

Other ETSs may also feature some period of learning in the early stages when their credibility is still developing, prices may not yet represent fundamentals, and participants are still getting used to trading. However, the lessons learned from the EU ETS and the RGGI in certain US states should help authorities and participants plan and adapt more quickly to newly created ETSs in other countries.

---

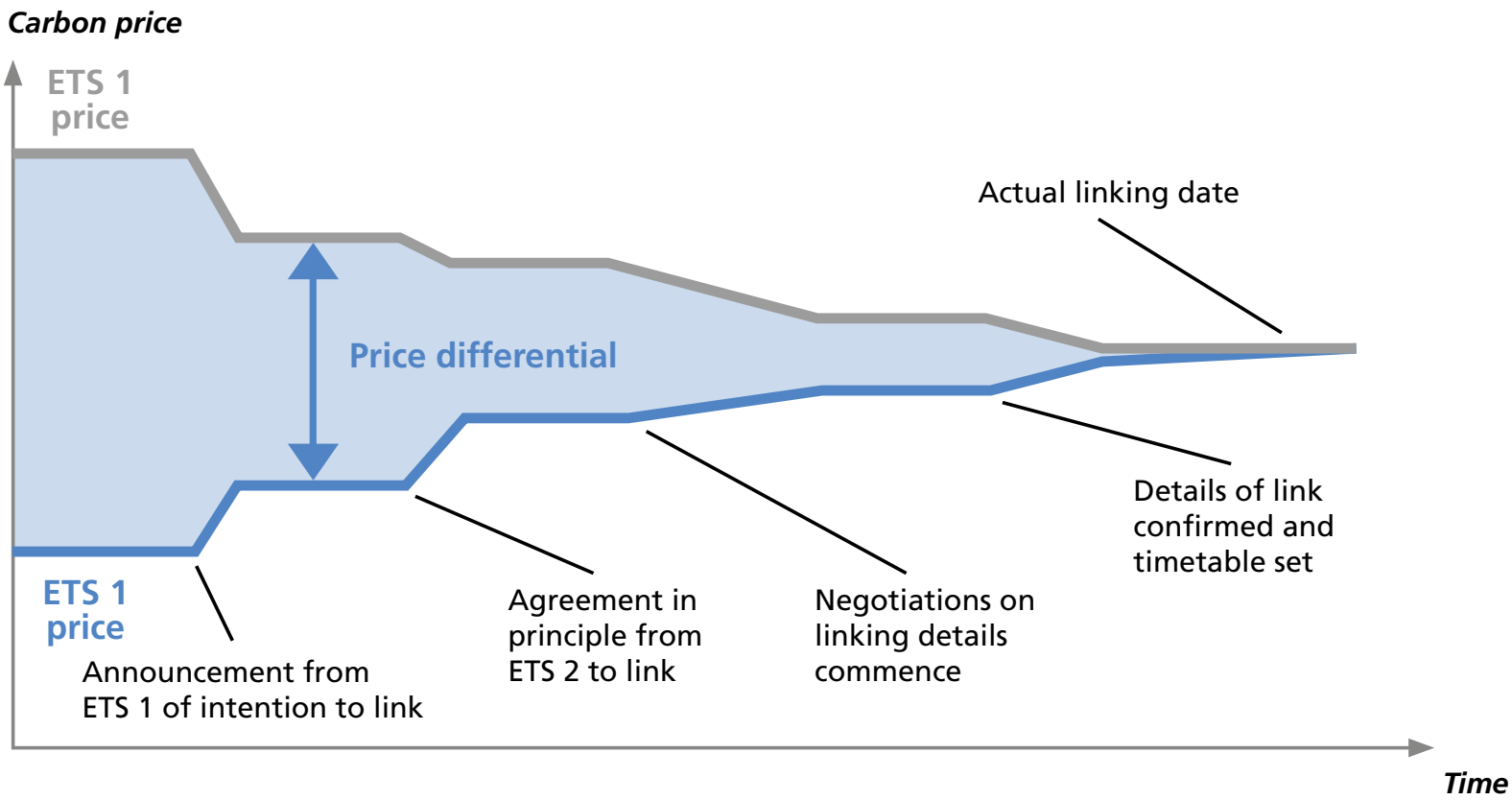
30 IETA (2009): 'Price management is the option least favorable to IETA since it is the most interventionist and would essentially eliminate most benefits arising from a market system.' Available at http://www.earthportal.org/news/?p=462

31 Stern (2006), Fankhauser and Hepburn (2009)

In addition, to enhance policy predictability, ETSs should announce a notice period of several years before linking to another ETS. For instance the Australian CPRS authorities would give 'five years notice before accepting a new type of unit, if it is expected that the unit will have a significant impact on domestic permit price'.[32] A period of notice fulfils three important objectives:

- it gives a newly created ETS a period of time to gain credibility and for participants to learn how the system operates;
- it allows ETS authorities sufficient time to negotiate coordinated design features;
- it can smooth price convergence of different ETSs before linking (see Figure 5.7). This is particularly the case where unrestricted banking between compliance periods occurs, and where data on trades and compliance volumes are transparent. As linking becomes more certain, prices converge. This can avoid an immediate large price shock at the time of linking.

Figure 5.7 Effects of giving notice on carbon price convergence – an illustrative example



5.4 GOVERNMENT-LEVEL TRADING

Trading at the government level should help reduce emissions cost effectively in sectors where an ETS is not the most suitable tool to drive reductions.

As set out in previous chapters, a government is unlikely to rely solely on an ETS in order to reduce its emissions because an ETS may be less suitable for use in some sectors than others. Emissions from sectors such as power and industry should be covered by ETSs because they are relatively straightforward to measure and monitor and, particularly in power, emissions can be capped upstream, reducing the transaction costs of monitoring, verifying and enforcing. Depending on the country's circumstances, sectors with more extensive and fragmented ownership of emissions should only be included in ETSs if the associated transaction costs are lower than the efficiency gains.

32 Australian Government (2008)

Given that ETSs are not suitable for covering all sectors in all countries, and because some governments may prefer to choose other instruments to implement their national caps for country-specific reasons, governments will probably wish to continue to trade emissions allowances to meet their targets cost effectively. Government trading gives countries more flexibility to meet their targets, especially when emissions reductions from sectors not covered under ETSs are difficult to predict with accuracy.

In the short term, because the overall cap of the first Kyoto commitment period (2008-2012) is likely to be met easily, trading of Kyoto allowances (AAUs) will probably remain limited.[33] Another reason for limited AAU trading is that countries not likely to meet their Kyoto targets may prefer to buy CERs from developing countries. Nevertheless, some countries with Kyoto targets that are difficult to meet, either due to country-specific sectors that are unsuitable for inclusion in ETSs or due to targets that were set too optimistically based on the evidence available, may benefit from government trading. Modelling suggests that certain OECD countries could face costs of between two and three times higher than the costs incurred when international trading is allowed if their governments used domestic action only to meet their Kyoto targets.[34] As set out above, ETSs are often the most effective and efficient means to meet stringent targets cost effectively, and countries should investigate the use of an ETS where possible. Government trading should be used as a means of 'house-keeping' emissions reductions that cannot be traded at the emitter level.

In the long term, with the adoption of more stringent caps and a larger participation of countries, government trading will be a cost-effective way to meet countries' targets. In the transition period, government-to-business trading should also help countries meet their targets cost effectively. In addition to the purchase of CERs by governments with binding targets, government-to-business trading could include trading between businesses in ETSs and governments adopting sectoral crediting, for example to reduce emissions from deforestation and degradation (see Chapter 6 for further details).

5.5 RECOMMENDATIONS

- Emissions in sectors responsive to carbon pricing with low transaction costs and robust measurement criteria, such as power and industry, should be delegated to emissions trading systems. Specific sectors in specific countries may not be suitable for inclusion.
- A network of linked ETSs should be developed through a series of bilateral agreements between developed countries over the next decade.
- Linking the EU ETS with a federal US ETS (cap and trade system) should be a priority and, though ambitious, could be achieved by 2015.
- Four major design features should be coordinated so that ETSs can benefit from the huge gains available from linking: MRVCE processes, entry of international credits, banking and borrowing of allowances, and the avoidance of price intervention.
- A notice period of several years should be provided prior to linking ETSs to allow time to negotiate common standards, give emitters and investors time to prepare, and smooth the convergence of prices in different systems.

33 World Bank (2009)
34 GLOCAF modelling (see Annex D). It assumed that a maximum of 50% of the country's abatement effort could be imported in the form of allowances and/or credits to meet the country's target

6 DEVELOPING COUNTRIES – A PHASED APPROACH

KEY MESSAGES

Participation of developing countries in climate change mitigation is essential: most future growth in greenhouse gas emissions is set to take place in developing countries.

For the world to have a chance of limiting the average global temperature rise to 2˚C, developing countries as a group need to deviate from business as usual emissions. Recent analysis indicates that this reduction in emissions will need to be in the order of 15-30% by 2020.

The current international framework for emissions reductions provides for developing country participation through the Clean Development Mechanism. The current CDM has delivered emissions reductions and finance for developing countries, but has some significant limitations.

Scaled-up mechanisms for developing countries are needed that are more effective, efficient and equitable – providing substantial, real emissions reductions and financial flows to the developing world.

Countries at different levels of development will be ready to use different mechanisms at different rates, in accordance with the principle of common but differentiated responsibilities and respective capabilities.

Under Sectoral Trading, developing countries could choose to implement their government-level sectoral targets using an ETS, taxation, regulation and/or subsidies. Domestic ETSs would provide countries with the opportunity to implement sectoral targets effectively and efficiently, maximising revenues from enhanced carbon trading opportunities – particularly when linked with other countries' ETSs.

Countries participating in sectoral mechanisms would no longer need to be governed by the CDM Executive Board for the sectors in question. Instead, such countries would assume responsibility for submitting national emissions inventories to the UNFCCC on an annual basis.

Sectoral Crediting provides a national-level sectoral baseline and moves beyond offsetting by including own action activity. For some countries, this activity could be supported with finance from the international community.

Deforestation in developing countries contributes around 17% of all the world's greenhouse gases. For countries without Sectoral Trading, government-level Sectoral Crediting could be particularly suitable for providing finance to forest nations and preventing deforestation simply being displaced from one locality to another. This should involve the participation of forest communities.

Comparing mechanisms, Sectoral Trading offers the most effective means for more advanced developing countries to access carbon markets. It can guarantee emissions reductions and can be supported at emitter level with an ETS. Modelling suggests that ADCs engaging in Sectoral Trading in key sectors could achieve substantial abatement at no net cost in 2015. And using Sectoral Trading could reduce the global cost of abatement financed through carbon trading by up to a half compared with the CDM.

Sectoral Crediting could be used in developing countries not yet in a position to participate in Sectoral Trading. It is more effective and efficient than the current CDM. In one scenario modelled, Sectoral Crediting could double net revenues compared to the CDM, while delivering emissions reductions beyond offsetting. Unlike the CDM, these revenues would be channelled directly to ADCs rather than to project developers and carbon market intermediaries.

Developing countries not yet in a position to participate in government-level sectoral mechanisms should be assisted to take part in a reformed CDM. This should use benchmarking and a more 'rules-based' approach where possible to increase the environmental integrity of CDM credits, increase efficiency and minimise uncertainty.

The UK Government estimates that developing countries will need around $100 billion per year by 2020 from the international community to address climate change. A proportion of this finance will need to come from non-market sources.

Non-market finance will be important for capacity building, demonstration activities, R&D, technology transfer and adaptation, as well as realising additional climate change mitigation. Low carbon development strategies could be an important means of avoiding duplication between market and non-market mitigation finance.

6.1 IMPORTANCE OF DEVELOPING COUNTRY PARTICIPATION

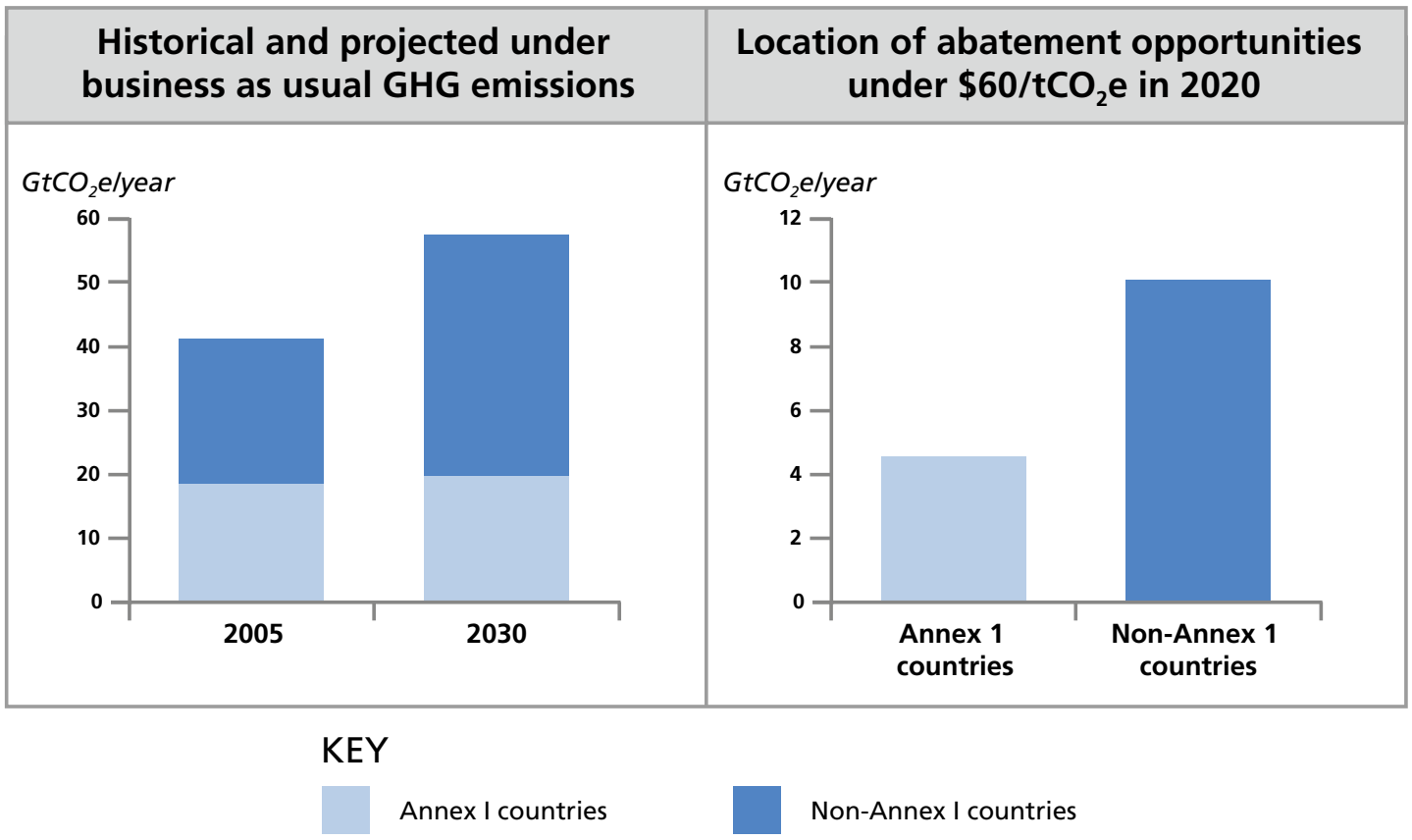
Participation of developing countries in climate change mitigation is essential: most future growth in greenhouse gas emissions is set to take place in developing countries.

For the world to have a chance of limiting the average global temperature rise to 2˚C, developing countries as a group need to deviate from business as usual emissions. Recent analysis indicates that this reduction in emissions will need to be in the order of 15-30% by 2020.

Participation of developing countries in climate change mitigation is essential if we are to avoid the worst impacts of climate change. The vast majority of future growth in greenhouse gas emissions will be in developing countries, which is also where more than two thirds of low-cost abatement

opportunities are located (see Figure 6.1). Even if all developed countries reduced emissions to zero, the world would still not be able to achieve its 2˚C goal without developing country mitigation.[1]

Figure 6.1: Projected emissions growth and low-cost abatement opportunities in non-Annex I countries



Source: BAU emissions projections (not including those from shipping) and marginal abatement cost curves used for GLOCAF

At the same time, the impacts of climate change will be greatest in developing countries. It is important that any international agreement on reducing emissions and adapting to climate change recognises the principle of common but differentiated responsibilities and respective capabilities. Recent analysis indicates that by 2020, developed countries will need to reduce their emissions by 25-40% below 1990 levels and developing countries as a group to deviate between 15-30% below business as usual emissions.[2]

6.2 DEVELOPING COUNTRY TRANSITION: SCALED-UP MECHANISMS

The current international framework for emissions reductions provides for developing country participation through the Clean Development Mechanism. The current CDM has delivered emissions reductions and finance for developing countries, but has some significant limitations.

Scaled-up mechanisms for developing countries are needed that are more effective, efficient and equitable – providing substantial, real emissions reductions and financial flows to the developing world.

Countries at different levels of development will be ready to use different mechanisms at different rates, in accordance with the principle of common but differentiated responsibilities and respective capabilities.

---

1 DECC (2009a)
2 den Elzen and Höhne (2008). These figures also used in European Commission (2009) and in the March 2009 EU Environment Council conclusions.

As Chapter 2 set out, the UNFCCC and the Kyoto Protocol have provided a useful framework for reducing global carbon emissions, setting commonly-agreed standards and a period of learning. However, the Clean Development Mechanism (CDM) has several important limitations. Some offset projects have been questioned for their environmental integrity[3] and economic efficiency. Furthermore, concerns over equity include the fact that less than 1% of CDM projects take place in least developed countries (see Chapter 2).

In this Chapter, two new government-level, sectoral carbon market mechanisms are examined: Sectoral Trading and Sectoral Crediting. Under both these sectoral mechanisms, developing countries could participate to scale up their mitigation and access greater levels of carbon market finance than in the current CDM. A reformed CDM for countries not able to access sectoral mechanisms is also examined. These mechanisms can facilitate and accelerate long-term low-carbon growth through leap-frogging to cleaner technologies and development paths.

Both sectoral mechanisms use government-level targets, but they are different in several key respects. Sectoral Trading would involve carbon units (allowances) being issued at the start of the period, and the government in question purchasing extra carbon units from abroad if it could not meet its target domestically. Conversely, with Sectoral Crediting, the carbon units (credits) would be issued at the end of the period if emissions had been lowered below a baseline. However, the government would not need to purchase extra carbon units from abroad if the country failed to reach its baseline.

Both mechanisms provide the opportunity to scale up mitigation above levels currently possible using the CDM. The capacity-building requirements for participation in a government-level sectoral mechanism are set out in a background paper to this report[4] and discussed in Chapter 8.

Developing countries do not constitute one homogenous group. They are at different stages of development. Only some of them are currently ready to access carbon market finance using scaled-up mechanisms, and to contribute significantly to climate change mitigation. Scaled-up sectoral mechanisms are particularly relevant for more advanced developing countries (ADCs)[5] and other developing countries with the capacity to establish and implement sectoral targets at the government level. In addition, the CDM should be reformed for countries not able to participate.

3 Michaelowa et al (2008)
4 Ecofys (2009)
5 In this report we use the phrase ‘Advanced Developing Countries’ to include countries such as Brazil and China.

Figure 6.2: Different speeds of participation for countries at different levels of development

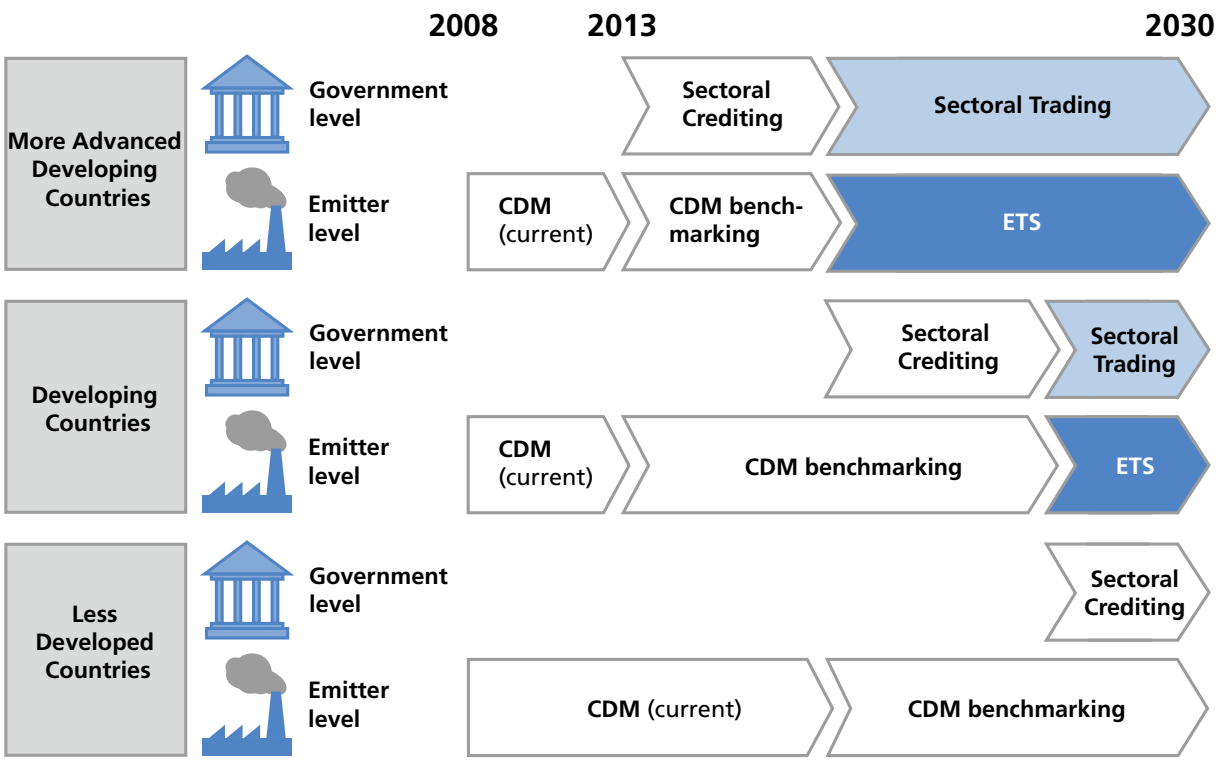


Figure 6.2 gives a very broad overview to illustrate how different types of developing country might participate in different carbon market mechanisms at any given time, depending on their capacity. The timings are solely illustrative. Some mechanisms could operate in parallel in a given country, though in different sectors (for example Sectoral Crediting and CDM benchmarking). Others, for example Sectoral Trading and an emissions trading system (ETS), could operate in the same sector at the same time – the latter a means of implementing the former. Finally, a country would not need to progress through all the mechanisms illustrated. For example, Sectoral Crediting could be bypassed and a country move straight to Sectoral Trading.

6.3 SECTORAL TRADING

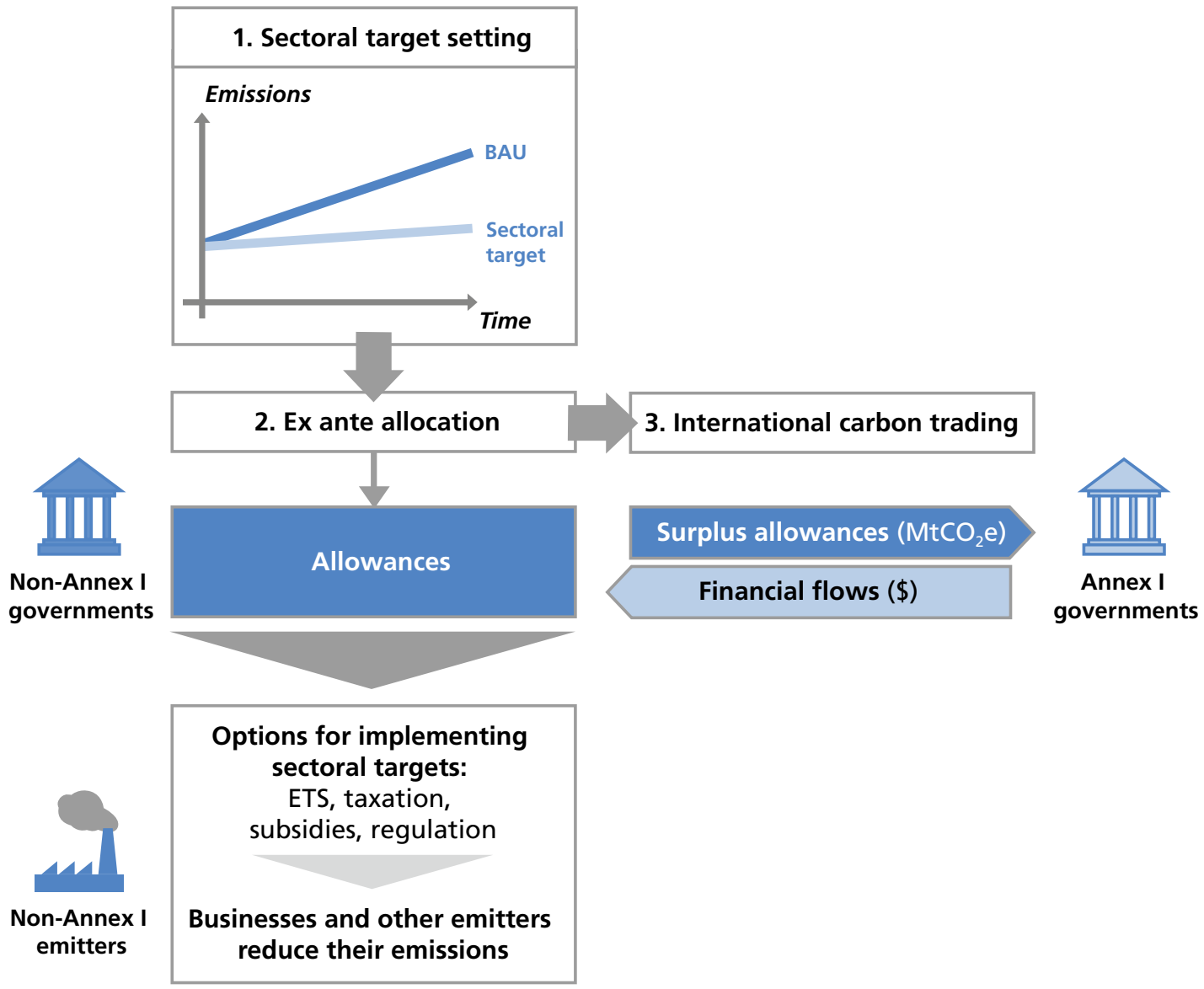
Under Sectoral Trading, developing countries could choose to implement their government-level sectoral targets using an ETS, taxation, regulation and/or subsidies. Domestic ETSs would provide countries with the opportunity to implement sectoral targets effectively and efficiently, maximising revenues from enhanced carbon trading opportunities – particularly when linked with other countries' ETSs.

Countries participating in sectoral mechanisms would no longer need to be governed by the CDM Executive Board for the sectors in question. Instead, such countries would assume responsibility for submitting national emissions inventories to the UNFCCC on an annual basis.

Sectoral Trading would involve agreeing an emissions target for a particular sector, such as power. Emissions allowances would be allocated to the government of the country in question, up to the level of the target. The government would then need to limit its emissions to the level of this cap during the course of the period in question. It could use a portfolio of policy instruments to do this, including an ETS, taxation, subsidy and/or regulation. Exactly how a country would implement a sectoral target to achieve its emissions reductions would be a sovereign decision. At the end of the period, any surplus allowances would be sold into carbon markets.[6] This sequence of steps is illustrated in Figure 6.3.

6 If, however, there was a deficit in allowances then carbon units would need to be bought from other countries to plug the gap.

Figure 6.3: Illustration of Sectoral Trading, with options for implementing the sectoral target

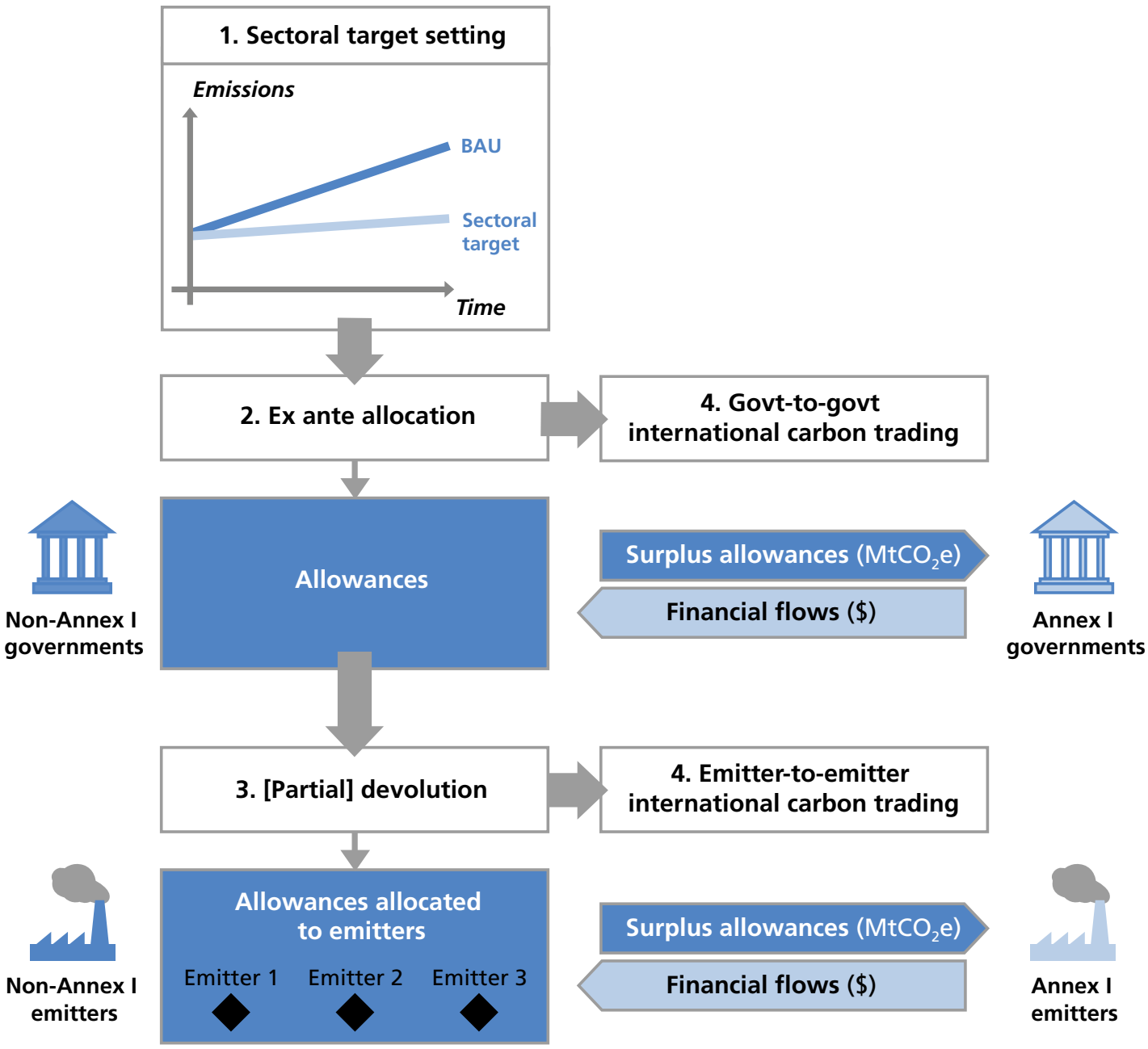


A key feature of Sectoral Trading is that the carbon units (allowances) are allocated at the beginning of the period. This facilitates the devolution of abatement effort to businesses and other emitters within the country through an ETS. An ETS would allow the government to devolve responsibility to emitters, passing on the carbon price signal to the actors best placed to reduce the emissions. ETSs are cost-effective implementation tools because they allow domestic trading: businesses and other emitters which might otherwise find meeting their targets prohibitive can purchase surplus allowances from emitters with greater low-cost abatement opportunities.

An ETS also opens up international trading opportunities if linked to other ETSs, which can maximise the financial benefits available to the country from trading surplus allowances. Given the low-cost abatement opportunities in developing countries, there is good potential for trading surplus allowances (see Chapter 5 for further discussion of ETSs and linking).

Figure 6.4 illustrates how Sectoral Trading would operate if an ADC government devolves some of its allowances to businesses and other emitters through an ETS that is linked to other countries' ETSs. It is unlikely that all allowances would be devolved, as it would probably be more cost effective to target the largest emitters in a sector in the first instance.

Figure 6.4: Illustration of Sectoral Trading, implemented using an ETS



Countries participating in Sectoral Trading (or Sectoral Crediting) would no longer need to be governed by the CDM Executive Board. Instead, such countries would need to submit national communications to the UNFCCC containing national greenhouse gas inventories, emissions projections and details of the policies and measures that have been put in place to reduce emissions, as is currently the case for Annex I countries. National inventories are submitted on an annual basis and reviewed by international teams of experts from developed and developing countries, coordinated by the UNFCCC secretariat. This process is essential in order to ensure that emissions inventories, which underpin the environmental integrity of global carbon trading, are accurate. Both developed and developing countries engaged in sectoral mechanisms should prepare their national greenhouse gas inventories using the 2006 IPCC guidelines.[7]

7 IPCC (2006)

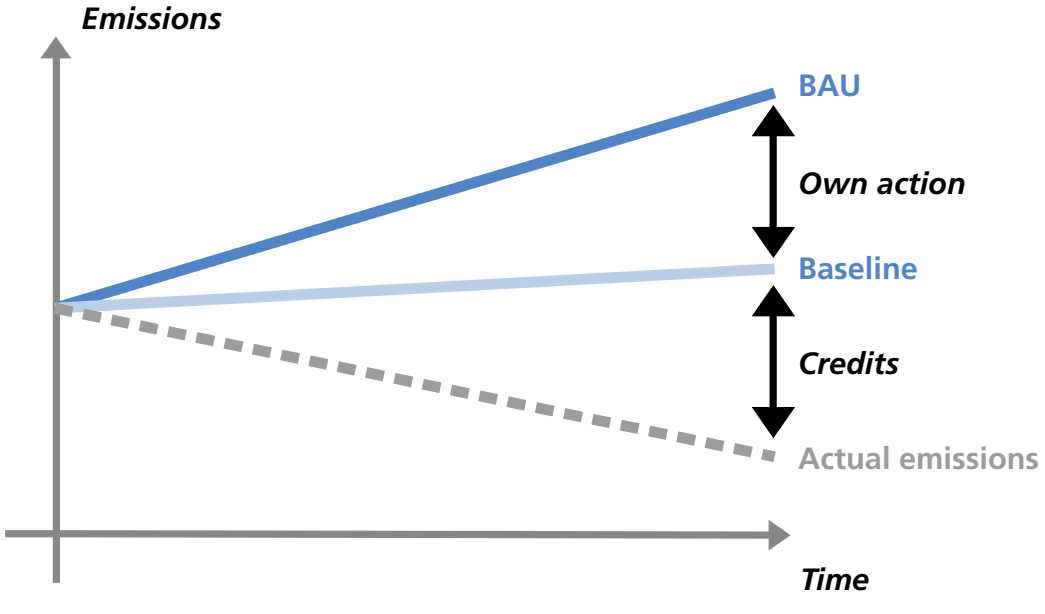
6.4 SECTORAL CREDITING

6.4.1 Sectoral Crediting: moving beyond offsetting

Sectoral Crediting provides a national-level sectoral baseline and moves beyond offsetting by including own action activity. For some countries, this activity could be supported with finance from the international community.

Sectoral Crediting is a mechanism that has been proposed for inclusion within a global deal, but which does not currently exist. It would involve a country agreeing a sectoral emissions baseline prior to the start of the period, set below predicted business as usual emissions. The government in question would then use a portfolio of domestic policy instruments to reduce its actual emissions below the baseline, in the same way as a government would implement a sectoral target under Sectoral Trading. At the end of the period, the government would receive a number of credits equal to the total number of emissions abated below the baseline. Sectoral Crediting is sometimes also referred to as a 'sector no lose target'.[8] Sectoral Crediting differs from Sectoral Trading in two key respects: the carbon units are issued at the end of the period; and there would be no obligation on the government to purchase carbon units from elsewhere if it did not achieve its baseline. Sectoral Crediting is illustrated in Figure 6.5.

Figure 6.5: Illustration of Sectoral Crediting



The abatement achieved between the level of business as usual (BAU) and the baseline is referred to as 'own action': abatement for which credits are not issued. Own action is the way a country can make a net contribution to tackling climate change by generating additional atmospheric benefits. If all abatement below BAU were to be awarded credits, then these credits would be offsets that simply displace more expensive abatement activity in developed countries. In this case Sectoral Crediting would resemble CDM (albeit a scaled-up version with a national-level baseline rather than a project-level one) and would be an offsetting mechanism that makes no net contribution to reducing global GHG emissions. The EU and others have proposed that some own action activity should be supported with finance from the international community.[9]

8 Höhne et al (2008)
9 European Commission (2009)

Other means proposed for moving Sectoral Crediting beyond offsetting include:

- discounting credits at the supply side (for example four credits are awarded for five tonnes of avoided CO_2 below the baseline);
- discounting credits at the demand side (for example a business within an ETS would need to buy five credits to make up a deficit of four allowances);[10] and
- buyers acquiring and cancelling a number of credits.[11]

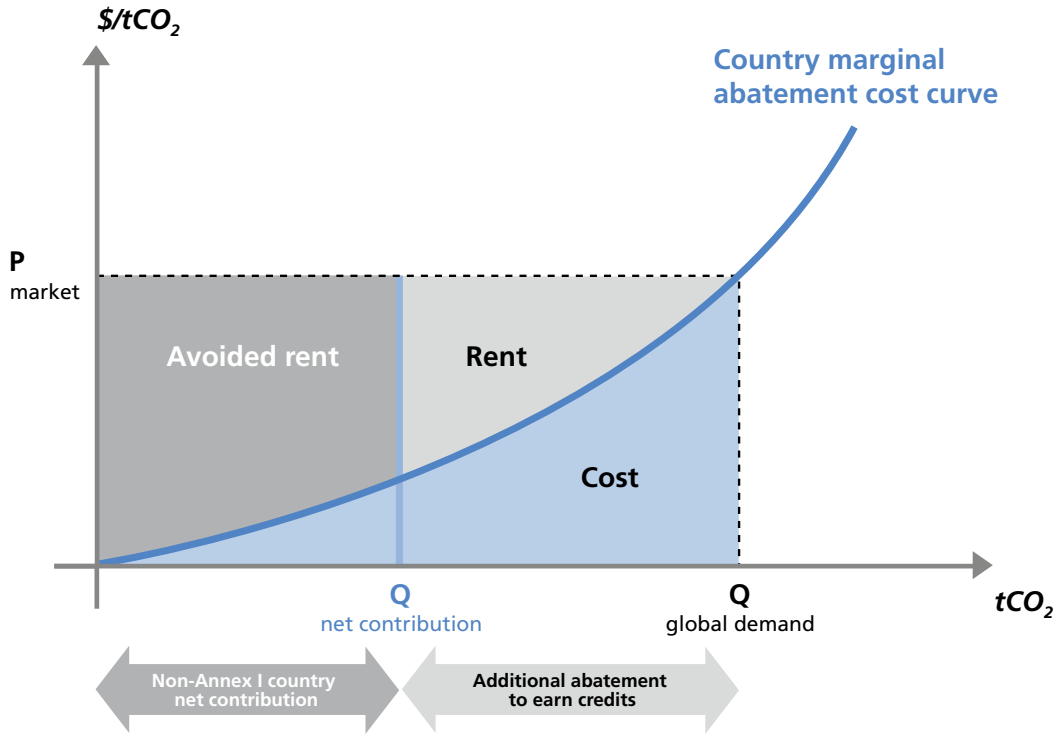
However, setting baselines that involve own action is probably the simplest and most transparent to negotiate.[12] Supply-side discounting would open a further front of political discussions to the already complicated matter of negotiating baselines. Demand-side discounting could create uncertainty and market distortions if different ETSs set different discount rates. And credit cancellation would require all mitigation actions to be credited through the Sectoral Crediting mechanism, placing further strain on the institutions governing the mechanism. This would also be less cost-effective (see Box 6.1 below on rents). However, it should also be recognised there is a danger involved in setting crediting baselines that involve own action: if they are too ambitious then governments might simply decide not to attempt to reduce emissions below it.

10 Schneider (2008)
11 Müller and Ghosh (2008)
12 OECD (2009)

Box 6.1: Rents

Figure A below represents a marginal abatement cost curve which, for a given year, traces out the cost of realising the last unit of greenhouse gas emissions abatement in a specific country's emissions sector. The area underneath the curve (in blue) represents the cost of supplying the amount of abatement. Because all of this abatement could be sold at the market price P_{market}[13] the sellers of credits could also capture additional profit represented by the grey colour. This is often described as 'rent', which can be defined as abnormal profit over and above the profit incentive needed to supply the quantity of abatement in question. The greater the amount of low cost abatement in an emissions sector or sub-sector, the greater the potential for rent.

Figure A: Illustration of reduced rent through own action in Sectoral Crediting



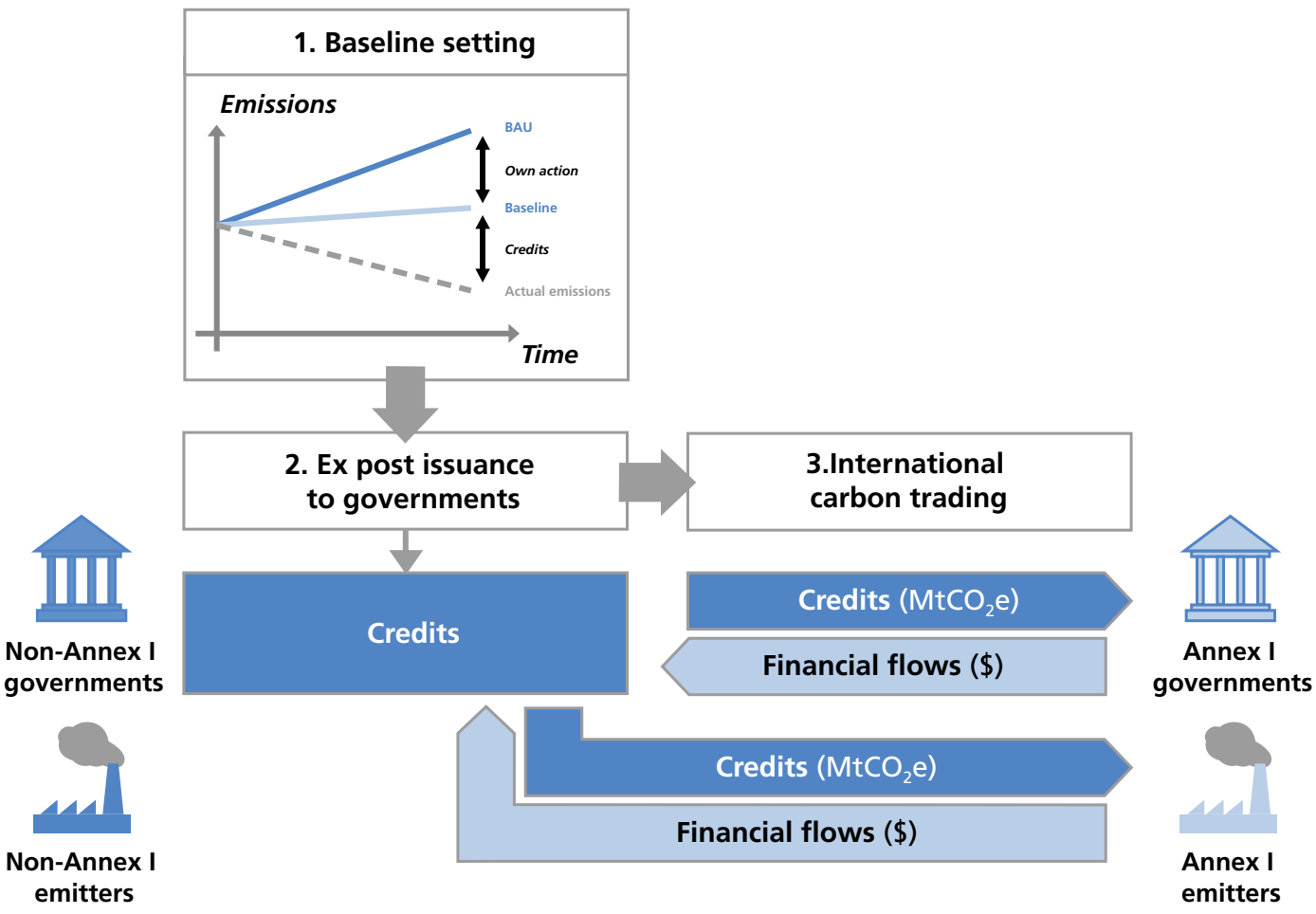
If abatement is purchased at the marginal rather than incremental cost, and so includes rent, then the global finance available to fund climate change mitigation in developing countries will be able to realise less abatement than would have otherwise been the case. However, by contributing to reduce global emissions through own action, some of the rent is removed (illustrated by the darker grey area in the figure). The finance that would have gone on rent could then be applied to realise further abatement in developing countries and achieve a better global result for the environment. There is, however, a danger in bearing down too much on rent because this reduces the incentive for countries participating in Sectoral Crediting to attempt to surpass their crediting baseline. There is therefore a trade-off between enhancing the cost effectiveness of Sectoral Crediting on the one hand and increasing the likelihood that developing countries decide to attempt to surpass their crediting baselines on the other hand.

13 P_{market} is likely to vary as the market price will change before and after the net contribution takes place. $Q_{global\ demand}$ is a function of the stringency of all countries' binding targets. $Q_{net\ contribution}$ represents the amount of abatement required to deliver the own action target for the country in question.

At its simplest, a Sectoral Crediting baseline would be set in terms of absolute emissions (tCO_2e). However, it would also be possible to set the baseline in terms of an intensity target, for example tCO_2/MWh. Sectoral Crediting, because of its no-lose nature, is uncertain in terms of environmental outcome compared with Sectoral Trading. However, Sectoral Crediting would be more certain with an absolute baseline. Performance would be easier to measure (because there are fewer variables involved). And it would be easier to devolve effort to businesses through an ETS. On the other hand, an intensity target does give greater flexibility to developing countries for unexpectedly high growth, which might mean that developing countries would be prepared to agree a more stringent baseline. Further, an intensity target would also hold up better than an absolute target to a recession or some structural change to the economy. Intensity-based targets would also be less affected by errors in BAU emissions projections. They are likely to offer more environmental integrity in a situation where BAU emissions projections are overestimated.

Figure 6.6 illustrates the flow of finance and credits involved in Sectoral Crediting where it is the government that receives and trades credits. Here, the government is issued credits directly in return for reducing emissions below the baseline using its choice of emissions reduction policies (ETS, subsidies, taxation and/or regulation). It is worth pointing out that the resulting credits could then be sold on to other governments with a deficit of allowances as well as those with carbon budget constraints (such as the UK Government). Credits could also be sold to businesses with a deficit of allowances within an ETS that permits the acquisition of such credits. In this respect, credits from Sectoral Crediting could be sold in the same way as CDM credits today.

Figure 6.6: Illustration of Sectoral Crediting by a developing country government

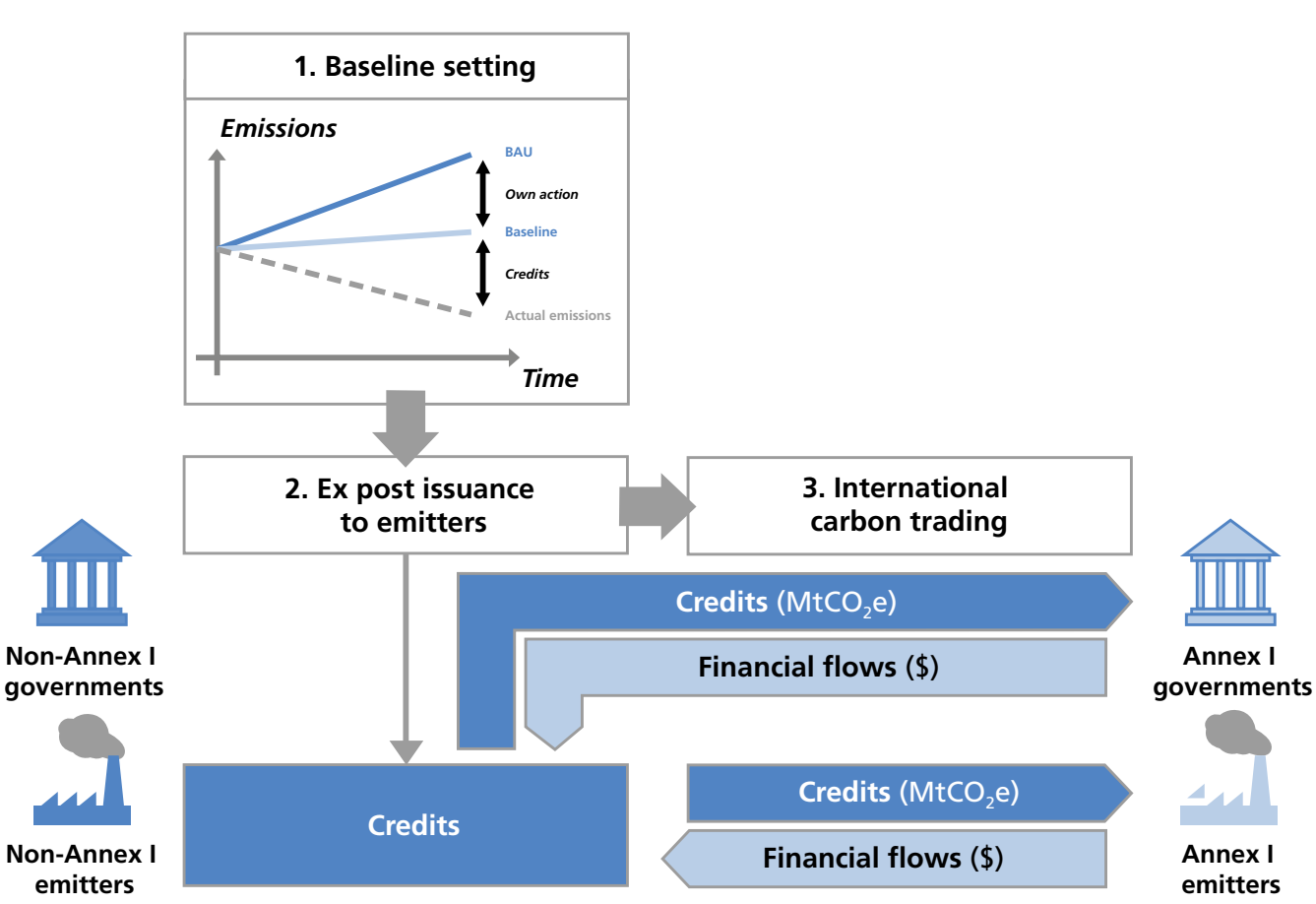


Some proposals for Sectoral Crediting suggest a 'nested approach', whereby individual CDM-like projects could still operate within a sector participating in Sectoral Crediting. Projects would receive a portion of the credits earned by the country as a whole surpassing its sectoral baseline. However, this report considers that such a mechanism would be unlikely to operate successfully, for the reasons given in Box 6.2.

Box 6.2: A 'nested approach' to Sectoral Crediting?

Figure B illustrates how a 'nested approach' to Sectoral Crediting could operate. Project developers would be incentivised by the potential receipt of a proportion of credits earned by a country as a whole surpassing its sectoral baseline. However, in practice project developers would be unlikely to invest in a project if receiving credits was dependent on reducing emissions across the whole sector. They would be unlikely to want to bear the risk of poor performance on behalf of the government or other project developers resulting in the baseline not being met, or not being sufficiently exceeded to produce enough credits to reward them for all of their project's abatement.

Figure B: Illustration of Sectoral Crediting involving a 'nested approach'



One potential solution offered is for governments to take on the liability to acquire sufficient credits on the international market to fully compensate project developers who have been successful at reducing emissions within the confines of their project area. However, Sectoral Crediting is more likely to be adopted by governments that deal directly with credits and revenue themselves (as in Figure 6.6). The carbon price signal would essentially stop at the government, which would then be responsible for adopting policy instruments, such as an ETS, to create a carbon price signal of its own. An ETS would be more likely to achieve emissions reductions (and therefore credits for the government) than credits promised to individual firms contingent upon sufficient sector-wide performance. In any case, a direct price signal from international carbon markets might not be sufficiently powerful if businesses in the sector are already regulated or do not operate in a competitive environment.

6.4.2 Sectoral Crediting in the forestry sector

Deforestation in developing countries contributes around 17% of all the world's greenhouse gases. For countries without Sectoral Trading, government-level Sectoral Crediting could be particularly suitable for providing finance to forest nations and preventing deforestation simply being displaced from one locality to another. This should involve the participation of forest communities.

The forestry sector is likely to be a crucial element of a new global deal on climate change. It is the third largest emissions sector, with around 96% of emissions coming from developing countries.[14] This sector offers the opportunity to reduce a significant proportion of global emissions, without which we would be unlikely to reach the 2˚C goal, in a manner that involves substantial financial flows to developing countries. The Bali Action Plan calls for: *'Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.'*

The Eliasch Review,[15] commissioned by the UK Prime Minister, recommended a period of capacity building followed by government-level Sectoral Crediting over the medium term for reducing emissions from deforestation and degradation (REDD) in developing countries, in conjunction with public funds and other forms of private finance (see Box 6.3 for a summary of the Eliasch Review). However, forest nations are unlikely to achieve sustainable reductions in forest emissions without strengthened governance and the full participation of forest communities. In the short term, most forest nations need to build up their capacity not only to measure and monitor emissions accurately but also to have institutions, policies, laws and enforcement mechanisms in place capable of making a real impact on forestry emissions. This will require public funds.

14 Houghton (2003)
15 Eliasch (2008)

Box 6.3: The forestry sector and the Eliasch Review

Emissions from deforestation and degradation in the forestry sector constitute around 17% of global emissions,[16] higher than the entire global transport sector and comparable to the total emissions of the US or China. Around 96% of deforestation emissions are estimated to come from developing countries in the tropics. The main driver of deforestation is the expansion of agriculture.

Modelling for the Eliasch Review estimates that the climate change-related damages of unabated deforestation will rise to around $1 trillion per year by 2100.[17] It can take a number of decades for today's forestry emissions to have their full impact on the atmosphere. The finance required to halve emissions from the forest sector to 2030 could be between $17-33 billion per year if forests are included in global carbon trading. The cost-benefit ratio of tackling deforestation is large, even if rents from selling REDD credits are included.[18]

The Eliasch Review identified four key elements for tackling forestry emissions over the medium term through a Sectoral Crediting mechanism:

1. **National-level targets** are particularly important in the forestry sector as large amounts of intra-national carbon leakage would result if deforestation was tackled on a project by project basis.
2. **Robust forest emissions measurements** can be achieved using satellite technology coupled with research on the ground. The Review estimated the cost at around $50 million to set up national emissions registries for 25 forest nations, with annual running costs of $7-17 million.
3. **Carbon finance.** Linking national-level forest credits to carbon markets could generate up to $7 billion a year by 2020 for developing countries to reduce deforestation. This could be achieved while having little or no impact on ETS allowance prices if targets and credit limits are set at appropriate levels. However, public and private funds will also be required to halve forestry emissions by 2020 and make the sector carbon neutral by 2030.
4. **Strong governance.** Forest nations are unlikely to achieve sustainable reductions in forest emissions without strengthened governance and the full participation of forest communities. The Review recommends that forest nations should provide information on policies and measures undertaken in annual communications to the UNFCCC, including information on consultation of forest communities in accordance with Articles 18 and 19 of the United Nations Declaration on the Rights of Indigenous Peoples.

In the short term, most forest nations need to build up their capacity not only to measure and monitor emissions accurately but also to have institutions, policies, laws and enforcement mechanisms in place capable of making a real impact on forestry emissions. Work for the Eliasch Review suggests that the costs of building capacity in 40 forest nations could be up to $4 billion over five years on the basis of a number of assumptions, including political will.

Source: Eliasch (2008)

16 IPCC (2007)
17 This figure does not include the additional damage costs relating to other environmental services that are lost or impaired, such as water systems and biodiversity.
18 The opportunity costs alone of halving emissions from the forest sector to 2030 were estimated to be between $7-15 billion per year.

6.4.3 Supply and demand of credits

Sectoral Crediting, like CDM, relies on developed country cap and trade systems to provide sufficient demand for the credits to be supplied. It has been estimated that annual average demand for international credits from US and EU ETSs combined could amount to, on average, around 1 $GtCO_2e$ per year in the period 2012-2020.[19] Other developed countries will augment this demand. The level of demand will depend on a number of factors, including: the level of targets; the number of ADCs participating in Sectoral Trading; the creation of ETSs; restrictions on the import of credits; and how the current surplus of AAUs is dealt with.

The principal objective of an ETS is to achieve a given amount of abatement in an efficient manner (ie at least cost). ETSs provide certainty of environmental outcome, but not certainty of price. However, if a secondary objective for an ETS is to achieve a certain level of carbon price in order to drive investment in low carbon technologies, the best way of achieving this would be to set more stringent targets for the ETS. Evidence shows that ETS carbon prices can be maintained on the entry of relatively low-cost credits (in this case REDD credits) by setting targets and credit import rules at appropriate levels.[20] An ETS can achieve a similar carbon price with either: 1) a relatively more stringent target and looser import restriction or 2) a relatively less stringent target and tighter import restriction. The former combination will result in greater overall emissions reductions.

If sufficient policy certainty exists regarding cap and trade systems (in particular more certainty of stringent future targets and also certainty of credit import rules), and if emitters and investors make sufficiently long-term investment decisions, then short-term demand for credits can be increased. Surplus credits may be bought in the current commitment period (when relatively cheap) for use or sale in a successive period (when credit prices are relatively more expensive). Banking between and within periods is already a feature of the EU ETS. However, for banking to make a positive contribution to the environmental integrity of the system then it is important to minimise further 'hot air' being brought into carbon markets,[21] as the effect of banking can be to lock it in for perpetuity. This can be achieved through rules that initially limit banking of credits or allowances from new carbon market mechanisms until it becomes clear that baselines and targets have been set at appropriate levels.

6.5 COMPARING DIFFERENT CARBON TRADING MECHANISMS

Comparing mechanisms, Sectoral Trading offers the most effective means for more advanced developing countries to access carbon markets. It can guarantee emissions reductions and can be supported at emitter level with an ETS. Modelling suggests that ADCs engaging in Sectoral Trading in key sectors could achieve substantial abatement at no net cost in 2015. And using Sectoral Trading could reduce the global cost of abatement financed through carbon trading by up to a half compared with the CDM.

Sectoral Crediting could be used in developing countries not yet in a position to participate in Sectoral Trading. It is more effective and efficient than the current CDM. In one scenario modelled, Sectoral Crediting could double net revenues compared to the CDM, while delivering emissions reductions beyond offsetting. Unlike the CDM, these

19 OECD (2009)
20 Eliasch (2008), Section 11.3
21 See Chapter 4 for a discussion of the surplus AAUs in the first Kyoto commitment period.

revenues would be channelled directly to ADCs rather than to project developers and carbon market intermediaries.

Having now considered Sectoral Trading and Sectoral Crediting in isolation, the mechanisms are compared in this section. Table 6.1 provides a qualitative comparative analysis. Sectoral Trading is more environmentally effective and efficient than Sectoral Crediting. Sectoral Trading guarantees a certain level of emissions reductions, is not dependent on there being sufficient demand for credits from developed country markets, is more suitable for devolving to businesses through an ETS and guarantees a net contribution to global abatement efforts. However, with Sectoral Trading, gaining agreement on sufficiently stringent targets could be challenging, given their binding nature.

Table 6.1: Qualitative analysis of Sectoral Trading and Sectoral Crediting

MECHANISM	PROS	CONS
Sectoral Trading	• Allowances are awarded ex ante, giving governments a tangible carbon asset they can devolve to emitters straight away, who can start carbon trading immediately • Promotes certainty of environmental outcome • A net contribution to global abatement	• May be more difficult to gain agreement on stringent, hard targets because of their binding nature • Only gives certainty of environmental outcome if hard target is enforceable
Sectoral Crediting	• May be easier to get agreement because of its no-lose nature, providing a possible first step for governments to engage with carbon markets • Enforcement not an issue, as credits are only awarded ex post	• No certainty of environmental outcome • Credits awarded ex post – more difficult to incentivise emitters • Zero-sum if solely generates offsets • Potential to give rise to large rents • Difficult to set baseline at a level that provides an incentive yet is ambitious • May delay realisation of long-term framework • Reliant on there being sufficient demand

Quantitative analysis of Sectoral Trading and Sectoral Crediting was also undertaken for this report, using the Clean Development Mechanism (CDM) as a comparator (see Annex D for more information on the GLOCAF model used). The modelling was performed for the year 2015.[22] The developing countries modelled were China, Mexico, Brazil and certain Middle Eastern countries. These more advanced developing countries (ADCs) were partly chosen on the basis of the availability of country-specific marginal abatement cost curves. For the purposes of modelling,

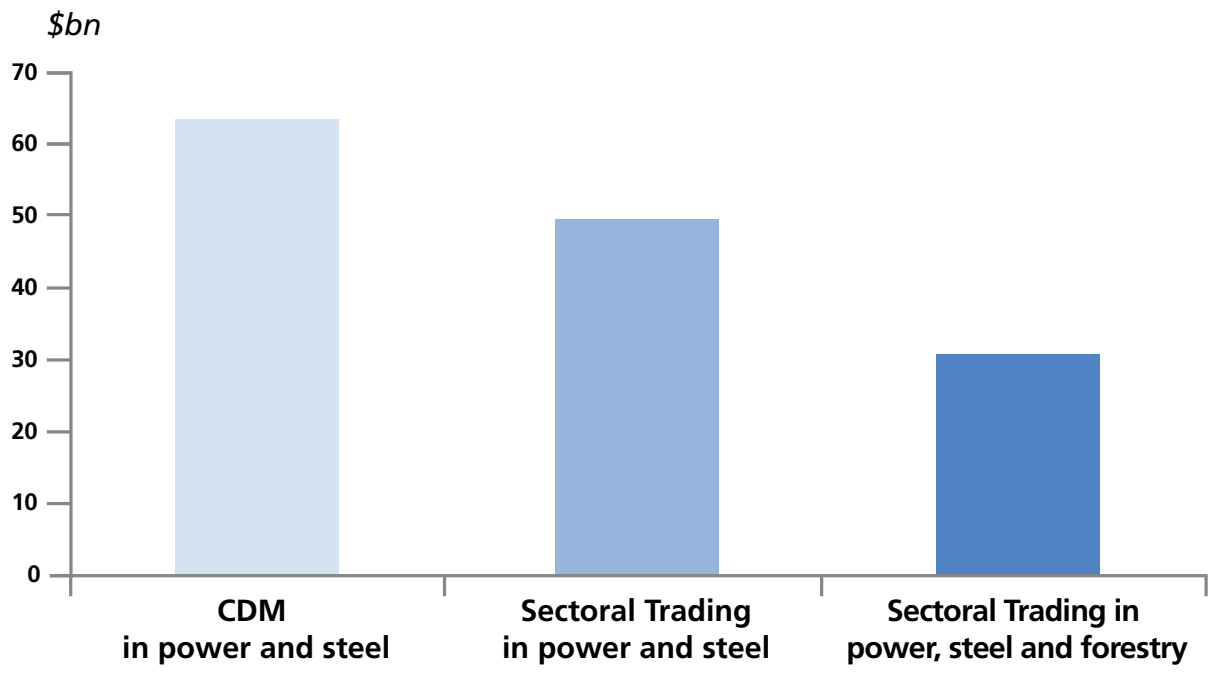
22 The trajectory used by the model involves global abatement of around 7 $GtCO_2e$ in 2015 to be consistent with our 2˚C objective. However, in the scenarios modelled here the carbon market alone is not assumed to be used to finance the whole of this abatement.

other developing countries were assumed to continue to participate in the CDM, although in practice they could potentially participate in sectoral mechanisms as well.

The modelling results suggest that the global cost of the abatement financed through carbon markets could be reduced by around 50% if ADCs use Sectoral Trading rather than continue to use the CDM (see Figure 6.7). This is despite the carbon market delivering around 70% of required global abatement in the least cost Sectoral Trading scenario, whereas only around 60% of necessary global abatement is delivered in the CDM scenario. This difference in levels of abatement is because the CDM is currently an offsetting mechanism providing no net contribution to a reduction in global emissions, whereas Sectoral Trading would involve domestic abatement that would reduce global emissions overall.

The difference in global abatement costs between Sectoral Trading and the CDM is due to several reasons. First, Sectoral Trading is a more efficient mechanism than CDM, with lower transaction costs. Second, the CDM is not able to make use of relatively low cost abatement potential in the forestry sector because of the significant intra-national leakage that would result from the use of project-level baselines. Third, developed world carbon markets set limits on the import of developing country credits, partly due to concerns over additionality and the offset nature of CDM credits. Such concerns would diminish were Sectoral Trading to be used, which would mean that import restrictions could be relaxed. In fact, if Sectoral Trading involved ADCs creating ETSs and linking them fully to OECD country ETSs, there would be no limits on the import of ETS allowances from ADCs.[23]

Figure 6.7: Global cost of carbon market-financed abatement using Sectoral Trading compared with CDM



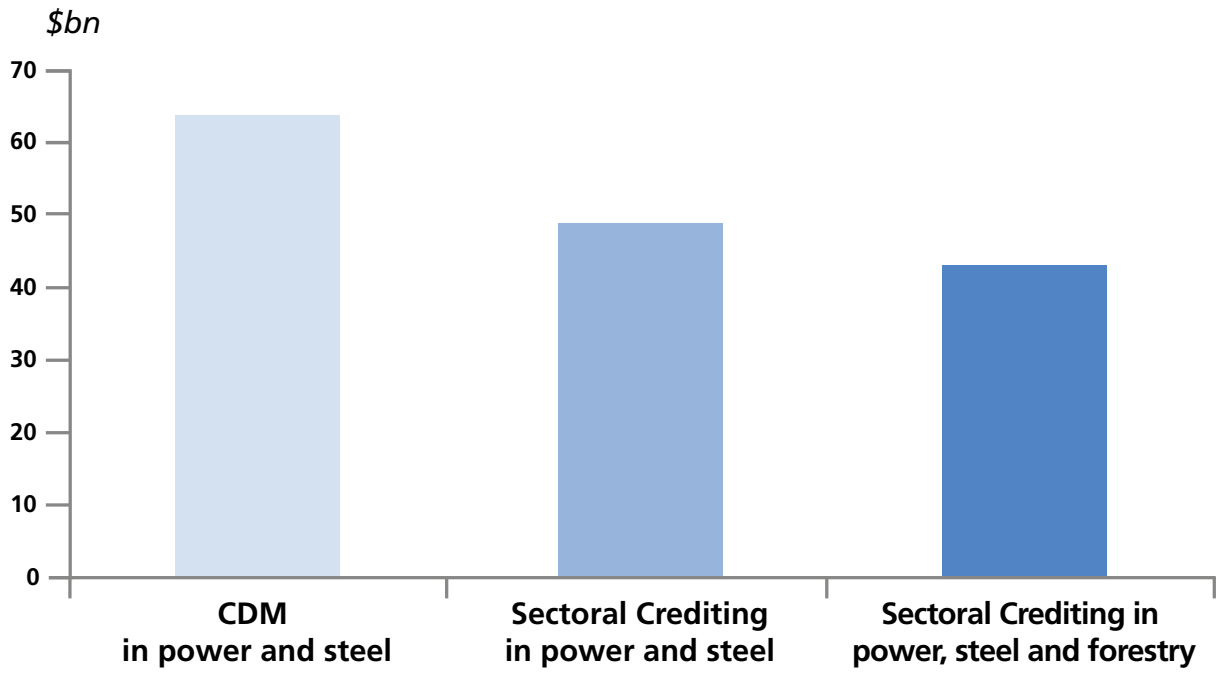
Source: GLOCAF modelling for this report of ADCs using Sectoral Trading in 2015.

We saw above that for developing countries not yet able to participate in Sectoral Trading, Sectoral Crediting might be used as an alternative. The cost effectiveness of Sectoral Crediting relative to CDM was therefore also modelled. The modelling results suggest that the global cost of the abatement financed through carbon markets could be reduced by around 35% where ADCs use Sectoral Crediting rather than CDM (see Figure 6.8). The least cost Sectoral Crediting scenario also provided around 10% more of the global abatement required in 2015 than the CDM scenario, due to the own action element. The reasons for the Sectoral Crediting scenario being more cost

23 Credit import restrictions in developed country markets were relaxed by around half in the Sectoral Trading scenarios relative to the CDM scenario.

effective include reduced transaction costs from the greater efficiency of the mechanism, the ability of Sectoral Crediting to access the relatively low abatement opportunities in the forestry sector, and also a partial relaxing of developing country carbon market import limits in light of the fact that Sectoral Crediting with own abatement moves the credits beyond offsets.[24]

Figure 6.8: Global cost of carbon market-financed abatement using Sectoral Crediting compared with CDM



Source: GLOCAF modelling for this report of ADCs using Sectoral Crediting in 2015.

In summary, modelling for this report suggests that the use of Sectoral Trading by developing countries could be around 30% more cost effective for the world than Sectoral Crediting, which in turn could be around 35% more cost effective for the world than the current CDM. Furthermore, both Sectoral Trading and Sectoral Crediting can deliver a greater amount of global abatement through carbon markets compared with the production of CDM offset credits.

Developed countries should take on more stringent targets themselves on the basis of the global abatement cost savings involved in ADCs using Sectoral Trading or Sectoral Crediting. More stringent targets would help to ensure that carbon market finance available to other developing countries is maintained or enhanced.

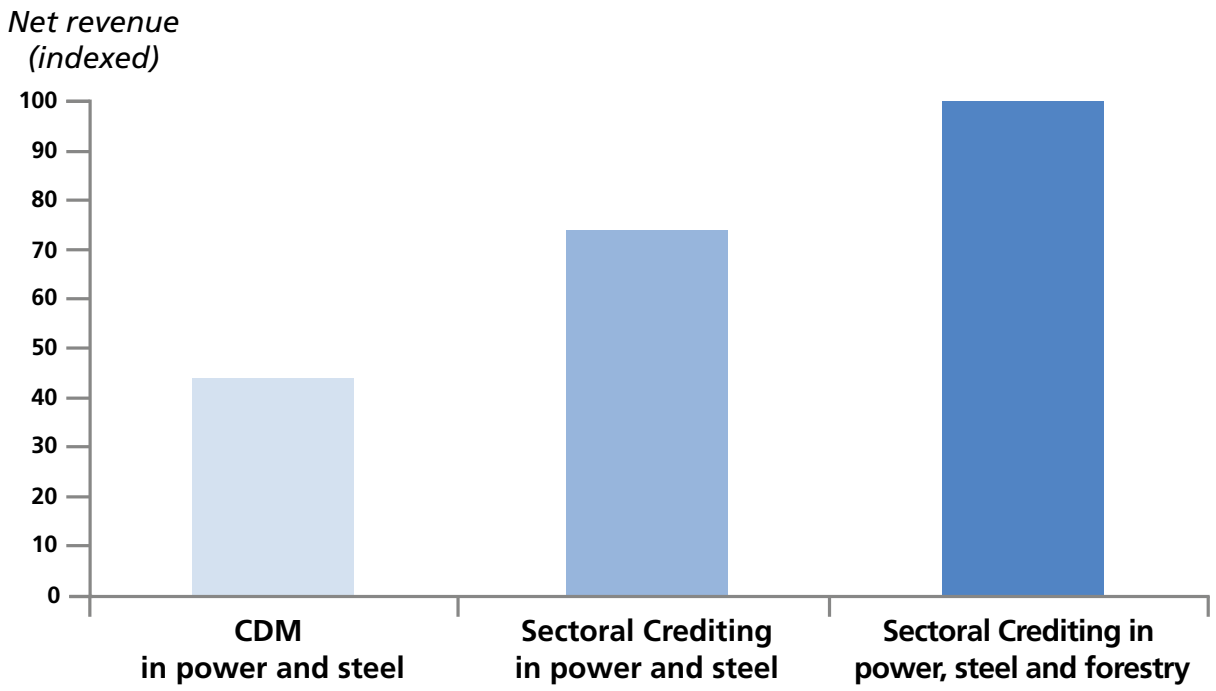
Sectoral mechanisms should be designed to ensure not only that emissions in developing countries are reduced substantially, but also that developing countries benefit from international support to ensure that their economies grow sustainably. Modelling suggests that developing countries engaging in Sectoral Trading in key sectors could achieve substantial emissions reductions in 2015 at no net cost to themselves. This means that the finance received through the sale of surplus allowances would be sufficient to cover the cost of meeting domestic sectoral targets.

For developing countries not yet in a position to participate in Sectoral Trading, Sectoral Crediting with substantial own action could generate net revenues[25] for developing countries of more than double those project developers and other carbon market players could receive under CDM (see Figure 6.9).

24 Credit import restrictions in developed country markets were relaxed by around a third in the Sectoral Crediting scenarios relative to the CDM scenario.

25 Net revenue is the financial flow resulting from trading surplus allowances or credits, minus the cost of generating those surplus allowances or credits together with the cost of meeting domestic sectoral targets or performing own action.

Figure 6.9: Net revenues for project developers (CDM) and developing countries (Sectoral Crediting) in 2015



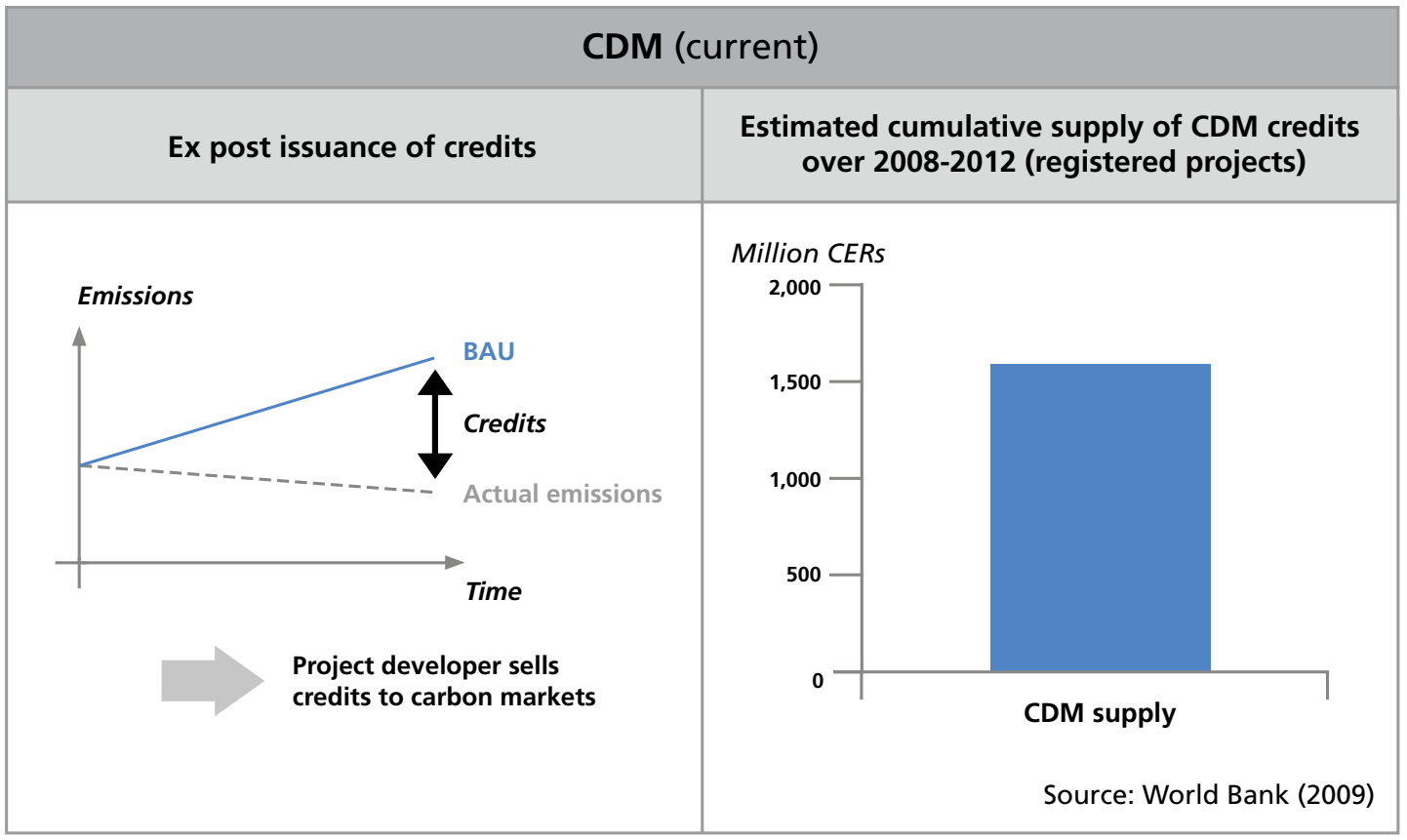
Source: GLOCAF modelling for this report. Non-market finance to support own action abatement activity was not modelled.

6.6 REFORMING THE CLEAN DEVELOPMENT MECHANISM

Developing countries not yet in a position to participate in government-level sectoral mechanisms should be assisted to take part in a reformed CDM. This should use benchmarking and a more 'rules-based' approach where possible to increase the environmental integrity of CDM credits, increase efficiency and minimise uncertainty.

The CDM is a project-level, baseline and credit mechanism that currently supplies offset credits to Annex I governments and emitters that they use to minimise the cost of meeting their caps. In return for supplying credits, finance flows to developing countries which can aid their development. The strength of the CDM lies in the fact that it requires very little government capacity for its operation. Consequently, it will remain an important mechanism for those developing countries not yet in a position to participate in government-level sectoral mechanisms. The CDM as it currently operates is summarised in Figure 6.10.

Figure 6.10: Summary of current CDM



The CDM has been successful in engaging developing countries with carbon markets and supplying a significant quantity of offset credits. However, the approval of projects has been relatively slow and uncertain for investors, and there have been concerns over additionality and levels of rents, particularly in respect of HFC projects (see Chapter 2). Most importantly, while CDM offsets lower global abatement costs, they do not directly contribute to global emissions reductions beyond meeting developed country targets. To contribute, the money saved through cheaper abatement would have to be used to set more stringent developed country national caps. Table 6.2 summarises the successes of the CDM in its current form, as well as some of its shortcomings.

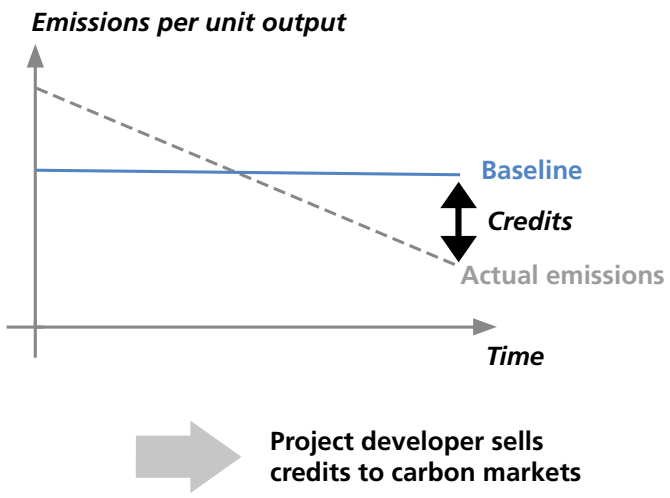
Table 6.2: Summary of the successes and shortcomings of current CDM

SUCCESSES	SHORTCOMINGS
• Engaged developing countries on the workings of carbon markets • Supplied a significant amount of offset credits to developed country governments and companies, reducing their abatement costs • Resulted in significant flows of finance to some developing countries • Enhanced the technology base in some developing country sectors	• Approval of individual projects or programmes is difficult to predict, resulting in investor uncertainty • Approval process is also bureaucratic and long • Abatement supplied consists of offsets that displace potentially more expensive abatement in developed countries: no net contribution to reducing global greenhouse gas emissions • Provides no incentive to developing countries to include abatement action as part of government policy • Information asymmetry can lead to gaming and non-additional projects • High transaction costs • Financial flows have been concentrated in just a few large, more advanced developing countries • Rents to project developers and carbon market intermediaries can be very large (eg HFC projects) • Unsuitable for the forestry sectors due to intra-national leakage

Source: Vivid Economics (2008), Michaelowa et al (2008) and own analysis

A number of shortcomings of the current CDM could be overcome through greater use of sectoral benchmarks in sectors and sub-sectors which produce a homogenous product (such as cement or aluminium). This reform would avoid the need for each project to be individually approved by the CDM Executive Board on the basis of a counterfactual: that the abatement would not otherwise have occurred (ie, that it is 'additional'). Figure 6.11 below summarises how CDM benchmarking works.

Figure 6.11: Summary of how CDM benchmarking works

<table>
<tr><th colspan="2">CDM benchmarking</th></tr>
<tr><th>Ex post issuance of credits</th><th>How CDM benchmarking can operate</th></tr>
<tr><td> 
</td><td>• One pre-determined baseline ('benchmark') is agreed for a sector or sub-sector, such as steel manufacture, within a country
• The benchmark is set in terms of X tonnes of CO_2e /tonne of steel produced by an emitter
• The benchmark level might be, for example, the first decile of firms ranked by efficiency
• Firms then gain credits for beating the benchmark
• A benchmark makes it unnecessary for the UN Executive Board to approve individual projects</td></tr>
</table>

Greater use of CDM benchmarking would be more effective and efficient than most current CDM projects because it would provide a clear price signal to investors, who would be able to rely on clear, pre-determined rules. It could also move CDM beyond offsetting and towards net reductions in global emissions; and it would avoid the need for a board to try to determine a counterfactual (ie what would have happened in the absence of the project). The information asymmetry between the project developer and the board makes this very difficult. CDM benchmarking, if the benchmarks are set sufficiently stringently, can also help to maintain rents within acceptable limits. The ways in which CDM benchmarking could address some of the current weaknesses of CDM are summarised in Table 6.3 below. CDM benchmarking will, however, require sufficient data within country sectors to set benchmarks at an appropriate level, which will be challenging to initially obtain.[26]

26 Michaelowa et al (2008)

Table 6.3: How greater use of benchmarking can overcome some shortcomings of the current CDM

Some current CDM shortcomings	How CDM benchmarking can address them
1. Approval of individual projects or programmes uncertain and bureaucratic, leading to investor uncertainty and delays	1. There would be one, pre-approved methodology for each sector or sub-sector in a country/region, reducing investor uncertainty, bureaucracy and delays
2. High transaction costs	2. This would lead to lower transaction costs
3. Large rents to project developers and intermediaries for least cost projects types	3. Benchmarks can be set at a level that limits rents to an acceptible level for least cost project types
4. Information asymetry leads to gaming and non-additional projects	4. There would no longer be a need to seek to determine a counterfactual (ie BAU emissions). Additionality would therefore no longer be an issue.

CDM credits should continue to be traceable to the projects to which they relate. This will enable purchasers to choose to buy credits which have been voluntarily generated against a higher standard, such as CDM Gold Standard credits which are certified by a private organisation to have been generated in a manner that contributes to sustainable development (as well as reducing greenhouse gas emissions). Such credits have traded at a premium of around 15% compared with standard credits, in part driven by voluntary market buyers seeking to meet self-imposed corporate social responsibility standards.[27] Purchasers of credits could also choose to buy them from least developed countries in order to increase financial flows to them, even if their credits are relatively more expensive than those from more developed countries.

6.7 MARKET AND NON-CARBON MARKET FINANCE

The UK Government estimates that developing countries will need around $100 billion per year by 2020 from the international community to address climate change. A proportion of this finance will need to come from non-market sources.

Non-market finance will be important for capacity building, demonstration activities, R&D, technology transfer and adaptation, as well as realising additional climate change mitigation. Low carbon development strategies could be an important means of avoiding duplication between market and non-market mitigation finance.

The Bali Action Plan calls for *'Improved access to adequate, predictable and sustainable financial resources'*. The UK Government is working on the basis that the amount of finance needed by developing countries from the international community for mitigation, forestry, adaptation and technology is likely to be around $100 billion per year by 2020.[28] The private sector is expected to be the main source of this finance with a reformed carbon market providing a significant proportion. However, a substantial proportion will need to come from non-market sources. Non-market finance will be particularly important for building carbon market capacity in developing countries, funding national-level demonstration activities, R&D, technology transfer and adaptation.

27 Hoare et al (2008)
28 DECC (2009a)

Where the international community provides developing countries with non-market finance for additional mitigation, it will be important to coordinate this with market finance in order to maximise efficiency and avoid double counting. Countries' low carbon development strategies could be an important means of avoiding duplication between market and non-market mitigation finance (see Chapter 7).

6.8 RECOMMENDATIONS

- The international community should create government-level sectoral mechanisms including Sectoral Trading and Sectoral Crediting, as well as reform the Clean Development Mechanism. Developing countries should be encouraged to participate in the mechanisms that are appropriate to their level of development.
- Alongside carbon market finance, public funds should be used to leverage further financial support for climate change mitigation, forestry, technology and adaptation in developing countries. Low carbon development strategies should be used to coordinate mitigation action financed through carbon trading with that financed through non-market international funds.
- The development of government-level carbon trading mechanisms in the forestry sector should involve the full participation of indigenous peoples and other forest communities.
- The Clean Development Mechanism should be reformed, using benchmarking where possible to increase environmental integrity and become more rules-based to reduce uncertainty.

7 GOVERNANCE AND INSTITUTIONS

KEY MESSAGES

Strong governance and institutions are needed to ensure that a dual-level system of carbon trading delivers cost-effective and equitable reductions in emissions.

Intermediary mechanisms for the participation of developing countries will also require sound institutional oversight.

The United Nations should continue to provide an international framework for national targets, agreed standards and verification of national-level emissions. However, the framework should be reviewed and strengthened in certain areas, such as target setting and compliance.

At emitter level, the national authority should maintain responsibility for the effective regulation and implementation of its own ETS, even after linking.

A light-touch joint committee consisting of representatives of national authorities could coordinate between linked ETSs and negotiate with new entrants.

Sectoral Crediting is likely to be an important mechanism for developing countries not in a position to participate in Sectoral Trading. New institutional functions will be needed to agree business as usual and crediting baselines on the basis of sound technical and emissions data.

For developing countries not in a position to participate in government-level sectoral mechanisms, the CDM should be reformed and streamlined. In the short term, the CDM secretariat should be strengthened with more permanent staff and scope to validate uncontroversial proposals more rapidly.

Developing countries are at different stages of development and will need to access carbon market and non-market finance in different ways. A high level body at the international level should be charged with ensuring effective coordination of this finance through low carbon development strategies.

Developed and advanced developing country reduction commitments need to be sufficient to generate demand for developing country credits. Non-market finance will also be important in bolstering incentives for developing county abatement.

The design and governance of forestry funds need to be based on equitable participation by developing and developed country governments, and should be carried out in consultation with indigenous groups and forest communities.

7.1 GOVERNANCE AND INSTITUTIONS IN THE INTERNATIONAL CLIMATE FRAMEWORK

Strong governance and institutions are needed to ensure that a dual-level system of carbon trading delivers cost-effective and equitable reductions in emissions.

Intermediary mechanisms for the participation of developing countries will also require sound institutional oversight.

A strong institutional architecture for a dual system of carbon trading will be essential to deliver verifiable reductions in emissions which are both cost effective and equitably distributed. At the same time, the intermediary mechanisms for developing countries described in the previous chapter will require sound institutional oversight. Governance for these systems will need to act at two levels: the international level, with agreement on national targets along with monitoring and verification of national emissions; and the national level, with countries having the sovereign right to use the most appropriate policy tools, including ETSs, to meet their national targets. Good governance must also be put in place for the linking of ETSs as well as the intermediary linking of developing countries.

Expansion and linking will bring additional actors, organisations and regulatory frameworks into global carbon trading. During this transition, the challenge will be to build cohesion and shared objectives rather than complexity and fragmentation. In this chapter, we examine the governance and institutional architecture required at the international and national levels to ensure that a cohesive system develops that delivers emissions effectively, efficiently and equitably.

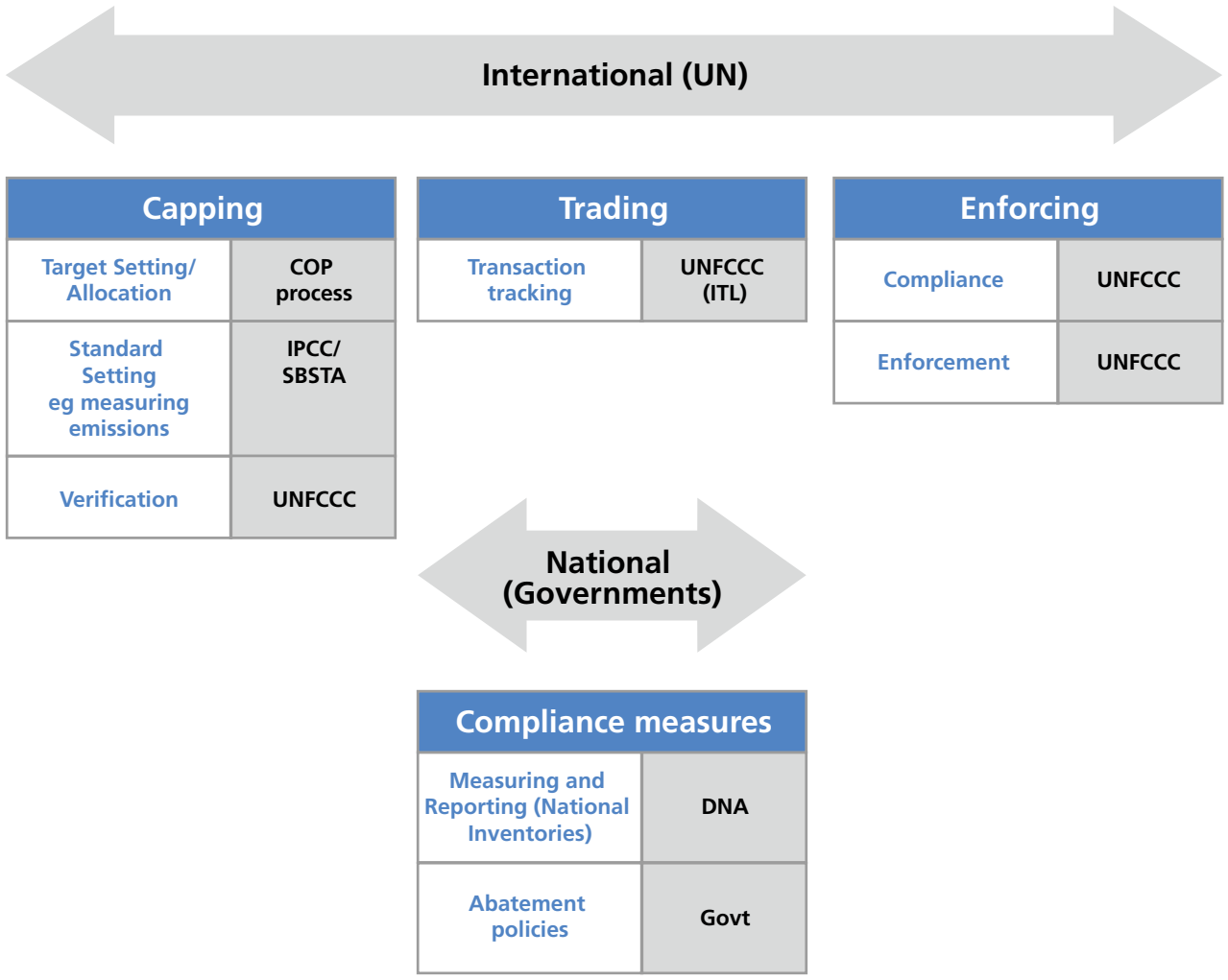
7.2 INTERNATIONAL GOVERNANCE – NATIONAL TARGETS IN DEVELOPED COUNTRIES

The United Nations should continue to provide an international framework for national targets, agreed standards and verification of national-level emissions. However, the framework should be reviewed and strengthened in certain areas, such as target setting and compliance.

The international level of governance provided for Annex I countries by the UNFCCC is characterised by a centralised architecture, with one set of rules which are agreed multilaterally at the Conference of the Parties (COP). Three broad functions are delivered by this architecture: the setting and verifying of targets, the trading of emissions allowances and enforcement. These broad functions include a number of subsidiary functions (see Figure 7.1).

Although the UN has the legitimacy to continue to provide the international framework for this level of governance, there are some areas such as target setting that could be strengthened. In addition, compliance mechanisms are as yet untested.

Figure 7.1: International level governance



7.2.1 Target setting

Without more stringent national targets, the international community will not succeed in reducing emissions below the global limit needed to avoid the worst impacts of climate change. Enhanced processes for target setting and the allocation of AAUs could help to set more ambitious targets in line with science. One option would be to agree a role for a technical body of nominated experts to make recommendations to all parties to the negotiations, including for specific country commitments. This apolitical body could draw on the technical advice shared between the IPCC and its working groups, the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the COP. As well as advising on country targets, it could provide recommendations on global totals, and potentially diminish the risk of insufficiently ambitious opening negotiating positions.

7.2.2 Compliance

Enforcement of national targets remains largely untested under the Kyoto framework because we are currently in only the first compliance period of the international agreement. There are nevertheless considerable challenges in constructing a binding instrument that will offer a credible compliance mechanism without deterring sovereign parties from participating in the system.

The Kyoto Protocol establishes a comprehensive international framework for compliance through its Compliance Committee, consisting of a Facilitative Branch, designed to promote compliance by assisting countries to meet their targets by offering advice and consultation; and an Enforcement Branch, which has the power to determine consequences for those parties which fail to meet targets (see Figure 2.2 in Chapter 2). The compliance framework is, according to some sources, probably without precedent among multilateral environmental agreements,[1] but it will not be

1 Yamin and Depledge (2004) p386

possible to assess whether parties are sufficiently deterred from non-compliance until after the end of the first compliance period. In the meantime, lessons from other international frameworks with enforcement mechanisms such as the WTO and the Montreal Protocol suggest that the importance of building in an appropriate balance of incentives and disincentives is fundamental to its success.[2]

Encouraging more developed countries to commit to legally-binding targets will be a crucial step in deepening global emissions reductions, and this is likely to rely on the establishment of a legitimate and transparent climate infrastructure which has the credibility to attract widening commitments from other countries.

7.3 NATIONAL GOVERNANCE – A NETWORK OF LINKED ETSs

7.3.1 National governance

At emitter level, the national authority should maintain responsibility for the effective regulation and implementation of its own ETS, even after linking.

While the UN has a role at the international level, sovereign nations should maintain the freedom to choose the most appropriate domestic policy tools to meet their national emissions targets. This means that at the emitter level, the national authority should remain fully responsible for the effective regulation and implementation of its own ETS. This should also be the case for regional systems such as the EU ETS.

Furthermore, cooperation between countries to link their domestic ETSs should take place outside the intergovernmental negotiation processes and institutions. This is not only because sovereign countries should maintain responsibility for their domestic policies, even when trading is involved, but also because it can provide the building blocks for developing and expanding a cost-effective carbon market without first having to wait for full international consensus and participation.[3]

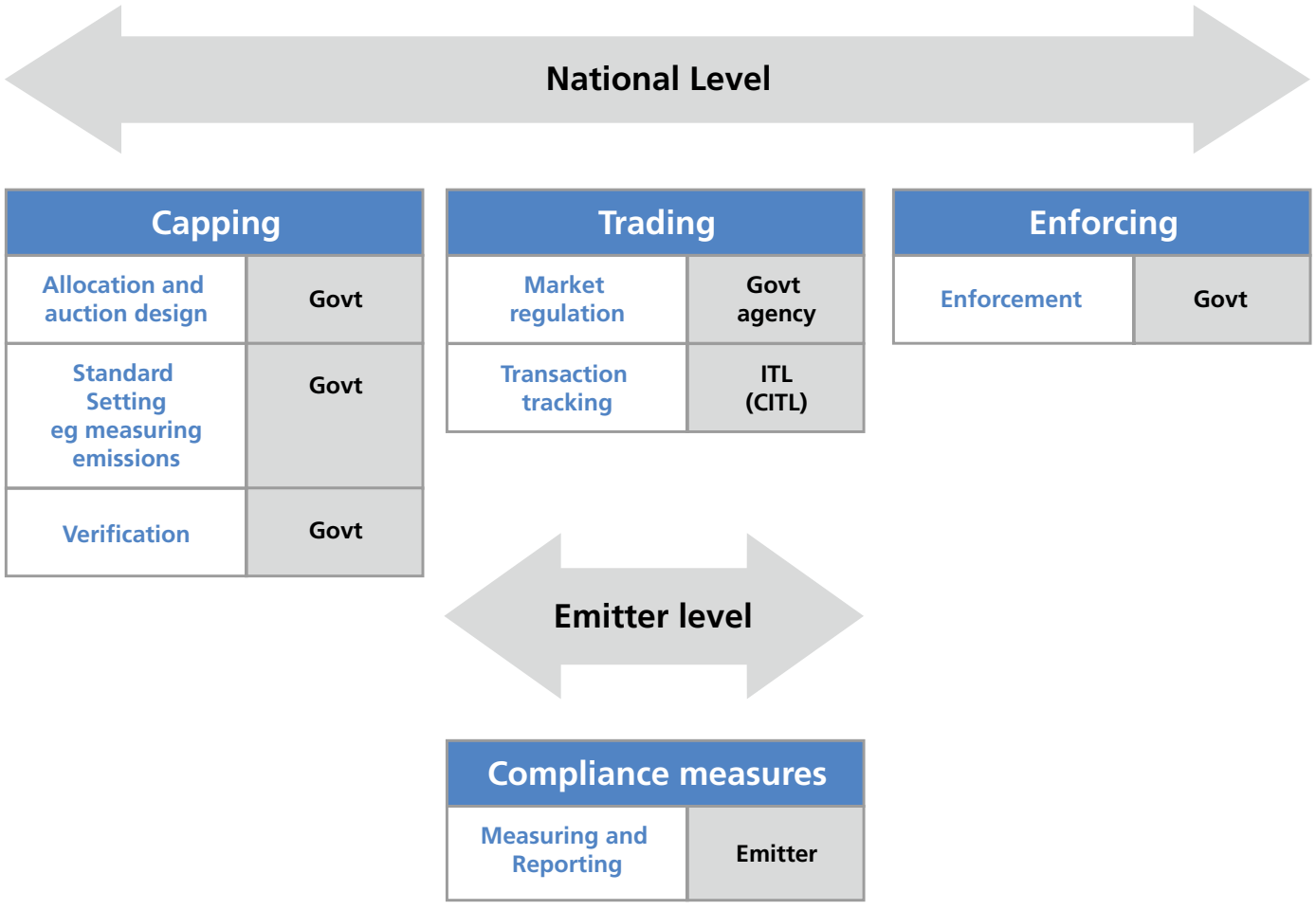
A number of functions will be essential to the operation of a linked ETS network, as set out in Figure 7.2. At the national level, domestic functions for the operation and regulation of the ETS should continue to be overseen by national authorities.[4] In the case of the EU, which has a unique regulatory structure, oversight of the EU ETS has two tiers. The first of these regulates the primary market (the process of allocation and auctioning of allowances), supervised by the European Commission in collaboration with the Member States. The second tier covers the secondary market in allowances (including 'spot' as well as derivatives trading) and this is overseen by the Member States. In the UK, for example, the Financial Services Authority (FSA) regulates derivatives of carbon allowances under the same framework as that regulating all derivatives.

2 The compliance regime within the EU ETS is unique and thus not analogous to the Kyoto framework. EU Member States are required to transpose EU Directives into national legislation. This means that each country retains responsibility for compliance by its emitters, while the EU is responsible as a Kyoto party for overall emissions from the EU.

3 Flachsland, Marschinski, and Edenhofer (2009)

4 Note that the EU ETS is not a linked network of ETSs; rather it is a single ETS covering a number of countries. Where regional ETSs of this kind are established, the relevant regional authority will retain overall responsibility for the regulation of that regional ETS.

Figure 7.2: Governance of ETSs



Within an ETS, some functions are also devolved to the emitter level. The measuring and reporting of emissions must be carried out by emitters themselves, and reports are then submitted to the national regulator responsible for regulating emissions. The regulator then reviews annual emission reports and may issue a financial penalty for any failure to surrender the appropriate amount of emissions allowances.

Similarities and differences between the international market in carbon allowances and credits and other global markets such as those in securities, currencies and commodities can inform the appropriate levels of governance and regulation of carbon trading (see Box 7.1). In general, it is important to note that carbon markets are distinct from these more mature markets in that they are artificially created and depend entirely on the climate change agreements and commitments made between governments. The generation of policy certainty by governments is therefore a key building block in the establishment of a credible emissions market. A second key difference is that carbon markets are still in a formative stage. Because they depend on government climate change agreements, policy-makers will play an important role in enabling these markets to mature.

Box 7.1: Lessons learned from the governance and regulation of other markets

Commodities, securities and currencies

Commodities such as coffee, oil and coal are traded both on physical markets and on derivatives markets (such as in futures or forward contracts). The difference between these two types of market has resulted in different regulatory approaches. In the UK, for example, where carbon is treated as a commodity, the Financial Services Authority (FSA) does not regulate spot trades of commodities, while it does regulate the market in derivatives.

A security is a financial instrument which represents a financial asset of some kind, such as debt, equity (shares) or derivatives (including options, forwards and futures). Multinational companies wishing to trade in different financial jurisdictions have shown that they are willing to absorb the costs involved in doing business across different regulatory regimes because the costs are often outweighed by the greater access to capital.

Governance of global financial markets is carried out by governments and central banks, and central bank policies are coordinated at an international level by organisations such as the Bank of International Settlements in Geneva, which now has 55 members.

The markets above provide valuable lessons for carbon markets:

- **The role of government.** Unlike many other markets, carbon markets are constructed by governments to address a market failure. Carbon markets are compliance markets, imposed on emitters. This government control can ensure that market design regulations are robust. Commitment phases also give governments regular opportunities to strengthen the system.
- **Confidence and credibility.** Confidence that a market will continue to exist and that the tradable will maintain and increase its value is more important than standard short-term market fluctuations for planning investment in low carbon projects. Price volatility will also decrease as emissions trading systems expand and link into deeper and more liquid markets.
- **Scarcity.** Markets depend on the level of scarcity of the tradable. This level of scarcity establishes price. Creation of scarcity in carbon markets is the outcome of government agreements with respect to emissions caps and allowances, which means that governments have a stronger role to play than in the more mature commodities or financial markets.
- **Market manipulation.** A market may be vulnerable to manipulation if dominated by a small number of large participants. A deep and liquid market with many participants reduces the risk of market manipulation. In addition, the relevant authority should be tasked with identifying manipulation quickly and should have powers to act against offenders.
- **Derivatives.** Derivatives can play an important role. For example, hedging can mitigate risk, thereby encouraging more investments in low carbon projects. However, the market needs to be appropriately regulated (this is undertaken by the FSA in the UK) with ongoing scrutiny of the regulatory framework.

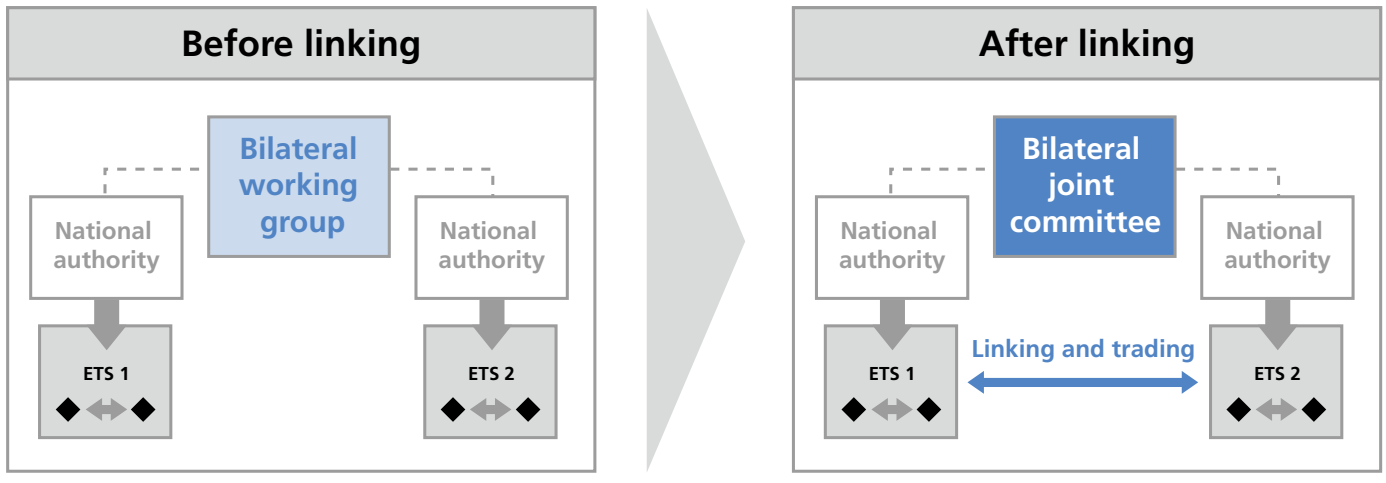
7.3.2 Coordination of linked ETSs

A light-touch joint committee consisting of representatives of national authorities could coordinate between linked ETSs and negotiate with new entrants.

Bilateral linking of national and regional ETSs will need detailed planning and coordination between the relevant authorities. As discussed in Chapter 5, coordination is particularly important for ensuring that different design features of ETSs, such as MRV, banking and borrowing of allowances, types of international credits, and price interventions, do not act as barriers to linking. Technical issues, such as the harmonisation of allowance-tracking software, will also need to be addressed. Coordinating the linking of two ETSs could be undertaken by a bilateral working group consisting of experts and authorities from the two nations (or regions) involved (Figure 7.3).

At present, the International Carbon Action Partnership (ICAP) offers a knowledge sharing forum for governments of countries wishing to implement mandatory cap and trade systems (or those that already have). Country representatives can come together through ICAP to share experiences and discuss best practice.

Figure 7.3: Coordinating the linking of ETSs



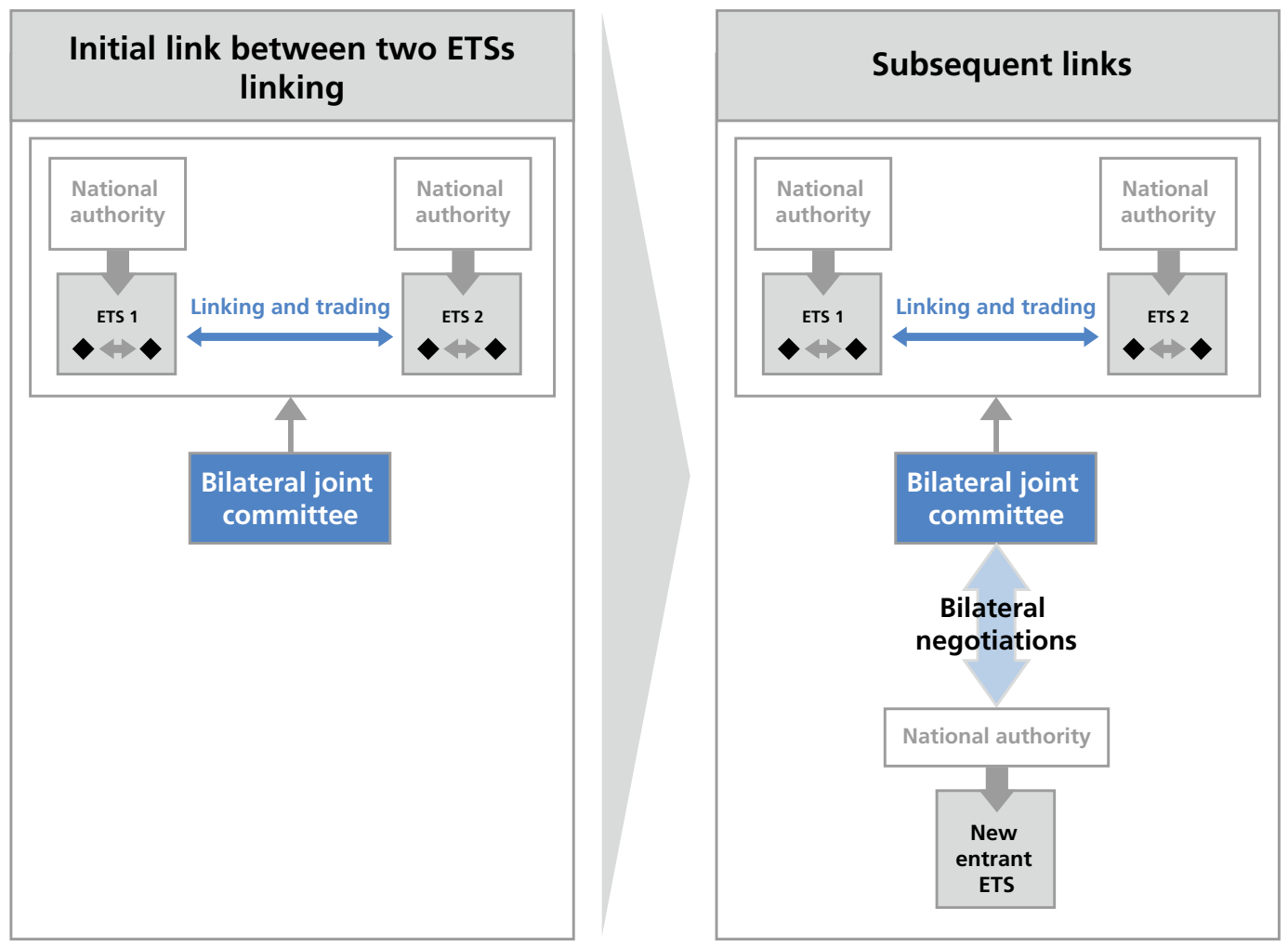
The terms of any proposed bilateral link could be set out in a memorandum of understanding (MOU), or other bilateral agreement, between the two parties. This would help to provide both parties with confidence that any future changes to the operation of the systems would be effectively coordinated.

Once the link has been established, and allowances are being traded between ETSs, a light-touch joint committee of the two ETS authorities could help to resolve any technical issues that require coordination. It could also act as a platform for the negotiation of further links with other ETSs (see Figure 7.4).

This joint committee would not need to be involved in the regulation or compliance of each individual ETS, as these should continue to be administered by the national authority (or regional authority, such as in the EU ETS). Given this limited need for decision making, any decisions could be made through consensus.

As well as setting out terms for the mutual recognition of carbon allowances, an MOU or linking agreement could also contain a provision for dispute resolution. For example, this could enable parties to agree a procedure for the appointment of an arbitration panel to arbitrate in the case of a dispute. Alternatively, disputes could be resolved on an ad hoc basis, keeping the linking agreement between the parties as light-touch as possible.

Figure 7.4: Governance for a network of linked ETSs



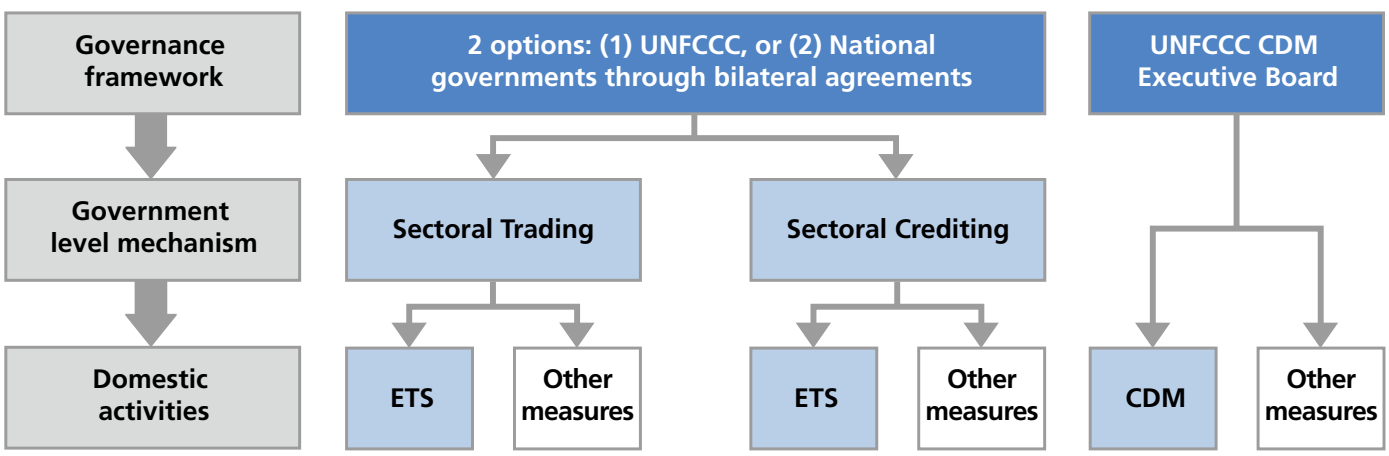
The process of admitting new entrants to the network could be managed by negotiations between the joint committee and the new entrant. In trying to understand how this might work, lessons could be drawn from the GATT model, which offered a common negotiating framework without the establishment of a formal institution. In admitting a new ETS to the network, where an MOU or linking agreement has been drawn up, the agreement could either be complemented by a new linking agreement with the new entrant, or amended to include the new entrant in a multilateral agreement.

7.4 PARTICIPATION OF DEVELOPING COUNTRIES

Intermediary mechanisms for the participation of developing countries will also require sound institutional oversight.

The previous chapter sets out pathways for developing country participation in global carbon trading. Developing countries will move along these pathways at different speeds, according to their relative levels of economic growth, development, national circumstances and capacity. They will therefore participate through a number of different mechanisms appropriate to country-specific circumstances. These mechanisms include Sectoral Trading, Sectoral Crediting, Sectoral CDM and a reformed CDM, which are described below as well as in greater detail in Chapter 6 (see also Figure 7.5).

Figure 7.5: Governance options for developing country carbon market mechanisms



7.4.1 Sectoral mechanisms for developing country participation

Sectoral Crediting is likely to be an important mechanism for developing countries not in a position to participate in Sectoral Trading. New institutional functions will be needed to agree business as usual and crediting baselines on the basis of sound technical and emissions data.

More advanced developing countries should, when possible, move towards Sectoral Trading in which developing country governments agree targets for specific sectors. Commitments could

be agreed in a similar manner to national targets in developed countries, ie through a centralised negotiation process at the UNFCCC COP. These negotiations could be informed by preliminary advice from the technical advisory body referred to in Section 7.2. If the country in question then opts to implement its sectoral commitments through an ETS, governance of that ETS would be a sovereign matter as it would for any other domestic implementation instrument (Figure 7.5). Verification of emissions data could then be carried out as outlined in Box 7.2 below.

Box 7.2: Verification of emissions reductions for developing country participation

Verification of Annex I country emissions inventories currently takes place through the following processes:

- a yearly centralised review of the country's emissions inventory conducted by a pool of nominated UNFCCC technical experts from developing and developed countries.
- an in-country review every four years which is conducted by a small team of experts selected from the nominated pool.

The credibility of this approach means that it offers a strong model for the verification of emissions reductions in other countries. Additional capacity will be needed to provide international technical expertise for the review of emissions data. This is discussed in more depth in Chapter 8.

Sectoral Crediting is likely to be an important mechanism for developing countries not in a position to participate in Sectoral Trading. Under this new mechanism, the government would receive credits for surpassing an ambitious, pre-determined, national-level crediting target. Agreeing business as usual emissions and setting the appropriate crediting target for the chosen sector (one that delivers an *own contribution* by the host country while providing scope for gaining credits) will be important.

A body within the UN framework, consisting of a manageable number of significant buyer and seller countries, could gain preliminary agreement on such baselines, backed by advice from the technical advisory body referred to above. In addition, the timely provision of good quality emissions data should be a key eligibility criterion for countries wishing to participate in Sectoral Crediting. Verification of emissions data should be carried out as outlined in Box 7.2.

While sectoral mechanisms are still being developed, bilateral credit agreements between buyer and seller countries could trial sectoral methodologies and approaches. Sectoral baselines and finance could be agreed by countries (or sub-nationally) on a bilateral basis outside any intergovernmental process. An example of this type of arrangement currently being discussed between California and two Chinese provinces.[5] Bilateral agreements could also operate in parallel with UNFCCC sectoral mechanisms. However, fungibility of the different credits would require international standards and verification to avoid double counting between the two systems.

7.4.2 Reform of the Clean Development Mechanism

For developing countries not in a position to participate in government-level sectoral mechanisms, the CDM should be reformed and streamlined. In the short term, the CDM secretariat should be strengthened with more permanent staff and scope to validate uncontroversial proposals more rapidly.

5 Discussion with Californian Air Resources Board, 18 June 2009

The Clean Development Mechanism will remain an important mechanism for developing countries not in a position to participate in government-level sectoral mechanisms. However, as the previous chapter set out, the CDM will need reforming to include greater use of benchmarks for projects to avoid the bureaucracy involved in assessing each individual project for additionality.

In addition, a number of improvements could be made to the institutional structure of the CDM within the UNFCCC in order to reduce project review times and avoid bottlenecks. Currently, the CDM Executive Board supervises the CDM under the authority and guidance of the Conference of the Parties. The shortcomings of this arrangement could be addressed in large part by extending the responsibilities of the CDM Secretariat and appointing a permanent Secretariat staff. This permanent staff could validate uncontroversial projects, and submit more controversial ones to the Executive Board for review. In addition, the decision-making process should become more rules-based so as to improve the transparency of the system.

7.4.3 Non-market finance: low carbon development strategies

Developing countries are at different stages of development and will need to access carbon market and non-market finance in different ways. A high-level body at the international level should be charged with ensuring effective coordination of this finance and that it is being used to produce quantifiable emissions reductions through low carbon development strategies.

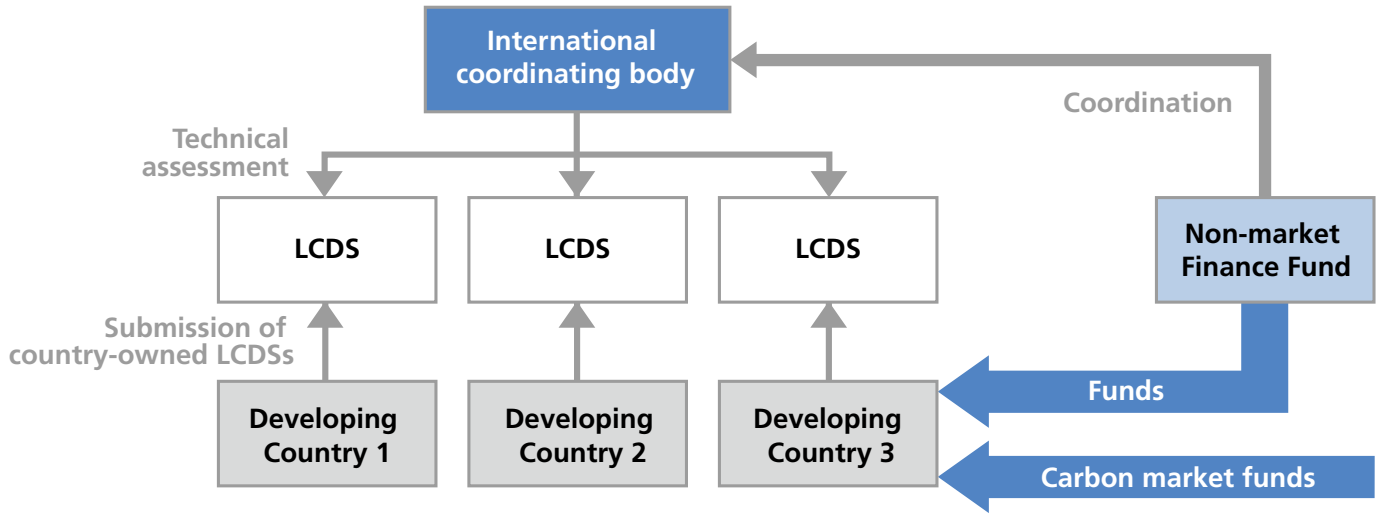
Developed and advanced developing country reduction commitments need to be sufficient to generate demand for developing country credits. Non-market finance will also be important in bolstering incentives for developing county abatement.

The previous chapter discussed the adoption of low carbon development strategies (LCDSs)[6] in order to maximise the efficiency of non-market funding from the international community to developing countries, and to ensure that double counting is avoided. The assessment of LCDSs is likely to be most suited to more specialised bodies (for example, thematic bodies or committees with expertise in certain areas, such as adaptation, mitigation and technology), but overall coordination should be the function of a single international coordinating body, which would form part of the broader institutional landscape.

In their LCDSs, developing countries could set out a vision for achieving low carbon development and the mitigation action that needs to be taken to get there. These strategies should highlight those mitigation actions that the country intends to fund itself or to finance through the carbon markets. They should also set out areas to be supported through the allocation of non-market finance, which should be coordinated overall by the coordinating body referred to above. A centrally-maintained register of all projects and initiatives receiving non-market finance from the international community would ensure that duplication is avoided and would bolster the availability of information. Figure 7.6 below illustrates how such a system could work.

6 This term is used in the EU Environment Council Conclusions on the further development of the EU position on a comprehensive post-2012 climate agreement (Contribution to the Spring European Council, March 2009). The recent Declaration of the Leaders of the Major Economies Forum on Energy and Climate (made in Italy on 9 July 2009) used the term 'low-carbon growth plans' when they declared that MEF countries would prepare low-carbon growth plans, and that the developing countries of the MEF would 'promptly undertake actions whose projected effects on emissions represent a meaningful deviation from business as usual in the midterm, in the context of sustainable development, supported by financing, technology, and capacity-building.'

Figure 7.6: Architecture for coordination of market and non-market finance (LCDSs)



The benefits of allocating non-market finance to countries through a high-level body of this kind include the opportunity to minimise the complexity of institutional arrangements for funding to developing countries, as well as the possibility that developing countries are only required to report mitigation activities against a single plan (the LCDS) in order to access a range of finance from various sources in the international community. As well as helping to develop a public financing framework that is scalable and fit for purpose, such a system should also increase the scope for ensuring that agreed international standards of financial reporting are adhered to, thereby providing high levels of financial probity.

Data collected by this high-level body could also offer a valuable contribution to the evaluation of the supply of credits from developing countries. This is an important function because in the absence of stronger commitments from developed countries, there is a risk that surplus carbon allowances could be generated through an improved CDM framework or the establishment of sectoral mechanisms. It is therefore important to ensure that a comprehensive and dynamic framework is established which balances the urgent need for stringent targets to encourage upfront domestic abatement, with the need to understand and respond quickly to supply patterns in the context of those targets.

This framework should incorporate the following features in order to address the risk of surplus credits:

1) stringent caps and ambitious baselines;

2) regular reviews of caps and baselines;

3) banking of credits from one compliance phase to the next;[7] and

4) access to non-market finance, for example the Forest Carbon Partnership Fund (see Box 7.4).

Although the setting of targets and baselines is always likely to be subject to negotiation amongst parties, preliminary advice from the independent technical advisory body proposed in the sections above could help to facilitate an effective and speedy regular review process. Ambitious emissions reduction targets in developed countries could also be supported by the ability for both sellers and buyers to bank credits and to use them to meet targets in future compliance phases.

7 Banking may be limited during initial or trial phases of new mechanisms (such as sectoral mechanisms) to allow time for baselines to be set appropriately.

Lastly, non-market finance will also be an important part of the toolkit for minimising the risk of credit surpluses. Examples of dedicated funds for abatement in certain sectors already exist with respect to forestry (see Box 7.4), and it is important that this approach is adopted in other areas, especially those facing the most challenges in accessing market finance, such as other land use sectors (agriculture for example) especially within Least Developed Countries. Approaches to forest funding are explored in more depth in the following section.

7.4.4 Forests: funding and governance

The design and governance of funds for reduced emissions from deforestation need to be based on equitable participation of developing and developed country governments, and should be carried out in consultation with indigenous groups and forest communities.

As outlined in Chapter 6, reduced emissions from deforestation and degradation (REDD) will need to be a crucial component in the agreement of any new global deal on climate change. Because the majority of forestry emissions come from developing countries, the establishment of a strong governance architecture for the various forest funding mechanisms proposed to tackle forest emissions will be key to ensuring participation by these countries, as well as by the indigenous peoples affected by the issues involved in REDD.

The international coordinating body referred to in the previous section might also provide capacity to coordinate funding for REDD activities and to ensure that an equitable approach underpins any gains from the extensive abatement opportunities available in this sector. Similarly, the framework should facilitate equitable participation by developed and developing countries, and should be based on early consultation with forest communities and indigenous peoples on the design of REDD mechanisms.

The role of the international coordinating body would not prevent the establishment of bilateral forest funding arrangements between countries. Rather, it would help to track and record projects that are taking place beyond the perimeters of multilateral funding mechanisms, thereby enhancing the sharing of information and experiences among actors in this sector. In addition, recipient forest nations will still be free to select their own delivery partner, (such as regional development banks, NGOs, bilateral implementing agencies or private-sector organisations) for the delivery of projects funded through these mechanisms.

Box 7.4: Multilateral funds to support country programmes to reduce emissions from deforestation

Global Environment Facility (GEF)

The GEF was established in 1991 to help developing countries fund projects and programmes that protect the global environment. GEF grants support projects related to biodiversity, climate change, international waters, land degradation, the ozone layer and persistent organic pollutants. It has financed forest preservation and sustainable land management projects under its land degradation theme and will continue to have a role in pilots and demonstration activities around forests, although new mechanisms set out below are designed to provide large-scale and dedicated finance to the forest sector.

UN-REDD

UN-REDD is a collaborative programme which aims to help prepare countries to access a REDD mechanism should formal agreement be reached at COP 15 in Copenhagen. Its work (which will initially run until March 2010) covers the following areas:

- capacity building needs assessment;
- support for strategy development and capacity for monitoring and measuring;
- development and dissemination of guidelines, methods and tools for REDD;
- testing approaches (for example for data management and distribution mechanisms) and collating and disseminating lessons.

Forest Carbon Partnership Facility (FCPF)

The FCPF was launched by the World Bank during the Bali climate talks in December 2007. It is a multi-stakeholder partnership of developing and industrialised countries, NGOs and international financial institutions.

The FCPF comprises two separate mechanisms:

1. **Readiness Fund:** designed to help developing countries participate in a future system that rewards REDD, by supporting the development of measuring and monitoring systems and REDD strategies.
2. **Carbon Fund:** intended to 'pump-prime' crediting mechanisms for REDD. The Carbon Fund will buy credits from countries in accordance with negotiated contracts for verifiably reducing emissions below a reference scenario.

The FCPF will have a national approach but will not preclude implementation of sub-national programmes and projects.

World Bank Strategic Climate Fund (SCF) and the Forest Investment Programme (FIP)

The SCF and the Clean Technology Fund together make up the World Bank's Climate Investment Funds. The SCF funds pilot projects for new development approaches or to scale up activities aimed at specific climate change challenges through targeted programmes. The SCF framework incorporates the FIP which, at the time of writing, had just completed the preliminary design and pledging phases of its implementation. This programme will mobilise investments for REDD activities as well as promoting improved sustainable forest management.

Adapted from Eliasch (2008)

7.5 RECOMMENDATIONS

- At emitter level, the appropriate national authorities should continue to be responsible for the effective regulation and implementation of national (or regional) Emissions Trading Systems, even after linking.
- A light-touch joint committee consisting of national representatives of linked Emissions Trading Systems should coordinate between Emissions Trading Systems and negotiate with new entrants.
- Baselines for government-level Sectoral Crediting should be determined with the advice of a technical body and the agreement of buyer and seller nations.
- Bilateral credit agreements between buyer and seller countries or subnational entities outside the intergovernmental process should be trialled while sectoral mechanisms are being developed.
- The CDM secretariat should be strengthened with more permanent staff and more scope to validate projects that are uncontroversial.

8 CAPACITY BUILDING

KEY MESSAGES

A wide range of capacity building initiatives have already been undertaken to prepare countries for participation in carbon trading. The international community needs to build on these initiatives urgently to demonstrate and realise the potential of carbon market instruments as a policy tool to abate emissions.

Capacity building to prepare countries to participate in carbon trading should focus on three main requirements: 1) measuring, reporting and verification of emissions both at national and emitter levels, 2) policy and legal reform and 3) institutional reform. Further capacity building will be required in specific sectors (for example reform of land rights for the forestry sector) along with wider support for development. These requirements will be country specific.

One estimate suggests that the costs of capacity building to enable developing countries to participate in sectoral mechanisms and a reformed CDM over the next decade could be up to $5 billion. This covers capacity building to share and transfer knowledge and build expertise in monitoring, reporting and verification as well as policy and institutional reform. This estimate does not include the costs of implementation or wider sector-specific capacity building, which would substantially increase costs.

The importance of non-market funding for capacity building will be crucial in the short term as carbon market finance will be limited at the early stages of development.

International funding should be coordinated effectively to avoid a proliferation of competing mechanisms and to prioritise capacity building efforts.

8.1 EXISTING CAPACITY BUILDING INITIATIVES

A wide range of capacity building initiatives have already been undertaken to prepare countries for participation in carbon trading. The international community needs to build on these initiatives urgently to demonstrate and realise the potential of carbon market instruments as a policy tool to abate emissions.

8.1.1 Capacity building and the Kyoto Protocol

Previous chapters have shown how both developed and developing countries can link to global trading networks through a range of mechanisms. However, many developing and some developed countries will require timely and appropriate support for capacity building to allow them

to participate in trading. In this report, capacity building is defined as the preparatory activities required to link countries, sectors, projects and/or businesses to carbon markets and allow them to participate through a range of trading mechanisms, including baseline and crediting and cap and trade.

Various capacity building initiatives already exist. Article 10e of the Kyoto Protocol summarises capacity building requirements in order to address the shortfall in capacity.[1] Consequently, capacity building has focused on national emissions inventories, as well as the promotion of the CDM in developing (non-Annex I) countries. The Global Environment Facility (GEF) is financing the development of national inventories in developing countries, in collaboration with implementation agencies such as the United Nations Development Programme (UNDP). To date, 134 countries have produced their first national communication including a national inventory – mostly based on 1994 data – and, at the time of writing, ten had also produced a second national communication.[2] Mexico is the only non-Annex I country to have produced three national communications, with a fourth one in preparation.[3]

In terms of capacity building in specific sectors, the World Bank Forest Carbon Partnership Facility's Readiness Fund carries out capacity building activities in forest nations.

Capacity building for the CDM in developing countries has provided both expertise and institutional strengthening. Initiatives such as CD4CDM (Capacity Development for the CDM) managed by the United Nations Environment Programme (UNEP) and financially supported by the Dutch Government, has raised awareness in developing countries of the benefits of the CDM.[4] CD4CDM has conducted capacity development projects in 19 countries across Asia, Africa and Latin America, gaining valuable experience in rolling out CDM capacity in developing countries. Similarly, the World Bank's Carbon Finance Assist programme is working across developing countries to promote and support CDM projects and programmes through a learning-by-doing approach.

More recently, the focus has shifted to capacity building in Least Developed Countries (LDCs), because they have had limited participation to date in the CDM: less than 1% of CDM projects occur in LDCs (see Box 2.1). There are many structural reasons for the lack of project investment and activity in LDCs, such as risks related to governance, and lack of capacity and infrastructure – but also due to the general low emissions growth in those countries. The Nairobi Framework – launched in 2006 and initiated by the World Bank, UNEP, UNDP and UNFCCC – aims to bring together key UN agencies and multilateral development banks to catalyse investment in the CDM in LDCs, particularly in Africa, through coordinated capacity building initiatives, including workshops, technical support as well as campaigns to raise awareness of CDM opportunities. Although the implementation of the Nairobi Framework has been delayed and it has suffered from a lack of international support, it is a good example of collaboration between two agencies, the UNDP and the UNEP, which have worked jointly to carry out capacity building activities in LDCs in the context of the CDM.

---

1 '[All Parties shall] cooperate in and promote at the international level, and, where appropriate, using existing bodies, the development and implementation of education and training programmes, including the strengthening of national capacity building, in particular human and institutional capacities and the exchange or secondment of personnel to train experts in this field, in particular for developing countries, and facilitate at the national level public awareness of, and public access to information on climate change[…]'

2 These 10 countries are: Argentina, Kazakhstan, Kyrgyzstan, Macedonia, Mauritania, Mexico, South Korea, Tajikistan, Uruguay, Uzbekistan

3 UNFCCC website

4 CD4CDM website: http://www.cd4cdm.org/

In order to ensure that CDM credits from LDCs are recognised in the market post-2012, the EU has guaranteed a market for CDM credits from LDCs in the EU ETS.[5] In addition, the Millennium Development Goals (MDG) Carbon Facility has been created to translate capacity building in LDCs into actual CDM projects. The MDG Carbon Facility aims to combine poverty reduction and climate change mitigation objectives through the development of a portfolio of CDM projects with high sustainable development benefits.[6]

8.1.2 Capacity building and ETSs

Member States joining the EU are also required to join the EU ETS, which has led to an increase in the number of capacity building initiatives.

The EU ETS Compliance Forum was established in September 2008. Its objective is primarily to strengthen the EU ETS compliance chain by improving communication, raising awareness among stakeholders (including verifiers, operators, etc) and building capacity through training workshops and the exchange of best practice. This initiative will help spread knowledge, especially from older to more recent EU Member States, for strengthening measuring, reporting and verification (MRV). In the longer term, if the understanding of compliance rules improves among stakeholders, non-compliance rates should decrease, leading to a reduction in EU ETS administration costs.

The EU ETS experience has demonstrated that it is possible for countries (in this case economies in transition) to participate in an ETS within a relatively short time frame. This 'fast track' approach needs to be rigorous as the effectiveness of an ETS depends on the reliability of all its participants. With the assistance of other Member States and the European Commission, new EU Member States have succeeded in setting up accurate and rigorous MRV processes and institutional capacity.

In addition, emitter-level initiatives such as the Carbon Disclosure Project give the opportunity to emitters in developing countries to voluntarily report annual emissions.[7]

8.2 FUTURE CAPACITY BUILDING REQUIREMENTS

Capacity building to prepare countries to participate in carbon trading should focus on three main requirements: 1) measuring, reporting and verification of emissions both at national and emitter business levels, 2) policy and legal reform and 3) institutional reform. Further capacity building will be required in specific sectors (for example reform of land rights for the forestry sector) along with wider support for development. These requirements will be country specific.

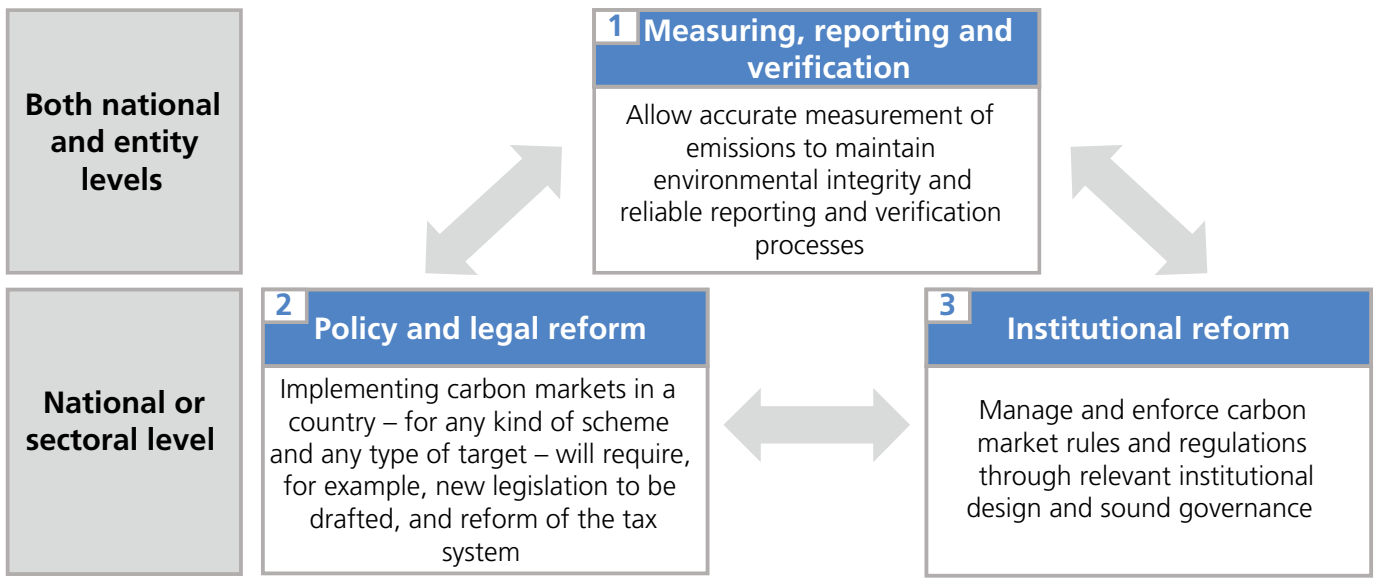
Capacity building should be driven by the needs of developing countries. In the transition period, countries at different stages of development will want to engage in different types of carbon trading mechanism which will have different capacity building requirements (see Chapter 6). The emissions profile of a country will also affect reforms needed. For example, a country with a high proportion of emissions from deforestation will have to build a different set of MRV standards, technologies and institutions to mitigate emissions compared to a country with emissions predominantly from industrial sources.[8]

---

5 Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.
6 UNDP (2005)
7 Although at present, the quality and quantity of data reported under this initiative varies.
8 Eliasch (2008)

Whichever trading mechanism is chosen by a country, three broad categories of capacity building will be required: 1) measuring, reporting and verification; 2) policy and legal reform, and 3) institutional reform. These are set out in Figure 8.1 and described below.

Figure 8.1: Three main categories of capacity building requirements



8.2.1 Measuring, reporting and verification

A robust MRV system is essential for ensuring that emissions reductions are real and verified and for building trust among market participants. Establishing robust MRV will require both knowledge and technology transfers at national, sectoral and emitter levels in order to:

- measure emissions with a minimum level of data accuracy, using methodologies defined in the IPCC guidelines. The level of accuracy of emissions can vary greatly according to countries, sectors and gases. One of the objectives of capacity building will be to ensure that the highest possible level of accuracy is achieved given the existing level of scientific knowledge. Identifying the minimum level of accuracy required to set targets and baselines is also important to design relevant capacity building activities.
- establish baselines in order to monitor emissions trends and implement mitigation policies.
- report emissions in a consistent format using dedicated IT tools. Setting up a reporting system also implies additional investments from governments to develop registries and links to transaction logs.
- build a credible and trusted verification process, either through the development of a network of independent third party accredited verifiers, or through a dedicated government authority.
- increase the number of UNFCCC-accredited experts to review annual inventories. At present, there are 120 experts covering all inventory sectors in 40 Annex I countries. The workload is therefore substantial and increasing the number of countries reviewed to include non-Annex I countries (152 countries in all) would require up to around 450 additional experts with sufficient knowledge and expertise in all sectors.
- define clear and transparent compliance and enforcement procedures.

8.2.2 Policy and legal reform

Policy and legal reforms will also be required. These include:

- drafting new and reformed legislation. For example, the creation of an ETS requires the implementation a new and complex policy framework, including the adoption of MRV guidelines, design and management of the scheme (including choice of allocation methodology). This requires resources and policy expertise.
- removing policies that would hinder emissions reductions from carbon trading. For example, subsidies to carbon-intensive technologies create price distortions and reduce the effects of carbon pricing. Analysis suggests that if energy subsidies were removed in China, fuel demand could decrease by 21% by 2020.[9]
- developing new standards and technical guidelines, in order to allow consistent and harmonised emissions data gathering. At present, there is a wide range of carbon accounting standards used across the world, including IPCC guidelines, ISO 14064, WRI/WBCSD GHG Protocol and the Gold Standard.
- consulting stakeholders to create consensus among key participants and promote public understanding of carbon markets.

Another important role of legal reform will be to give statutory powers to institutions tasked with managing carbon trading and enforcing the rules.

8.2.3 Institutional reform

Although the international community has a role to play in helping build institutional capacity through funding and knowledge transfer, institutional reform should be driven by nation states themselves.

Institutional capacity for linking to a global trading network should include:

- negotiation of targets and baselines;
- coordination of data collection process;
- supervision of the MRV, as well as compliance and enforcement processes;
- availability and accessibility of emissions data.

In countries where an ETS is a possible future policy, it will also be important to assess the readiness of businesses to deal with market infrastructures and institutions, for example exchange platforms and financial regulators.

In the case of developing countries accessing a reformed CDM, some national institutional arrangements are a pre-requisite to the development of CDM projects, including:

- setting up a legal entity in the host developing country – a designated national authority – whose role is to approve CDM projects and ensure that they contribute positively to sustainable development, including a technical committee to screen the proposals.
- developing finance facilities for CDM projects and providing guidance and information through dedicated entities (for example one-stop shops).

9 OECD (2008)

8.2.4 Other sector-specific requirements

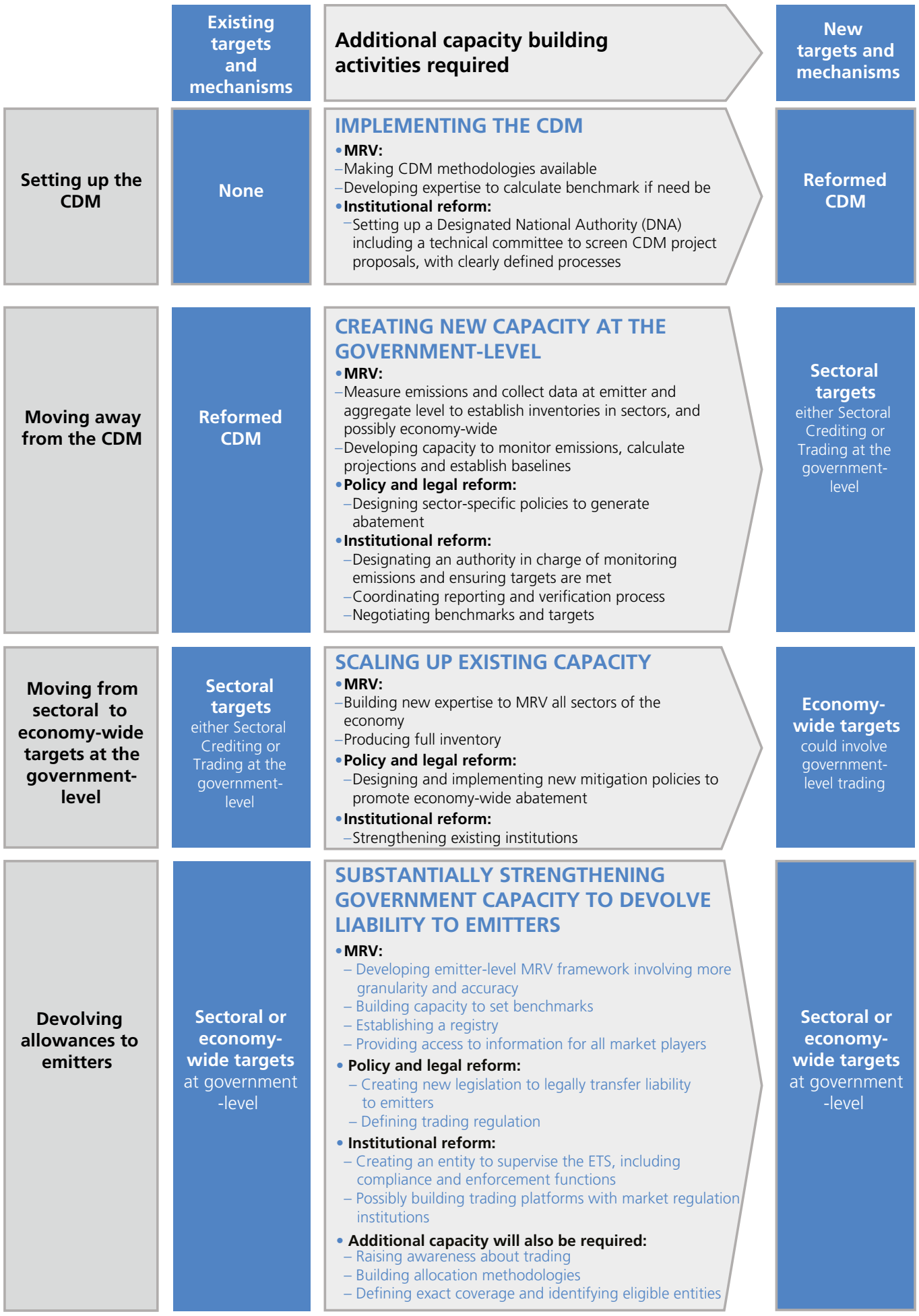
There will also be additional capacity building requirements specific to certain sectors. For example, the Eliasch Review showed that in the forestry sector, a range of capacity building activities will need to be implemented in forest nations beyond the requirements mentioned above (see Chapter 6).[10] Forestry-specific preparatory activities include:

- research and analysis of the national drivers influencing deforestation and the impacts of forest activities on the livelihoods of communities;
- land tenure reform to increase reliability and transparency of the legal framework;
- land use planning and zoning; and
- demonstration activities to test new market-based approaches and assess their environmental, social and economic impacts.

Finally, capacity building is a continuous process. The capacity developed to implement one trading mechanism will be useful to evolve in moving towards more economically efficient and environmentally effective mechanisms. Figure 8.2 illustrates the additional capacity required to go from one carbon trading mechanism to another.

10 Eliasch (2008)

Figure 8.2: Summary of capacity building requirements in the transition from one mechanism to the next



8.3 THE COSTS OF CAPACITY BUILDING

One estimate suggests that the costs of capacity building to enable developing countries to participate in sectoral mechanisms and a reformed CDM over the next decade could be up to $5 billion. This covers capacity building to share and transfer knowledge and build expertise in monitoring, reporting and verification as well as policy and institutional reform. This estimate does not include the costs of implementation or wider sector-specific capacity building, which would substantially increase costs.

This report commissioned analysis to assess the capacity building costs of linking developing countries to carbon markets.[11] Three different linking scenarios were modelled: low, medium and high ambition. Modelling a high ambition scenario generated a cost estimate for capacity building initiatives prior to implementation of around $2-5 billion over the next 10 years, with a central estimate of around $3.7 billion.[12] The analysis:

- assumes the transfer of knowledge occurs in an efficient manner (for example with no duplication of effort). In practice, inefficiencies are likely to occur which will drive costs up.
- includes the cost of building capacity to enable countries to sign up to targets, in other words the preparatory work required before a country is able to participate in carbon markets.
- adjusts costs according to existing governance capacity in developing countries.
- excludes the implementation costs of market mechanisms, which would constitute additional costs above and beyond what we define as capacity building costs (see Figure 8.3).

In addition, these costs do not include wider capacity building costs associated with specific sectors (such as land rights reform in the forestry sector) or wider development assistance. Taking these additional needs into account would substantially increase costs. For example, the Eliasch Review estimated that necessary reform and capacity building in 40 forest nations would cost up to $4 billion over 5 years.[13] This estimate included capacity building to implement an instrument to address forest emissions. Most of this would be additional to the $2-5 billion over 10 years estimated in this report for accessing trading mechanisms.

The linking options under the high ambition scenario are that:

- non-Annex I countries which are part of the OECD (for example Mexico and South Korea) sign up to a national target under the UNFCCC international framework, complemented by an ETS covering emitters from the power and cement sectors.
- advanced developing countries sign up to a national target, possibly involving trading of allowances
- other developing countries have sectoral targets involving either crediting or trading mechanisms at the government level.
- Least Developed Countries have access to the CDM, or a reformed version of it.

By 2020, the most important cost component of capacity building will probably be MRV, which the analysis estimates at around $3 billion. Measuring and monitoring emissions accurately are estimated to cost around $1.2 billion alone. The cost of reforming the legal system ($1.1 billion) and designing relevant institutions ($1 billion) are also estimated to be high (see Figure 8.4), though these would be predominantly upfront costs.[14]

---

11 Ecofys (2009)
12 The most important cost factor is staff, which represents over 80% of capacity building costs. A sensitivity analysis has been conducted focusing on staff costs, using +/- 50% staff time. This sensitivity test results in a cost range of $2-5 billion.
13 Eliasch (2008)
14 Ecofys (2009). Break-down based on high end of the cost estimate.

Figure 8.3: Scope of the capacity building cost assessment

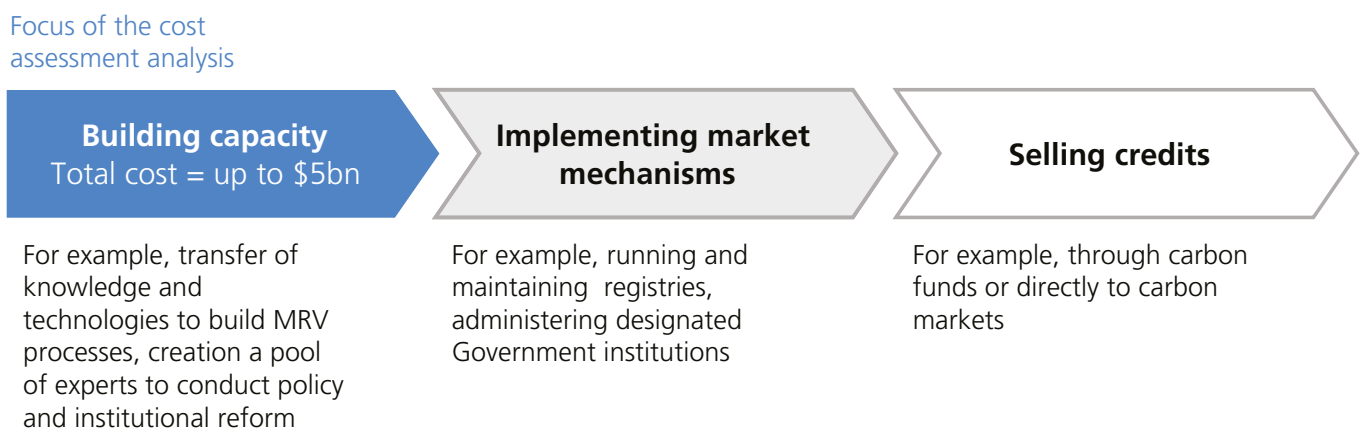
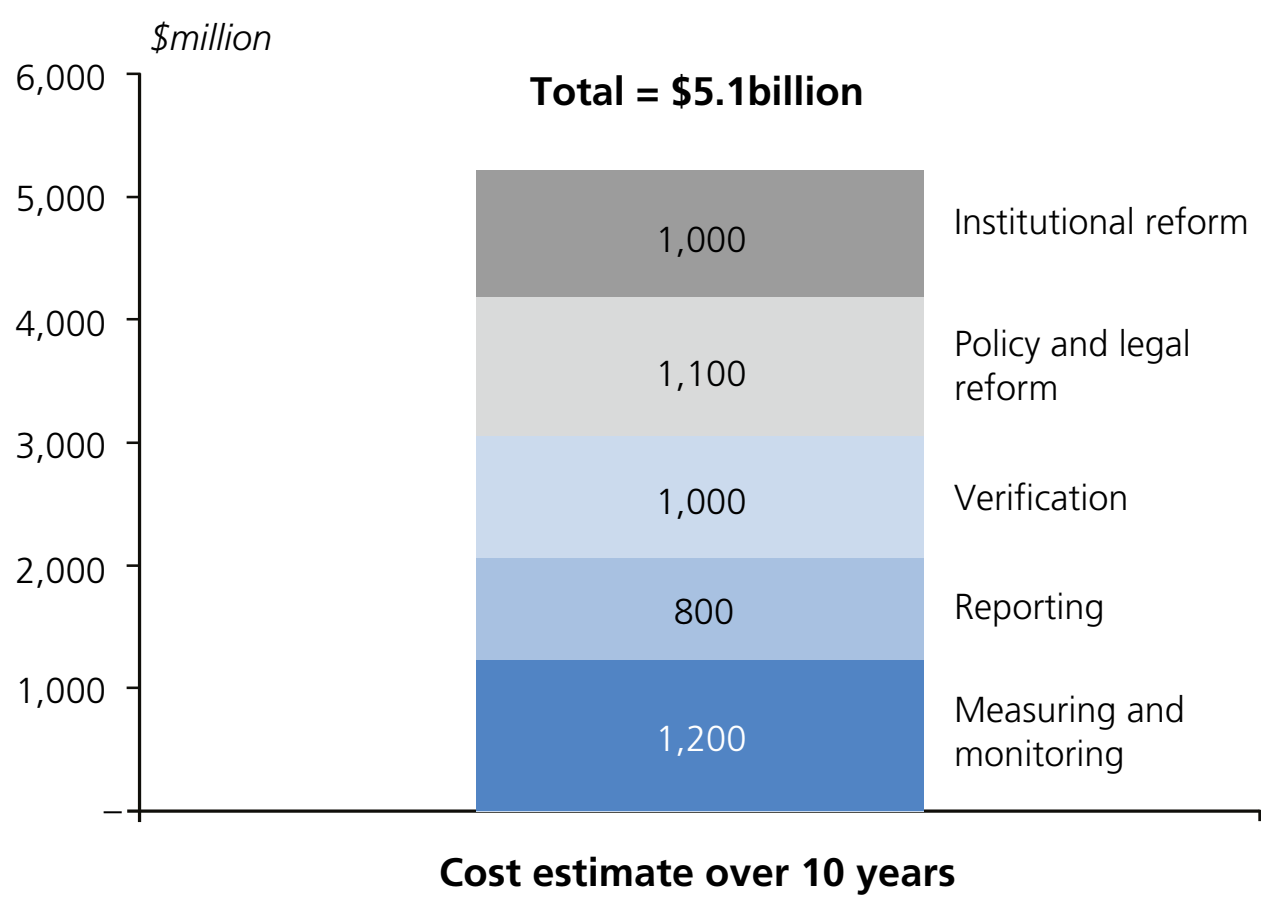


Figure 8.4: Breakdown of capacity building costs (high end estimate)



Source: Ecofys (2009)

8.4 FUNDING FOR CAPACITY BUILDING

The importance of non-market funding for capacity building will be crucial in the short term as carbon market finance will be limited at the early stages of development.

Funding for capacity building to develop and expand carbon trading could come from two main sources:

1) **Indirect funding from the carbon market** includes auction revenues from ETSs, as well as taxes and levies on the proceeds of international credits. Market revenues can then be used like any other source of public finance. Although this source of funding is likely to be limited in the early stages of the development of carbon markets, it could increase in the future as carbon trading expands.

2) **Non-market funding** will be crucial in the meantime and could come from both public and private sources. As illustrated in Figure 8.5, private finance could complement public

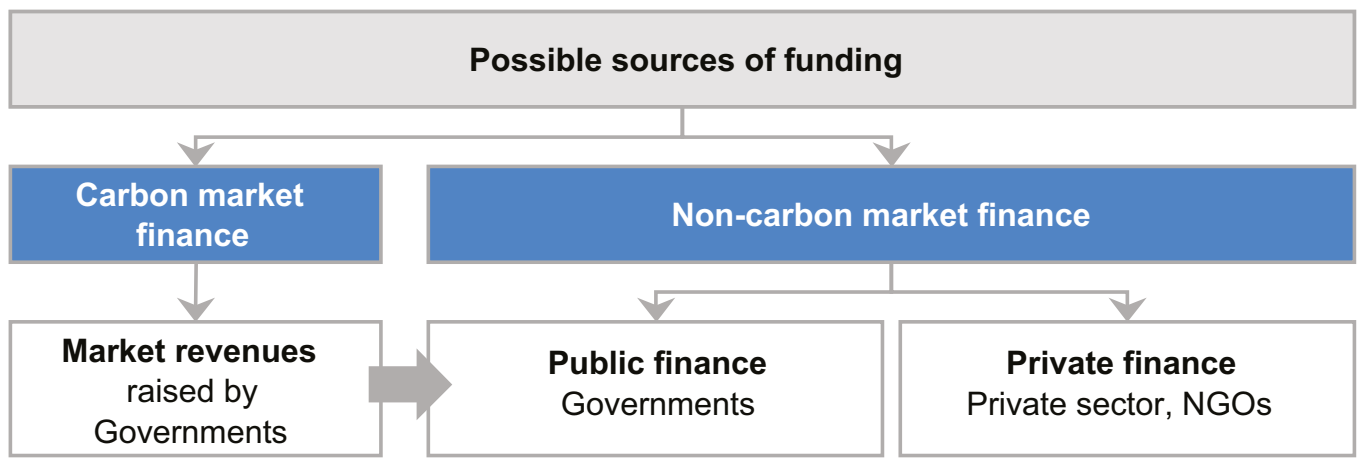
finance, especially in the development of certain market instruments. For example, when developing an emitter-level ETS in a country such as Mexico, bilateral cooperation between governments could build institutional capacity and transfer expertise, allowing the Mexican Government to efficiently launch and supervise its ETS.[15] In parallel, the private sector could also invest in capacity building initiatives at the company level. This is most likely to occur where a multinational company operates both in Mexico and in countries where it is already included in an ETS (for example the EU ETS). Transferring knowledge and technologies to its Mexican subsidiaries will make the transition to an ETS smoother and less costly.

Under the CDM, private companies investing in CDM projects have an interest to ensure that relevant capacity building initiatives have been carried out and that a robust investment environment is in place. Blending public and private finance, for example through partnerships, could generate additional funding for CDM-related capacity building. Similar public-private cooperation would be beneficial in other trading mechanisms such as Sectoral Crediting.

Figure 8.5: Sources of funding for capacity building activities

As mentioned above, carbon market funding will be limited in the short term. As a result, up-front capacity building – sharing knowledge, transferring measurement and reporting systems – will need to be funded mainly through non-market funds. Furthermore, the implementation of carbon trading mechanisms could then be financed through a mix of market and non-market funding. Non-market funds could be used, for example, to bridge the gap between the capacity building phase and the point at which carbon trading starts to generate revenues (see Figure 8.6). In addition, the timing of capacity building efforts will be crucial. Capacity building activities therefore need to be ramped up immediately in order to expand carbon markets as described in Chapter 6.

Figure 8.6: Blending carbon market and non-market funding over time



15 Mexico announced the implementation of an emitter-level ETS by 2012 in December 2008 during the UNFCCC conference in Poznan, Poland.

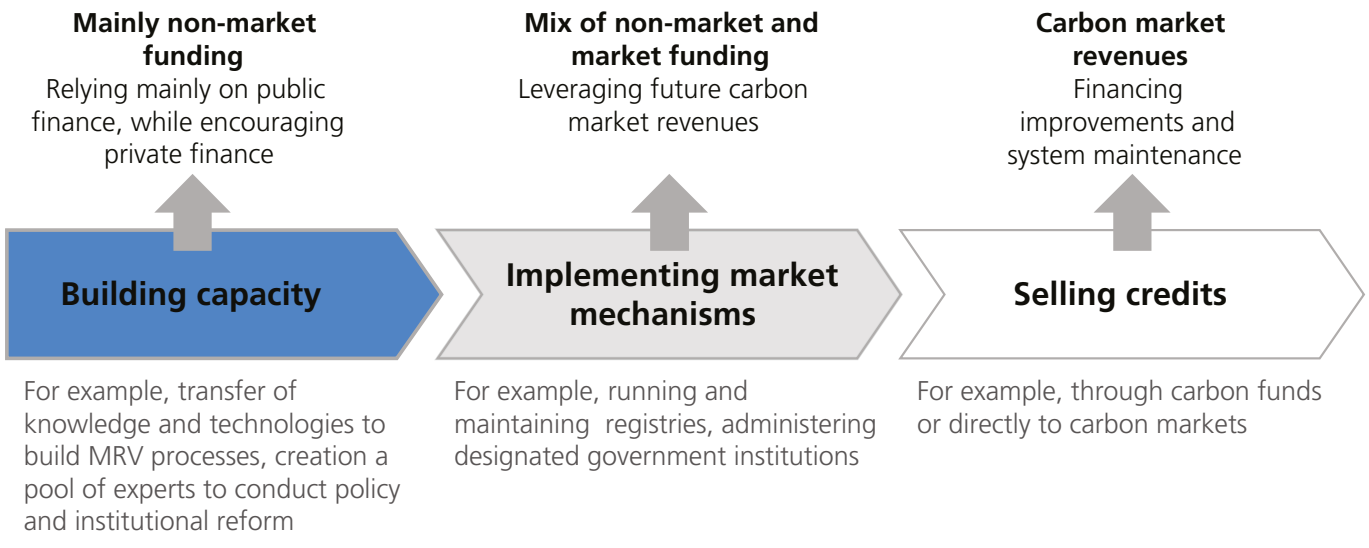
8.5 COORDINATING FUNDING FOR CAPACITY BUILDING

International funding should be coordinated effectively to avoid a proliferation of competing mechanisms and to prioritise capacity building efforts.

Funding for capacity building will come from several sources, both public and private, and will need to be coordinated effectively (see Chapter 7). Carbon market finance can be managed and allocated through the same governance frameworks as non-carbon market finance. Public finance provided by governments is likely to be the cornerstone of capacity building funding, but it will also need to be blended efficiently with funding from private sources.

The key challenge of public funding governance will be to coordinate bilateral and multilateral finance. This will increase the impact of capacity building activities and help avoid duplication and proliferation of competing funding mechanisms.

Figure 8.7: Coordinating public finance



Bilateral funding can take the form of fund transfers as well as direct assistance, for example civil servants from one country transferring knowledge to another country. Direct assistance could be a useful tool for the development of national inventories, as well as for accessing carbon trading mechanisms. In that respect, innovative approaches such as twinning projects could be applied to capacity building for carbon markets (see Box 8.1), while financing could be provided by the international community through funds such as the GEF.

Box 8.1: Technical assistance and twinning projects in the EU

In the context of the enlargement process of the European Union, the EU has implemented technical assistance mechanisms for candidate countries.[16] The main goal is to reinforce 'the institutional and administrative capacity of beneficiary countries'. One type of technical assistance implemented in the EU is the Twinning Programme created in 1998. Under this scheme, public servants from EU Member States are seconded to the equivalent government entity in the beneficiary country, allowing transfer of hands-on public sector expertise.

The role of the beneficiary country is central as it has the responsibility to assess and prioritise its capacity building needs and select potential project partner institutions once EU Member States have submitted their proposals. Twinning is therefore designed to be a joint process, each party taking on responsibilities, while the funding is provided by the European Commission.

More recently, eligibility has been extended to a wider group of countries in the Mediterranean region.

A mechanism of this type may be an effective way to build the institutional capacity required for effective participation in carbon markets.

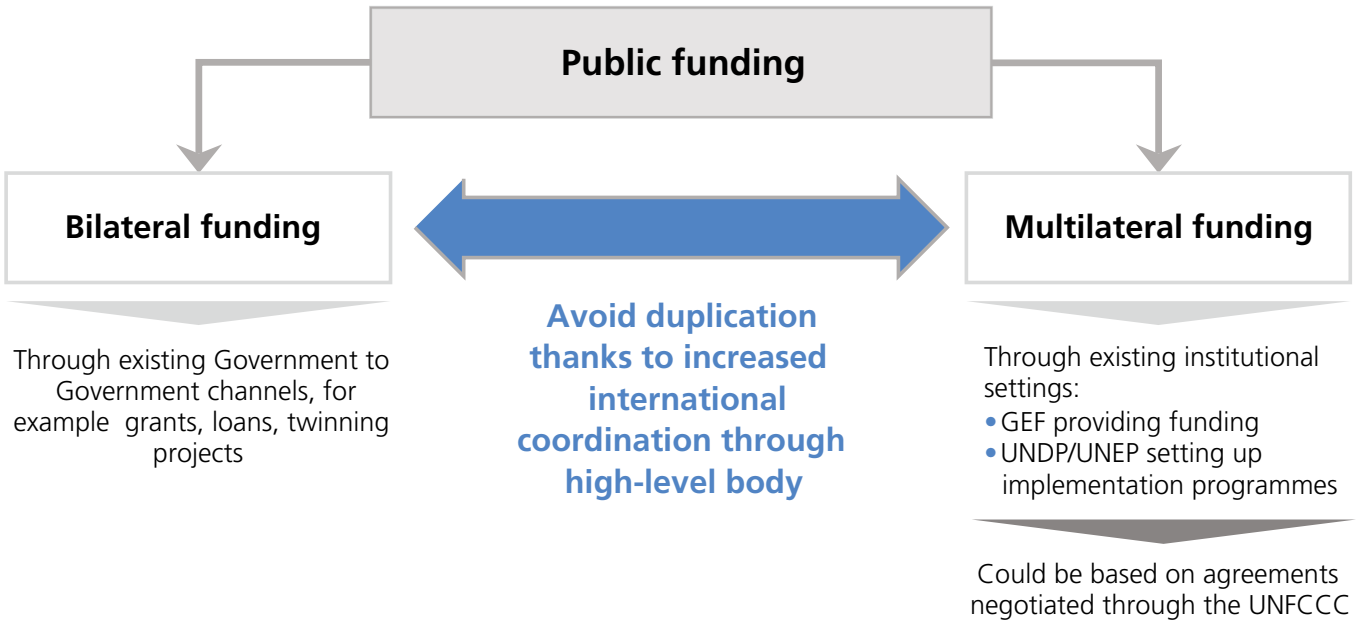
Multilateral funding is managed and allocated by international institutions that already have some experience in carbon market capacity building. These include the GEF, UNEP, UNDP, the World Bank and regional development banks. Building on these existing initiatives and using their governance structures will increase their effectiveness and efficiency. However, international funding will also need to be coordinated effectively across international institutions to avoid a proliferation of competing and overlapping mechanisms (see Figure 8.8). Chapter 7 discusses a possible international, high-level coordinating body which could perform such a role.

Prioritising the capacity building effort will allow a more organised and timely allocation of resources. There should be two main priorities:

- **Developing Countries** where emissions are projected to grow substantially in the future. Capacity building efforts should focus mainly on the development of inventories (measuring and reporting) in key sectors such as power and cement, and possibly economy-wide inventories.
- **Least Developed Countries** where capacity building activities to promote the CDM should be combined with clearly identified sustainable development objectives. In the long term, it is important to bear in mind that all countries will have to move away from the CDM.

16 EU Commission website: http://ec.europa.eu/enlargement/how-does-it-work/technical-assistance/index_en.htm

Figure 8.8: Coordinating public finance



8.6 RECOMMENDATIONS

- The international community should provide urgent support to developing countries to build capacity for accessing carbon trading mechanisms. This support should include the sharing of technical expertise, financial support and support for demonstration activities.
- International funds should build on existing initiatives such as the GEF and World Bank funds. However these should be coordinated effectively to avoid a proliferation of competing mechanisms.

9 CONCLUSIONS

All countries are experiencing the effects of climate change, with developing countries in particular exposed to the negative impacts of a rise in temperature. The world's 50 Least Developed Countries are responsible for less than 1% of global greenhouse gas emissions, and yet overall developing countries bear 90% of the burden of climate change.

To limit the global average temperature rise to 2°C and avoid the worst effects of climate change, the international community will need to use the full range of policy tools at its disposal to bring about immediate and substantial reductions in greenhouse gas emissions. These policy tools should be environmentally effective, economically efficient and equitable both across and within countries.

The existing international climate change framework under the UNFCCC comprises national caps and trading among some developed countries, and a crediting mechanism for projects in developing countries. The introduction by the EU and some US states of an emissions trading system has, in addition, demonstrated the potential for governments to devolve emissions reduction effort to businesses and other enterprises. However, current carbon market instruments, whether through their design or the way in which they were negotiated, have shortcomings which will need to be addressed in a post-2012 agreement.

In the long term, a dual system of cap and trade should prove a powerful policy tool for delivering emissions reductions in an effective, efficient and equitable way. At the government level, national targets can ensure sovereign responsibility for limiting emissions. Countries are then free to use the most appropriate domestic policy tools at the emitter level, including emissions trading systems, taxation, regulation and subsidies.

Realising a long-term framework of global carbon trading will require a period of transition and a roadmap with four key elements:

1) the expansion of national targets and strengthened MRV;
2) developing a global network of linked ETSs;
3) participation of developing countries through intermediary mechanisms; and
4) strong and effective international institutions.

In the short and medium term, capacity building will also be needed to ensure that developing country governments and other actors are well-prepared for participation.

In future, **national targets** will need to be more stringent and will have to cover a broad range of sectors in order to meet global emissions targets. All domestic sectors – power supply, industry, domestic transport, waste, buildings, agriculture and forestry – should be included under national targets. International aviation and shipping should also be capped through a dedicated transnational trading system. By 2013, we would expect to see emissions from all developed countries capped.

A **global network of ETSs** should develop as systems expand and link through bilateral agreements. Many planned ETSs could link up with each other over the next decade if they are well designed and coordinated.

Wherever possible, the design features of emerging ETSs should be coordinated so that they can benefit from the huge gains available through linking. Modelling for this report reveals that bilateral linking of ETSs could reduce abatement costs across two countries by between 30 and 50%. In light of this, linking the EU ETS with a federal US system should be a priority; it would increase the liquidity and stability of the market and result in the coverage of between 13 and 27% of global greenhouse gas emissions.

Linking **developing countries** into the climate change framework is also essential, as the vast majority of future growth in greenhouse gas emissions will be in these countries. However, countries at different levels of development will need to participate in carbon markets at different speeds, in line with the principle of common but differentiated responsibilities and respective capabilities.

More advanced developing countries could participate in Sectoral Trading in key sectors. Developing countries not in a position to take on government-level cap and trade could adopt government-level Sectoral Crediting as an alternative. Finally, those countries not in a position to adopt government-level mechanisms should be assisted to participate in a reformed CDM. These varied mechanisms would allow developing countries to participate in carbon markets to differing degrees, giving them the freedom to use the abatement policies most suited to national capacity and circumstances.

Carbon market finance from developed country governments and ETSs will provide some but not all of the funding required to support emissions reductions in developing countries. Additional public and private funds will also be required and should be coordinated at an international level.

The development of a global carbon trading system will need to be supported by **strong governance and institutions** to ensure that real emissions reductions are delivered in a manner that is both cost effective and equitable.

The United Nations should continue to provide a framework for national targets, agreed standards and verification of national-level emissions. However, the international framework needs to be reviewed and strengthened in certain areas, such as target setting and compliance.

Sovereign nations should maintain the freedom to use the most appropriate domestic policy tools to meet their national emissions targets. This means that at the emitter level, the national authority should remain responsible for the effective regulation and implementation of its own ETS, even after linking to other ETSs.

A wide range of **capacity building** initiatives have been undertaken to prepare countries for participation in carbon trading. We need to build on these initiatives urgently to demonstrate and realise the potential of carbon market instruments as a policy tool to abate emissions. The costs of capacity building to enable developing countries to participate in carbon trading could be up to $5 billion over the next decade. This covers capacity building for measuring, reporting and verification, legal frameworks and institutional reform for linking. When further costs are factored in, the overall costs of capacity building will be substantially higher.

The transition to a long-term framework of global carbon trading, supporting other mitigation measures, will be challenging. Nonetheless, the gains that such a system can provide are immense: guaranteed emissions reductions to a level consistent with the science, delivered cost effectively. The international community will also need to ensure that any system is designed fairly and equitably to ensure that all countries can play their part in preventing the worst impacts of climate change.

ANNEX A: SECTOR SUMMARIES

A1 POWER

DEFINITION

The power sector essentially consists of emissions from electricity-generating plants that supply electricity via the grid. However, it also includes emissions from 'autoproducers' (industries that generate electricity for their own use) as well as emissions from combined heat and power plants.

EMISSIONS

The power sector produced 25.9% of world emissions in 2004.[1] China and the US generate around half of global power emissions; emissions from the EU, Russia and India are also substantial.[2] Emissions are projected to rise from 11.4 $GtCO_2$ in 2006 to 18.1 $GtCO_2$ per year by 2030 under business as usual.[3] Almost all growth in emissions is due to come from non-OECD countries.

MITIGATION OPTIONS

Abatement options include energy efficiency improvements, switching to cleaner fossil fuels, use of renewable energies, carbon capture and storage, nuclear power and microgeneration.

MEASURING AND MONITORING

Emissions can be accurately estimated using a basic fuel-based methodology. The quantity of fuel combusted (usually taken from national energy statistics) is multiplied by emissions factors. Emissions factors vary by type (and therefore carbon content) of fuel. Combustion conditions are relatively unimportant.

The IPCC[4] provides default emissions factors that can be used (Tier 1). Alternatively, country-specific emissions factors can be used to increase accuracy slightly (Tier 2). They allow small variations in fuels, combustion technologies and individual plants to be factored in. Emissions can be estimated most accurately using emissions models or measurements and data at individual plants, at the cost of more detailed information and effort (Tier 3). Continuous emissions monitoring devices are generally not thought to be justified for measuring CO_2 emissions, but can be worthwhile for measurement of sulphur dioxide (SO_2) or nitrous oxides (NOx), where solid fuel is combusted and where the fuel used is highly variable.[5]

---

1 IPCC (2007)
2 IEA (2008)
3 Ibid
4 IPCC (2006)
5 Ibid, Volume 2, Section 2.3.1.3

INCLUSION IN NATIONAL CAPS

Annex I countries with national caps under the Kyoto Protocol must currently account for emissions from the power sector.

INCLUSION IN EMISSIONS TRADING SYSTEMS

The power sector is one of the most suitable for inclusion within an ETS (see Table A1). Power plants are generally highly concentrated, plant owners and consumers are relatively responsive to the carbon price signal and emissions are relatively straightforward to estimate. The power sector was one of the two original sectors included within the EU ETS (along with heavy industry) and also forms part of the only other mandatory ETS in the world, the RGGI in certain US states.

Table A1: Factors relevant to a decision to include the power sector in an ETS

POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
	Sensitivity to price signal	**Concentration of emitters**	**Measuring emissions accurately**
Plant	Power companies are receptive to a carbon price signal when considering alternative fuel supplies. Sensitivity would be further increased if government subsidies to the global energy sector were removed or more directed to low-carbon technologies.[6] When equipped with smart meters, consumers to whom the carbon price signal is passed can be relatively sensitive to it and be incentivised to improve energy efficiency of homes and thus reduce demand. However, carbon prices must be significantly higher than current EU ETS prices before technologies like CCS become competitive and before there is sufficient incentive to substantially increase investment in research and development into new low carbon technologies.	The power sector is one of the more concentrated sectors, hence emitters can be relatively conveniently administered within an ETS.	Estimating emissions from the power sector is simple and relatively accurate: the amount of fuel used multiplied by an emissions factor.

6 Government subsidies in the global energy sector have been reported to be in the order of 250–300 billion US$/yr, of which only around 2–3% supports renewable energy – IPCC (2007) WG III report, p306

DEVELOPING COUNTRIES

The power sector is relatively leakage-proof (due to low international competition), making project-level activities suitable for the CDM. Projects in renewable energy, fuel switching and energy efficiency accounted for 82% of contracted CDM abatement volume in 2008.[7] The sector is also one of the leading candidates for inclusion in new carbon market mechanisms in more advanced developing countries through the use of ETSs, Sectoral Trading, Sectoral Crediting and CDM benchmarking.

A2 INDUSTRY

DEFINITION

The IPCC defines the Industrial Processes and Product Use (IPPU) sector as comprising greenhouse gas emissions from industrial processes, from the use of greenhouse gases in products (for example as substitutes for ozone depleting substances in refrigeration and air conditioning), and from non-energy use of fossil fuel carbon (such as in solvents).

The main emissions sources are releases from industrial processes that chemically or physically transform materials (for example, the blast furnace in the iron and steel industry). Industrial processes include those relating to the mineral, chemical, metal, electronics, pulp and paper, and food and beverages industries.

EMISSIONS

The IPCC Fourth Assessment Report estimates that the industrial sector emitted about 7.2 $GtCO_2e$ in 2004,[8] or 19.4% of total global greenhouse gas emissions.[9] This rose to about 12 $GtCO_2e$ in 2004 if indirect emissions from energy use (power sector) are included. The iron and steel, chemical and petrochemical, non-metallic minerals, and paper, pulp and print industries accounted for 65% of global emissions from industry in 2006.[10]

The production of energy-intensive industrial goods has grown dramatically and is expected to continue growing under a business as usual scenario, as population and per capita income increase. Since 1970, global annual production of cement has increased by 271%; aluminium by 223%; steel by 84%; ammonia by 200%; and paper by 180%.[11] Global emissions from the industry sector are set to grow by about 40% to 2030 under a business as usual scenario (despite OECD emissions reducing over this period).[12]

Much of the world's energy intensive industry is now located in developing countries. In 2003, developing countries accounted for 42% of global steel production; 57% of global nitrogen fertiliser production; 78% of global cement manufacture; and about 50% of global primary aluminium production.[13]

---

7 World Bank (2008)
8 IPCC (2007) AR4, WG III report, p449
9 IPCC (2007) AR4 Synthesis Report: Summary for Policymakers
10 IEA (2008)
11 IPCC (2007) AR4, WG III report, p451
12 IEA (2008)
13 IPCC (2007) AR4, WG III report, p451

MITIGATION OPTIONS

Many options exist for mitigating greenhouse gas emissions from the industrial sector,[14] and these can be divided into three broad categories:

- **Sector-wide options**, for example more efficient electric motors, high efficiency boilers, fuel switching and recycling.
- **Process-specific options**, for example the use of bio-energy contained in food, pulp and paper wastes, and the use of turbines to recover the energy contained in pressurised blast gas furnaces.
- **Operating procedures**, for example the control of steam and compressed air leaks, and the optimum use of insulation.

It has been estimated that there could be 2.0-5.1 $GtCO_2e$ of mitigation opportunities in the industrial sector costing under $\$100/tCO_2e$ in 2030.[15] The largest mitigation potentials are located in the steel, cement, and pulp and paper industry sub-sectors. Much of the potential is available for under $\$50/tCO_2e$.

MEASURING AND MONITORING

The Industrial Processes and Product Use (IPPU) sector is in fact made up of a lot of diverse sub-sectors, some of which are mentioned above. The 2006 IPCC National Greenhouse Gas Inventory Guidelines[16] set out a methodology for estimating emissions in each of these sub-sectors to different levels of accuracy (Tiers 1-3).

INCLUSION IN NATIONAL CAPS

Annex I countries with national caps under the Kyoto Protocol must currently account for all emissions from their industrial sector.

INCLUSION IN EMISSIONS TRADING SYSTEMS

Heavy industry is relatively concentrated, sensitive to carbon prices, and emissions measurement is not unduly complex. This makes it suitable for inclusion in an emissions trading system (ETS) – see Table A2. All heavy industry (industry with production capacity above certain thresholds) is included in the EU ETS (although not the Regional Greenhouse Gas Initiative (RGGI) in certain US states, which is focused on the power sector).

14 IPCC (2007) AR4, WG III report, p449
15 Ibid
16 IPCC (2006)

Table A2: Factors relevant to a decision to include the industrial sector in an ETS

POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
	Sensitivity to price signal	**Concentration of emitters**	**Measuring emissions accurately**
Plant	Because of its high carbon intensity, heavy industry (such as iron and steel, cement, aluminium, paper, chemicals and petrochemicals) is sensitive to carbon pricing. However, the industry typically invests in long-lived capital infrastructure, so a clear indication of the future direction of carbon pricing is particularly important.[17]	Concentrated in heavy industry sub-sector; diffuse in light industry sub-sector.	Relatively low cost.

DEVELOPING COUNTRIES

Industrial CDM projects have successfully reduced emissions in developing countries and have been issued credits. They often focus on very low cost abatement opportunities available from reducing emissions of HFCs, PFCs and N_2O from chemical plants, as well as energy efficiency measures. The heavy industry sector or sub-sectors are also highly suitable for inclusion in new carbon market mechanisms in more advanced developing countries through ETSs, Sectoral Trading, Sectoral Crediting, and CDM benchmarking.

A3 FORESTRY

DEFINITION

Under the Kyoto Protocol, a forest is defined as a minimum area of land of 0.05–1.0 hectare with tree crown cover (or equivalent stocking level) of more than 10–30 per cent and with the potential to reach a minimum height of 2–5 metres at maturity *in situ*. For national inventory accounting purposes, forestry emissions are direct human-induced afforestation, reforestation and/or deforestation activities that started on or after 1 January 1990. Parties also have the choice to opt into their inventory the carbon stock changes resulting from human-induced forest management, up to a certain limit.[18]

'Deforestation' is defined as the direct human-induced conversion of forested land to non-forested land. 'Reforestation' is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land and did not contain forest on 31 December 1989. 'Afforestation' is defined as the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land

17 Stern (2007)
18 Decision 16/CMP.1

through planting, seeding and/or the human-induced promotion of natural seed sources. And 'forest management' is defined as a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner.[19]

EMISSIONS

Human activities are responsible for around 5.8 $GtCO_2$ of emissions from the forestry sector each year, constituting 17.4% of total global GHG emissions.[20] This makes it the third largest emissions sector after power and industry, and significantly more polluting than the entire global transport sector. Around 96% of emissions from deforestation arise in developing countries, while over 60% of sequestration from forestation is in temperate and boreal regions.[21] Brazil and Indonesia are responsible for a large proportion of global deforestation emissions. Future emissions projections vary,[22] although in most BAU projections global emissions decline over time as less forest remains for deforestation.

MITIGATION OPTIONS

The underlying drivers of deforestation are demand for agricultural land and, to a lesser extent, timber and settlements. These underlying drivers can lead to more proximate drivers of deforestation, such as building roads into forests and burning or clearing forest land. Putting a financial value on forests and investing in more efficient and sustainable forms of agriculture and timber production can be used to tackle these drivers. An effective portfolio of forestry emissions reduction policies will also address road-building, migration, national parks and a range of other policies. Demand for unsustainable agricultural and timber products also needs to be addressed, including restricting the use of certain products and internalising the damage costs into the price of products. The forestry sector contains a significant amount of relatively low-cost abatement opportunities.[23]

MEASURING AND MONITORING

Forestry emissions are accounted for in accordance with IPCC guidelines. This involves calculating carbon stock changes that result from converting forest land to other land uses (such as cropland, grassland, wetlands and settlements) and sequestration that occurs from converting these other types of land into forest land. Forests contain five different carbon pools, all of which need to be accounted for. The five pools are: above-ground biomass, below-ground biomass, dead organic matter, soil carbon, and non-CO_2 from burning biomass.[24]

The IPCC guidelines[25] have three tiers of emissions estimation methodology. Tier 1 is the most basic and uses equations and default values for emission and stock change factors. Tier 2 uses more country or region-specific data. And Tier 3 uses higher order methods, including models and inventory measurement systems tailored to national circumstances and which are repeated over time and driven by high-resolution activity data disaggregated at the sub-national level.

---

19 Ibid
20 IPCC (2007)
21 Houghton (2003)
22 Eliasch (2008), Section 2.4
23 Eliasch (2008)
24 IPCC (2006), Volume 4
25 Ibid

Satellite technology can provide rapid and transparent monitoring of forests. When combined with ground-based data to provide carbon density information and calibration with satellite images, robust emissions estimates can be achieved that are no less accurate than estimates for other sectors. However most tropical forest nations do not currently possess the capacity to make such estimates, and so capacity-building will be essential. The Eliasch Review[26] estimates that it could cost around $50 million to install such capacity in 25 forest nations, with a further $7-17 million per year in running costs.

The option for countries to account for emissions from 'forest management' activities[27] is currently insufficiently clear. Distinguishing between anthropogenic and non-anthropogenic (particularly natural sink) effects is problematic. The IPCC has proposed methodologies to better distinguish between the two and further work is ongoing. It is important that the international community improves this aspect of forestry emissions accounting.

INCLUSION IN NATIONAL CAPS

Annex I countries must currently account (in respect of their national emissions cap) for direct human-induced afforestation, reforestation and/or deforestation activities that started on or after 1 January 1990. As stated above, Annex I countries also have the option to include carbon stock changes resulting from human-induced 'forest management.'[28]

INCLUSION IN EMISSIONS TRADING SYSTEMS

The forest sector is not included within any mandatory ETS currently in existence. In countries where forests are privately owned, forest ownership can be highly diffuse. Estimating the individual emissions of a large number of small forest landowners, and administering an ETS involving them, is likely to be highly complex. The forestry sector is therefore likely to be less suitable for inclusion with an ETS than some other sectors. It will be most suitable for use in countries where most forest land is owned by a relatively concentrated group of private sector actors. Table A3 below considers the main factors relevant to a decision to include the sector within an ETS.

26 Eliasch (2008), Chapter 10
27 Article 3(4) Kyoto Protocol
28 Decision 16/CMP.1

Table A3: Factors relevant to a decision to include the forestry sector in an ETS

POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
	Sensitivity to price signal	**Concentration of emitters**	**Measuring emissions accurately**
Landholder	84% of the world's forests are owned by governments.[29] The main reason for using an ETS is to meet a national emissions target as efficiently as possible by allowing emitters to trade allowances with each other. Yet if the government is the emitter, it would have no other actors within the country with which to trade. The government could simply reduce its forestry emissions without the use of an ETS. However, it would be possible to set up an ETS for tenants/ concession-holders of government land in certain circumstances. In countries where there is clearly defined private sector ownership of forests, forest owners could potentially respond well to a carbon price signal resulting from an ETS. However, in many forest nations, forest ownership is currently disputed.	In countries where forests are predominantly owned by the private sector, the concentration of emitters can be very diffuse. There may, however, be certain countries where a manageable number of companies or individuals own a significant proportion of the forest.	Estimating emissions of individual forestry emitters for the purposes of trading within an ETS would be complex.

DEVELOPING COUNTRIES

Afforestation and reforestation activities are currently eligible for CDM projects,[30] although there has been little activity to date due in part to the rules which are more restrictive than for CDM in other sectors.[31] This is largely due to the challenge of dealing with the permanence of sequestration resulting from such projects.

With respect to avoided deforestation, the forestry sector is particularly prone to carbon leakage from project areas. If forests are protected in just one small area of one country then farmers and

29 FAO (2006)
30 Decision 19/CP.9 and Decision 14/CP.10
31 Baalman and Schlamadinger (2008)

loggers are likely to deforest another part of the country's forests instead. Therefore national-level targets or baselines are necessary.[32]

A4 AGRICULTURE

DEFINITION

Emissions from agriculture are a result of growing crops, rearing livestock, and other activities related to maximising crop and livestock production. Emissions from this sector consist mainly of non-CO_2 gases, methane and nitrous oxide. Agriculture can also produce carbon dioxide via soil and biomass management and these emissions fall under the land use change and forestry emissions category.

EMISSIONS

Emissions from agriculture account for an estimated 5.1 to 6.1 $GtCO_2e$/yr, equivalent to around 13.5% of global greenhouse gas emissions in 2005. This includes 3.3$GtCO_2e$ of methane, 2.8$GtCO_2e$ of nitrous oxide and a net flux of carbon dioxide of around 0.04$GtCO_2e$ (the exchange of carbon dioxide between atmosphere and agricultural lands).[33]

The main sources of non-CO_2 emissions from agriculture are fertilisers (38%), livestock (31%), rice (11%) and manure management (7%).[34] Most agriculture emissions occur in developing countries, mainly South and South-East Asia, China and India.

Agriculture emissions are projected to grow by around 6% between 2000 and 2010,[35] with most of the growth taking place in developing countries. For example, Africa's agriculture emissions are projected to increase by more than 40% between 2000 and 2010. In contrast, South and South Asian countries are likely to experience a 20% decrease in agricultural emissions, although they will still remain the biggest emitters.

The main mitigation options include:

- **Fertilisers:** the nitrogen in fertilisers can become a source of nitrous oxide emissions when applied inefficiently. Mitigation actions include placing nitrogen into the soil to make it more accessible to crops roots.
- **Livestock:** livestock, mainly ruminants (cattle and sheep), emit methane through enteric fermentation and voided by eructation. Excretions of all livestock generate nitrous oxide. Mitigation actions include improved feeding practices, the use of dietary additives as well as long-term livestock management changes and animal breeding.
- **Rice:** cultivated wetland rice soils emit significant quantities of methane. Emissions can be reduced by draining wetland rice once or several times a year during the growing season, and adjusting the timing of organic residue additions (incorporating organic materials in the dry season rather than in flooded periods).
- **Manure management:** animal manure releases greenhouse gases during storage, as well as after application to cropland or deposition on grazing lands. Manure management measures

32 Eliasch (2008)
33 IPCC (2007) AR4, Working Group III
34 Stern (2007) Annex 7
35 EPA (2006)

to reduce emissions include improving feeding practices for livestock, manure composting (anaerobic digestion) and more efficient use as nutrient source.

MEASURING AND MONITORING

There are high levels of uncertainty around emissions measurements from the agriculture sector. The 2006 IPCC guidelines[36] for national greenhouse gas inventories identify three tiers of approach, (moving to a higher tier will reduce uncertainty and improve accuracy in measurements):

- **Tier 1** methods are designed to be the simplest to use. They are often based on globally available sources of activity data estimates (for example deforestation rates, agricultural production statistics, fertiliser use, livestock data etc), although these data are usually insufficiently granular.
- **Tier 2** uses the same methodological approach as Tier 1 but applies emission and stock change factors that are based on country or region-specific data, for the most important land-use or livestock categories. Higher temporal and spatial resolution and more disaggregated activity data are typically used in Tier 2 to correspond with country-defined coefficients for specific regions and specialised land use or livestock categories.
- In **Tier 3**, higher order measurement methods are used, including models and inventory measurement systems tailored to address national circumstances, repeated over time and driven by high-resolution activity data and disaggregated at sub-national level. Systems may include regular field sampling and/or GIS-based data systems. Models should undergo quality checks, audits and validations and be thoroughly documented.

INCLUSION IN NATIONAL CAP

Agriculture is included in national caps in Annex I countries with targets under the Kyoto Protocol.

INCLUSION IN EMISSIONS TRADING SYSTEMS

Agriculture is currently not included in any ETS, although there have been proposals for its inclusion in, for example, the Australian ETS.

Emissions can be covered in three main ways:

- **direct coverage:** through farm businesses
- **indirect coverage:** either up-stream (for example fertiliser) or down-stream (for example food processors)
- **hybrid option:** point of liability up or down-stream (indirect coverage) with possibility for large farm businesses to manage their own emissions liability (direct coverage).

The preferred option would be a hybrid inclusion in order to reduce transaction costs. Table A4 is a summary of important factors to take into account when considering a hybrid inclusion of the agriculture sector in an ETS.

36 IPCC (2006), Vol 4

Table A4: Factors relevant to a decision to include the agriculture sector in a dedicated ETS[37,38]

POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
	Sensitivity to price signal	**Concentration of emitters**	**Measuring emissions accurately**
Hybrid (chemical or food processors; possible opt-in for large farms)	**Relatively insensitive because extensive subsidies in the sector dampen the price signal.** Excessive use of fertiliser or high nutrient livestock feeds are associated with high emissions, but by appropriate pricing, emissions can be reduced. However, in many countries fertiliser is subsidised to support the income of farmers, which is often in fact regressive as it is the richer farmers or agribusinesses who gain most.[39]	**Diffuse.** Large number of small emitters. For example, in the UK alone, there are more than 170,000 farms.	**Complex MRV, leading to potentially high transaction costs.** Relationship between emissions and activity complex and difficult, eg • Emissions from enteric fermentation processes in the stomach of ruminants livestock depend on how much food they have eaten. • High rainfall years result in higher productivity, higher carbon sequestration in soils and vegetation, and hence fewer emissions.

DEVELOPING COUNTRIES

Agriculture is currently included in the CDM, with 117 projects registered and generating a total of 4.9 $MtCO_2e$/yr in carbon credits, mainly from biogas flaring. The CDM does not currently support soil carbon sequestration projects. However, emerging markets in Canada and the US are supporting offset trading from soil carbon sequestration.

The potential for inclusion of agriculture in sectoral mechanisms is limited because of the issues mentioned above. Nevertheless, promoting agriculture in the CDM will help involve least developing countries in the carbon market, as a large proportion of their abatement potential lies in this sector.

37 Harbury and Lipsey (1992)
38 FAO (2008)
39 Stern (2007), Section 15.5

A5 SURFACE TRANSPORT

DEFINITION

Surface transport includes two main sources of emissions:

- Road: all combustion and evaporative emissions arising from fuel use in road vehicles, including the use of agricultural vehicles on paved roads.
- Rail: emissions from railway transport for both freight and passenger traffic routes.

EMISSIONS

In 2004, the transport sector produced 6.3 gigatonnes of CO_2 emissions (including aviation and shipping) equivalent to 23% of world energy-related CO_2 emissions – of which 74% were from road transport.[40]

Light-duty vehicles account for 56% of all surface transport emissions; heavy freight trucks for 21%; medium freight trucks 11%; buses 8% and two-wheelers and rail for 2% each.[41]

Non-OECD countries currently emit 36% of total emissions. Economic development and transport are inextricably linked. Development increases transport demand, while availability of transport stimulates even more development by allowing trade and economic specialisation.

Surface transport contributes to small amounts of non-CO_2 emissions, mainly methane (0.1-0.3% of total transport greenhouse gas emissions), nitrous oxide (2-2.8%) and fluorinated gases (5-10%). However, it is important to note that data on surface transport non-CO_2 gases is patchy and more evidence is required to increase the level of accuracy.

World surface transport emissions from vehicles are projected to increase by 140% by 2050, from about 4.6GtCO_2e in 2000 to 11.2GtCO_2e. The vast majority of CO_2 increases will be in developing countries.[42]

MEASURING AND MONITORING

Surface transport emissions can be accurately measured using emissions factors applied to the amounts of fuel burned. The 2006 IPCC guidelines[43] for measurements in the surface transport sector comprise:

The **Tier 1** approach, which calculates CO_2 emissions by multiplying estimated fuel sold with a default CO_2 emission factor.

The **Tier 2** approach, which is the same as Tier 1 except that country-specific carbon contents of the fuel sold in road transport are used.

There is no **Tier 3** as it is not possible to produce significantly more accurate measurements of emissions than by using the existing Tier 2.

40 IPCC (2007) AR4, Working Group III
41 WBCSD (2004), cited in IPCC (2004) AR4
42 WBCSD (2004)
43 IPCC (2006), Vol 2, Chap 3

INCLUSION IN NATIONAL CAPS

Surface transport is included in national caps in Annex I countries with targets under the Kyoto Protocol.

INCLUSION IN EMISSIONS TRADING SYSTEMS

Surface transport is currently not included in any ETS, although there have been proposals for its inclusion, for example in Australia.

Emissions mainly occur at the end-user level, which means that there is a very large number of individual vehicle users.

There are four main options for coverage:

- **Downstream schemes on motorists:** as emissions mainly occur at the end-user level, individual emitters could be required to comply. This would be hard to implement for individual car drivers but could be more feasible for businesses.
- **Midstream schemes on car manufacturers:** this would be comparable to a baseline and credit mechanism:
  - car manufacturers could be required to buy a number of permits equal to the estimated amount of CO_2 emissions caused by vehicles sold within a given trading period
  - the number of permits available would gradually decrease over time, promoting a reduction in aggregate annual fleet emissions.
- **Upstream on fuel suppliers:** a small number of fuel suppliers would be covered, using fuel usage as a proxy to calculate emissions. For example, only 20 fuel suppliers in the UK represent 99% of emissions in road transport.
- **Hybrid option:** users above certain thresholds could have direct liability, while smaller users could be covered by energy suppliers.

The preferred option would be an upstream coverage on fuel suppliers as it would decrease transaction costs.

In addition, although transport is perceived as unresponsive to price signals, studies have shown that if fuel prices rise by 10% and remain at that level:[44]

- the volume of traffic will fall by around 1% within about a year, with a reduction of around 3% in the longer term (about 5 years)
- the volume of fuel consumed will fall by about 2.5% within a year, with a reduction of over 6% in the longer term.

44 Dargay, Goodwin and Hanly (2003)

DEVELOPING COUNTRIES

Surface transport is currently included in the CDM, although the number of transport-related projects has been limited to date. Only two projects have been registered, abating around 2MtCO$_2$e by 2012: one, a rail project in India and the other, the development of a new bus lines project in Colombia. An additional eight projects are at validation stage.

The surface transport sector has limited potential in terms of CDM projects and other crediting mechanisms. This is mainly due to the scale of projects: although the cost of a vehicle is in the thousands of dollars and the purchase decision occurs at the individual level, the cost of changing the infrastructure to make it electric or hydrogen friendly can reach billions of dollars and involve massive large-scale investments, mainly driven by governments.

A6 INTERNATIONAL SHIPPING

DEFINITION

Emissions in the shipping sector are emissions from fuels used to propel all water-borne transport, including hovercraft and hydrofoils.[45] International shipping here refers to shipping between ports of different countries (excluding military and fishing vessels).

EMISSIONS

In its 2009 report, the International Maritime Organisation (IMO) estimated that international shipping was responsible for around 2.7% of total global CO_2 emissions in 2007.[46]

As well as CO_2, emissions from ships contain a number of other pollutants, including relatively large amounts of sulphur oxides (SOx). Some of these pollutants are addressed through the International Convention for the Prevention of Pollution from Ships (commonly referred to as MARPOL 73/78).[47]

According to the IMO, shipping emissions may grow by 150% to 250% (compared to 2007) by 2050 in the absence of policies to limit emissions.[48] The UK Committee on Climate Change has noted that global shipping demand is rising rapidly, with freight tonne-miles growing at around 3.5% per year.[49]

Analysis undertaken on behalf of the IMO indicates that operational and technical measures to improve efficiency could reduce emissions from the whole shipping sector by between 25% and 75%. These measures include improved fleet management and design improvements to the hull and superstructure, as well as to the power and propulsion systems. Alternative fuels and energy sources will also offer some scope for emissions reduction in the future, but it will be essential to ensure that any deployment of biofuels is from sustainable sources.

45 IPCC (2006)
46 IMO (2009)
47 A recent amendment to Annex VI of MARPOL imposes a global sulphur cap on shipping which will progressively take effect from 2012 onwards, save where specially designated areas are protected before that date.
48 This estimate is based on mid-range emissions scenarios.
49 UK Committee on Climate Change (http://www.theccc.org.uk/topics/global-targets/international-shipping)

MEASURING AND MONITORING

The IPCC sets out two methodological tiers for estimating emissions of carbon dioxide, methane and nitrogen dioxide from shipping. These apply emission factors to fuel consumption activity data, taking fuel and vessel type into account.[50] The first tier is the simplest, while the second tier uses more specific categories for the fuel, vessel and engine type.

The IPCC notes that possible weaknesses in this approach are most likely to occur through the misallocation of navigation emissions to another source category because measurement depends on fuel use records and in some cases (such as small craft) these may be difficult to obtain. Moreover, the IMO study found that discrepancies of up to 30% can occur between a fuel-based approach to measuring emissions and an activity-based approach.

INCLUSION IN NATIONAL CAPS

The international shipping sector is not included in national caps on Annex I countries. Domestic shipping however does count towards national caps. Commercial fishing is also caught by domestic caps under the reporting heading for agriculture.

INCLUSION IN EMISSIONS TRADING SYSTEMS

Carbon dioxide emissions from international shipping are not currently included in any ETS. However, a number of proposals for tackling CO_2 emissions from ships have been put forward at various sessions of the Marine Environment Protection Council of the IMO, (for example the Maritime Emissions Trading Scheme), which is a dedicated sectoral emissions trading system. When analysing the possibility of addressing shipping emissions through mechanisms that impose a price on emissions, a number of considerations will need to be made to ensure the environmental outcome is achieved efficiently and effectively, including the sensitivity of the sector to the increased costs, and the cost burden of accurately measuring emissions in that sector (see Table A6 below).

The 2009 EU directive on the EU ETS[51] recommends that, in the event that no international agreement on shipping is reached through the IMO/UNFCCC by 2011, the European Commission all propose a mechanism for including international shipping emissions in the EU emissions reduction strategy. In the US, proposals to include shipping in an upstream cap on fuel supplier emissions form part of the Waxman-Markey Clean Energy Bill.[52]

The IMO has found that with respect to international shipping: 'market-based instruments are cost-effective policy instruments with a high environmental effectiveness. These instruments capture the largest amount of emissions under the scope, allow both technical and operational measures in the shipping sector to be used, and can offset emissions in other sectors.'[53]

50 IPCC (2006)
51 Directive 2009/29/EC amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community. In this case, the Directive states that any resulting act should enter into force by 2013.
52 Waxman, Markey (2009)
53 IMO (2009)

Table A6: Factors relevant to a decision to include the international shipping sector in an ETS

SECTOR	POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
		Sensitivity to price signal	Concentration of emitters	Measuring emissions accurately
International Shipping	Operator/ Fuel supplier	**Additional costs imposed through the inclusion of shipping in an ETS would need to be handled through the operators' business models, either by passing the costs through to rates, or increasing efficiency and reducing costs.** Most forms of shipping are a cost-efficient means of transportation, and on average, shipping costs represent a very small fraction of the end price of the good. However, if a carbon price were to be imposed in respect of only a proportion of the sector, it is probable that (depending on the design of the ETS) leakage to ships not covered by such a system might occur.	**Concentrated if fuel supplier point of obligation is chosen; diffuse for operator point of obligation.** The number of emitters responsible for mitigation or for purchasing emissions allowances in an ETS will depend on the point of obligation. For example, the Waxman-Markey Clean Energy Bill proposes that shipping emissions are capped at the level of fuel suppliers. Other proposals envisage that the point of obligation would lie with the entity responsible for the transportation (such as the ship operator).	**Relatively low cost assuming comprehensive fuel use data available.** The IMO has noted that there is some scope for inaccuracy when basing emissions data on fuel statistics. More accurate figures can be obtained on the basis of activity data, although at present this entails an additional cost.

DEVELOPING COUNTRIES

As in developed countries, there are currently no mechanisms in developing countries for tackling CO_2 emissions from shipping. The UK Government[54] would like to see a transnational sectoral

54 DECC (2009a)

agreement reached in Copenhagen which would cover all international shipping. Such an approach would need to take the principle of common but differentiated responsibilities into account, whilst simultaneously addressing the high leakage risks in this sector.

A7 INTERNATIONAL AVIATION

DEFINITION

Aviation emissions result from the 'civil commercial use of airplanes, including civil and general aviation (for example agricultural airplanes, private jets or helicopters).'[55] International aviation is aviation with take-off in one country and landing in a different one.

EMISSIONS

International aviation currently accounts for around 1.9% of all global carbon dioxide emissions.[56] A range of estimates exist for the growth in emissions from this sector over time. However, in the absence of policy measures to tackle them, the Committee on Climate Change have suggested that international and domestic aviation together could account for 15-20% of all carbon dioxide emitted in 2050.[57]

The full climate change effect of aviation extends beyond CO_2 emissions alone because emissions arising from the combustion of kerosene include CO_2, water vapour (which leads to the formation of contrails and cirrus cloud at altitude), nitrogen oxides, particulates and other compounds. The impacts of these emissions at altitude is better understood for CO_2 than for the other emissions.[58]

A number of mitigation opportunities are available to the aviation sector. These include operational and air traffic management efficiencies as well as technical improvements, which range from small retrofitting improvements to switching to advanced technologies in the airframe and engine design. Using sustainably produced alternative fuels is also being considered by the aviation sector.

MEASURING AND MONITORING

Under the UNFCCC, domestic aviation is reported by developed countries as part of their national emissions inventories, while international aviation is reported as a memo item.

The 2006 IPCC guidelines set out three tiers for estimating greenhouse gas emissions from aviation, all of which distinguish between domestic and international flights. The choice of methodology will vary according to the type of fuel, the data available, and the relative importance of aircraft emissions in that country. The three tiers are as follows:

Tier 1 is based on an aggregate quantity of fuel consumption data for aviation, and should generally only be used for small aircraft, as well as for larger jet aircraft where operational data are not available.

---

55 IPCC (2006)
56 IMO (2009)
57 Committee on Climate Change (http://www.theccc.org.uk/topics/global-targets/international-aviation)
58 IPCC (1999)

- **Tier 2** is more detailed than Tier 1 and combines fuel consumption data with data on landing and take-off cycles.
- **Tier 3** uses movement data for individual flights.

Tiers 2 and 3 offer more accuracy in the distinction between domestic and international emissions, but they also require more resources to produce the data. The IPCC also notes that there may be significant discrepancies between the results of a bottom-up activity-based approach and a top-down fuel-based approach for aircraft.

INCLUSION IN NATIONAL CAPS

Domestic aviation is already subject to national caps under the Kyoto framework and is therefore addressed through a range of national policies. International aviation is not currently subject to any caps.

INCLUSION IN EMISSIONS TRADING SYSTEMS

International aviation is not currently included in any ETSs. The International Civil Aviation Organisation (ICAO), a UN Specialised Agency which coordinates international aviation policy and strategy, endorsed the inclusion of aviation in an open, international emissions trading system, implemented through a voluntary scheme, or the incorporation of international aviation into existing emissions trading systems.[59]

When looking at the possibility of limiting aviation emissions through market based mechanisms, a number of considerations will need to be taken into account to ensure the design of the mechanism achieves the environmental outcome efficiently and effectively, including the sensitivity of the sector to the increased costs, and the cost burden of accurately measuring emissions in that sector (see Table A7 below).

The EU has already taken a significant step towards addressing emissions from flights in Europe. From 2012, emissions from flights arriving at and departing from 'aerodromes' within the EU will be capped.[60] In addition, the Directive states that the EU will continue to work towards global measures to reduce aviation emissions. At the same time, proposals to include shipping in an upstream cap on fuel supplier emissions form part of the Waxman-Markey Clean Energy Bill in the US.[61]

59 IPCC (2007) AR4, Working Group III, Chapter 5

60 Directive 2008/101/EC amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading scheme within the Community. In 2012, the cap will be set at 97% of the average of emissions in 2004 to 2006 inclusive, decreasing to 95% the following year (subject to review of the Directive)

61 Waxman, Markey (2009)

Table A7: Factors relevant to a decision to include the international aviation sector in an ETS

SECTOR	POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
		Sensitivity to price signal	**Concentration of emitters**	**Measuring emissions accurately**
International Aviation	Operator/Fuel supplier	**Sensitive.** The airline sector is generally highly competitive with relatively tight margins. Airlines facing additional costs due to the requirement to cover the costs of emissions would need to handle those within their business models, for example by passing the costs through to passengers or freight customers or by increasing their efficiency and decreasing costs.	**Concentrated if fuel supplier point of obligation chosen; not concentrated for operator point of obligation.** The number of emitters responsible for mitigation or for purchasing emissions allowances in an ETS will depend on the point of obligation. For example, the Waxman-Markey Clean Energy Bill proposes that aviation emissions are capped at the level of fuel suppliers. In contrast, the EU ETS will make aircraft operators responsible for surrendering the appropriate emissions allowances.	**Relatively low cost, assuming comprehensive fuel use data available.** There is a direct relationship between the combustion of kerosene and CO_2 emissions.[62] However, the impact of other aviation emissions at altitude is less well understood (including the enhancement of cirrus clouds) and methodologies may evolve to factor in any additional impacts of radiative forcing resulting from emissions at high altitude as advances in science are made.

DEVELOPING COUNTRIES

No instruments are currently in place to address aviation emissions in the aviation sector in developing countries specifically, although flights to or from airports within the EU that are operated by developing country airlines will be subject to the requirements of the EU ETS. The UK Government would like to see a transnational sectoral agreement reached in Copenhagen to cover all international aviation.[63] Any future agreement on international aviation emissions will need to respect the principle of *common but differentiated responsibilities*.

62 AEA Technology (2009)
63 DECC (2009a)

A8 BUILDINGS

DEFINITION

Emissions from residential and commercial buildings consist of carbon dioxide from fuels consumed in the building (direct emissions) and electricity and heat consumption (indirect emissions), methane and nitrous oxide from biomass combustion and halocarbons.[64]

EMISSIONS

According to the IPCC Fourth Assessment Report, in 2004 the buildings sector was directly responsible for 8% and indirectly responsible for 20% of total greenhouse gas emissions and for 25% of total carbon dioxide emissions. This sector consumes about 50% of the total electricity and heat produced worldwide.[65]

The US and the EU were the two biggest emitters of carbon dioxide in 2004,[66] with about 2 $GtCO_2$ and about 1.2 $GtCO_2$ emitted by each respectively. Emissions from the buildings sector vary widely between countries, with a significant correlation between emissions and the level of socioeconomic development in a region.[67]

Emissions from buildings, both direct and indirect, are projected to increase from around 9 $GtCO_2$ in 2006 to 12 $GtCO_2$ in 2030,[68] an increase of 40% between 2006 and 2030, representing 15% of the total increase in global carbon dioxide emissions to 2030. Non-OECD countries will account for 88% of the total increase in building emissions worldwide, as most new building will be constructed in these regions in the coming decades. Non-OECD carbon dioxide emissions from buildings are forecast to grow at a rate of 2.4% per year, while emissions in OECD countries will grow at just 0.4% per year between 2006 and 2030.[69]

Mitigation opportunities include better-insulated and designed buildings which create lower heating and cooling energy demand; the substitution of gas with solar and biomass for space and water heating in developed countries; the implementation of efficiency standards in appliances and air-conditioning to achieve electricity savings; and the substitution of traditional biomass for cooking and heating with gas in developing countries. Additionally, mitigation opportunities arise from behavioural change to lower energy consumption patterns of the users of buildings, especially in developed countries and in some sectors of the societies in advanced developing countries.

MEASURING AND MONITORING

Emissions in this sector are potentially difficult to monitor and verify because the large number of small sources of emissions and the heterogeneous nature of the sector lead to high transaction costs. However, remote measurement of the energy consumed in the building by the energy suppy companies could reduce these costs.

---

64 IPCC (2007) AR4, Working Group III, chapter 6
65 IPCC (2007) AR4, Working Group III, chapters 1 and 6
66 WRI (2005)
67 Ibid
68 IEA (2008)
69 Ibid

The IPCC 2006 Guidelines for National Greenhouse Gas Inventories includes the direct emissions and the consumption of electricity and heat in buildings in the 'Other Sectors' and 'Energy Industries' sub-sectors of the Energy sector. However, emissions of carbon dioxide from biomass fuels are estimated and reported in the Agriculture, Forestry and other Land Use (AFOLU) sector and are reported as information items only in the Energy sector to avoid double counting. Methane and nitrous oxide emissions from biomass combustion in buildings are reported in the Energy sector.

INCLUSION IN NATIONAL CAPS

Carbon dioxide emissions from buildings are included in national caps covering the power sector in Annex I countries.

INCLUSION IN EMISSIONS TRADING SYSTEMS

Upstream emissions are included in ETSs covering the power sector. The coverage of fuel suppliers by an ETS would cover the use of electricity and gas (and other fuels) in buildings. However, this upstream coverage could be complemented with downstream measures to promote energy efficiency in particular. Such a policy response is appropriate where a carbon price is insufficient to incentivise take-up on energy efficiency because of hidden barriers. A necessary (but not sufficient) condition for downstream coverage to work is that the concentration of emitters remains at levels that do not incur high transaction costs. For example, the UK Carbon Reduction Commitment (CRC), due to start in 2010, will cover emissions from large commercial and institutional buildings.

Table A8 describes some of the most important factors when considering the inclusion of the buildings sector in an ETS.

Poorer households would be worse off compared to richer households if price mechanisms such as a tax or an ETS were to be implemented to address emissions from this sector. This is mainly due to poorer households spending a greater proportion of their income on energy and because energy saving measures require large capital expenditure which is beyond the means of poorer households. However, an upstream mechanism such as a carbon tax or an ETS can be both efficient and fair. An upstream trading mechanism is efficient because overall policy costs can be minimised and emissions capped. It can be made to be fair through allowance auctioning and the use of these revenues to improve the energy performance of poorer households who spend a greater proportion of their income on energy.

Table A8: Factors relevant to a decision to include the buildings sector in an ETS

POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
	Sensitivity to price signal	**Concentration of emitters**	**Measuring emissions accurately**
Fuel supplier (but downstream measures may also be necessary)	**Sensitive to some extent.** The sector benefits from energy efficiency-based abatement with large abatement potential and at low or negative cost. However, these abatement measures often require substantial up-front capital. In addition, the downstream building sector faces potentially big behavioural barriers and other barriers such as owner-occupier problems and asymmetric information. Therefore additional policies may be needed.	**Concentrated if point of obligation is fuel supplier; point of obligation at building-level would be extremely diffuse.** The downstream building sector is characterised by a very large number of small emitters. Therefore a threshold would be needed to include only commercial or large buildings in order to reduce transaction costs.	**Low cost.** Emissions are easy to measure and monitor if this is based on the energy consumed in the building. However this would rely on a self-verification system due to the large number of emitters typical of the sector. Double coverage may occur when upstream energy source is also covered under the ETS.

DEVELOPING COUNTRIES

A small number of programmatic energy efficiency projects that include efficient lighting, boilers, district heating, solar thermal and efficient cooking stoves, exist in the CDM,[70] JI[71] and the voluntary frameworks.

A9 WASTE

DEFINITION

The most significant emissions in the waste sector are methane emissions from solid waste disposal sites and wastewater treatment and discharge; nitrous oxide emissions from wastewater treatment; and discharge or carbon dioxide emissions from incineration and burning of waste containing fossil carbon.[72]

70 Five of the nine CDM Programmes of Activities in the CDM pipeline involve improved energy use in buildings and there are four registered CDM projects involving energy efficiency in households (CDM pipeline, 2009), available at: http://cdmpipeline.org/, accessed on 10th June 2009).

71 Two of the four JI Programmes of Activities in the CDM pipeline involve improved energy use in buildings (CDM pipeline (2009), available at: http://cdmpipeline.org/, accessed 19 June 2009)

72 IPCC (2006)

EMISSIONS

According to the IPCC Fourth Assessment Report, this sector was responsible for 2.8% of total greenhouse gases emissions in 2004.[73] However, in Annex I countries the share of these emissions was between 2 to 3% while in non-Annex I countries it was about 4.3%. 90% of emissions from the waste sector consisted of methane from landfill and wastewater, and these represented 18% of anthropogenic methane emitted in 2004. The main drivers of growth in methane emissions from landfill and wastewater in developing countries are population growth, rapid urbanisation and economic growth.

The US and China are the single largest emitters of methane from landfill and are expected to remain the largest up until 2020.[74] Industrialised countries' future methane emissions are expected to stabilise or decrease as these countries continue to reduce the amount of organic waste disposed of to landfills. On the other hand, landfill emissions from developing countries may increase as these countries move away from open dumps towards sanitary landfills.[75]

The largest emitters of methane from wastewater are India, China, Indonesia and the US.[76] These countries are expected to remain the largest by 2020. Methane emissions from wastewater are expected to increase by 50% globally between 1990 and 2020; this will be especially strong in the rapidly developing countries of Eastern and Southern Asia.[77]

Mitigation opportunities are well developed in the solid waste sub-sector because of the relatively wide range of waste management technologies. These include recycling and re-use, composting, gas capture and power generation, mechanical and biological treatment, incineration and anaerobic digestion. Abatement options in the wastewater sub-sector include improved wastewater treatment and anaerobic digestion with gas capture.

MEASURING AND MONITORING

Measuring methane emissions is difficult due to the uncertainty inherent in the methodologies to calculate landfill gas production rates, and the limited data available in the wastewater sector, especially in developing countries. However, measurement of carbon dioxide from incinerators does not face the same technical limitations and MRV is more reliable for this type of emission.

The IPCC 2006 Guidelines for National Greenhouse Gas Inventories recommends the use of three tiers to measure methane from solid waste disposal sites and wastewater. The Tier 1 method applies default activity data and default parameters. This method is considered good practice for countries with limited data. The Tier 2 method follows the same method as Tier 1 but allows for incorporation of good quality country-specific activity data. For a country with good quality activity data and advanced methodologies, a country-specific method or an IPCC method with country-specific key parameters could be applied as a Tier 3 method.

The rate of issuance of credits in CDM waste projects is one of the lowest of all project types. For example, the rate for solid waste projects (most of them based on landfill gas capture) is only 33%.[78] This may be due to a consistent overestimation of gas production rates by project developers, indicatinga lack of accuracy in the methodologies used.

---

73 IPCC (2007) AR4, Working Group III, chapters 1 and 10
74 EPA (2006)
75 Ibid
76 Ibid
77 IPCC (2007) AR4, Working Group III, chapter 10
78 CDM pipeline (2009), available at: http://cdmpipeline.org/, accessed on 10 June 2009

INCLUSION IN NATIONAL CAPS

Emissions from this sector are included in national caps in Annex I countries.

INCLUSION IN EMISSIONS TRADING SYSTEMS

Emissions from the waste sector are not included in existing ETSs. If they were included, the point of obligation would be better at plant level as this would minimise transaction costs. Table A9 describes some of the most important factors when considering the inclusion of the waste sector in an ETS.

Implementation of abatement options through an ETS or other policies and instruments tends to bring important co-benefits as it often implies the introduction of waste management technologies where previously these were poor or non-existent. Waste management may reduce local air pollution, pests, spontaneous gas fires and explosions but can also destroy local informal employment.

Table A9: Factors relevant to a decision to include the waste sector in an ETS

POINT OF OBLIGATION	FACTORS TO TAKE INTO ACCOUNT		
	Sensitivity to price signal	**Concentration of emitters**	**Measuring emissions accurately**
Plant	**Sensitive.** Cheap abatement options exist such as recycling, composting and landfill gas capture and flaring. However, up-front capital requirements are often a mayor barrier, especially in developing countries. In addition, some behavioural barriers may exist such as changing habits to avoid waste generation, increase recycling and composting. Therefore, additional policies may be needed.	**Concentrated.** There are relatively few emitters, implying low transactions costs. However, a threshold may be needed to avoid penalising smaller sites (as these cannot justify the investment in technology) which in turn may lead to 'local' leakage problems.	**Complex and high cost.** The time lag of landfill methane produced years after disposal of waste is an issue. Additionally, there is a lack of data especially from developing countries and large uncertainties in methane production rates.

DEVELOPING COUNTRIES

Capital requirements are often a major barrier for municipalities in developing countries that are considering implementing waste management projects with emission reduction goals. The CDM in the waste sector can help raise finance to cover some or all of the up-front costs. Solid waste projects represent 7% of the total CDM projects in the pipeline, and wastewater projects 3%. Solid waste projects use technologies such as combustion and gasification of municipal solid waste, composting, landfill gas flaring and power generation.[79]

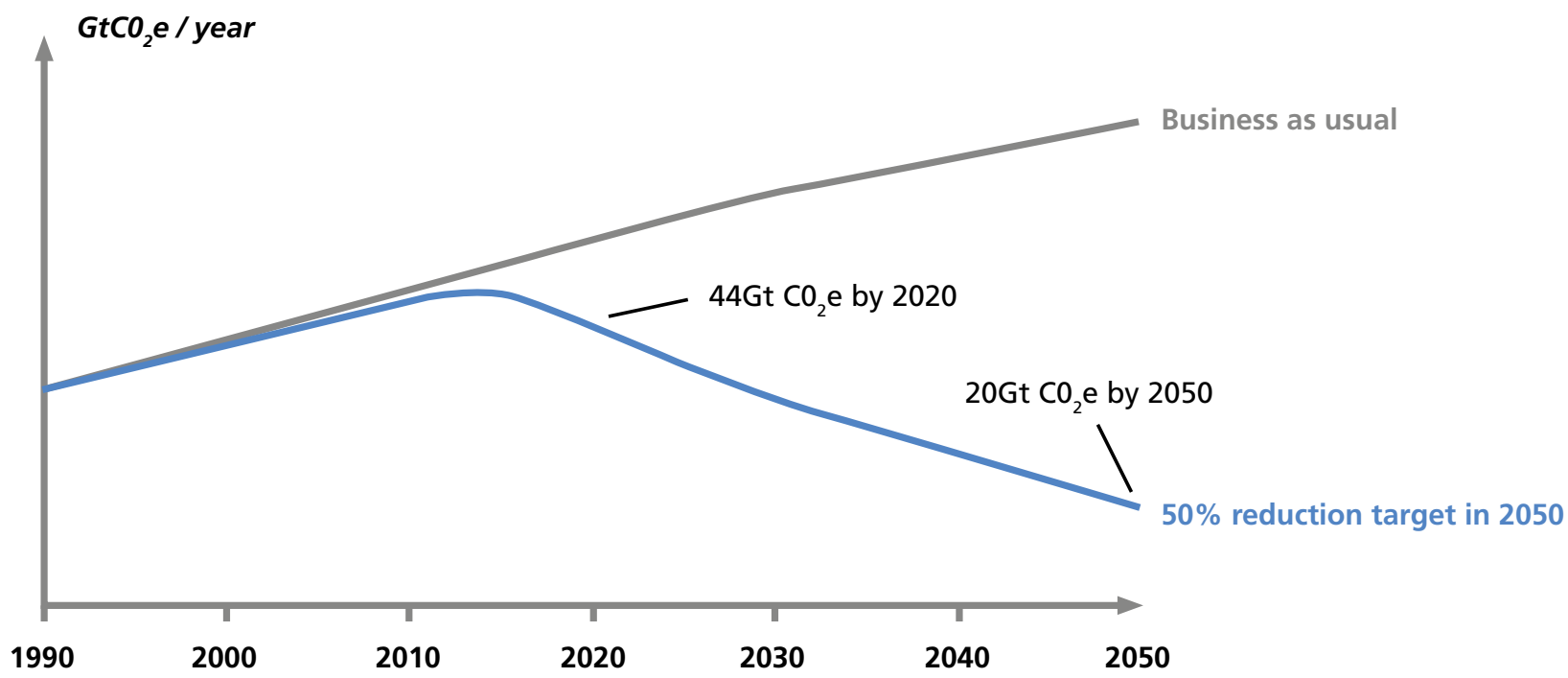
79 Ibid

ANNEX B: EMISSION TRAJECTORIES IN THE TRANSITION PERIOD

A trajectory of capped emissions compatible with the EU Commission recommendations[1] of keeping the global average temperature increase at 2°C[2] forms the basis of the modelling assumptions in this report.

The EU communication recommendations are based on the IPCC's Fourth Assessment report, which indicates that to achieve the 2°C objective, developed countries' emissions reductions should range from 25% to 40% by 2020 and from 80% to 95% by 2050 relative to 1990 levels.[3] The EU Commission's communication also cites the work by den Elzen and Höhne (2008), stating that developing countries' reductions should range from 15% to 30% relative to BAU emissions in order to meet the 2°C objective.[4] The ranges are accounted for by the differences in BAU projections used in different studies. The EU Commission's target for developed countries is a 30% cut relative to 1990 in 2020, and between 80% and 95% cuts relative to 1990 in 2050 to achieve a global reduction of 50% relative to 1990 levels by that year.

Figure B1: An illustration of an emission reduction trajectory to achieve the 2°C goal



1 Commission of the European Communities (2009), Executive Summary
2 IPCC (2007), chapter 3, Table 3.5, 198pp
3 IPCC (2007), chapter 13, Box 13.7, 776pp
4 den Elzen and Höhne (2008)

A trajectory believed to be compatible with the 2°C objective was used as the reference case for modelling purposes in the report. A stylised version of this trajectory is shown in Figure A5.1. More specifically, the trajectory was constructed based on the following main assumptions:

- in 2020, developed countries taking on a cap of 30% below 1990 levels and developing countries a cap of 15% below business as usual, achieving a global cap of about 44 GtCO2e in that year; and
- in 2050, developed countries taking on a cap of 80% below 1990 levels and developing countries a cap of about 60% below business as usual necessary to achieve a global cap of about 20 $GtCO_2e$.

ANNEX C: CAP AND TRADE IN PRACTICE – THE ACID RAIN PROGRAMME

SOx AND NOx EMISSIONS TRADING

The first use of emissions trading as a policy mechanism for environmental pollution was in the US. Under the 1990 US Clean Air Act Amendments, the Acid Rain Program was established, which led to the creation of emissions trading markets for SO_2 (sulphur dioxide) and NOx (nitrogen oxides), the gases responsible for acid rain. These are often referred to as the SOx and NOx markets. Due to the large scale and high profile nature of the Acid Rain Program, its relative success contributed to the change in attitude towards emissions trading in the 1990s and facilitated the creation of policies to tackle greenhouse gas emissions outside the US.[1]

An evaluation of the systems suggests that an active and efficient market for SOx and NOx allowances was created, illustrated by the single price per allowance; high levels of inter-emitter trading; low transactions costs; and the development of liquid contract and futures markets.

EMISSIONS REDUCTIONS UNDER THE SO_2 MARKET

According to the US Environmental Protection Agency (EPA), by 2004 SO_2 emissions had fallen by over 5 million tons from 1990 levels, or about 34% of total emissions from the power sector. Compared to 1980 levels, sulphur dioxide emissions from power plants have dropped by 7 million tons, or more than 40%.[2] Furthermore, the 2010 emissions target was reached by 2007. The EPA also estimates that by 2010 the overall compliance costs to businesses and consumers will be $1-2bn per year, a quarter of the original cost predictions.

Perhaps the most striking feature of the SO_2 trading system was the fall in sulphur dioxide emissions in the first year of the programme. Emissions had been falling steadily throughout the 1980s, even before Title IV of the Clean Air Act was enacted, and they continued to fall at about the same rate during the first half of the 1990s. However, the reduction from 1994 to 1995 was far greater than anything that had been seen before, strongly suggesting that it was caused by the SO_2 trading system that opened in 1995. One possible reason for the remarkable reduction in emissions in 1995, when the allowable emissions for that year required only a small reduction in emissions, was the ability to bank allowances. The prospect of higher marginal abatement costs after 2000 made abating more than was required in Phase I of the system an appealing option for smoothing the transition to the more demanding Phase II. As a result, the reduction in emissions

1 Tietenberg (2006)
2 EPA (2005)

experienced in Phase I was about twice what would have been required to bring emissions below the level allowed in these years.

The NOx trading system was set up to help the Northeast and the mid-Atlantic region to reduce harmful ground-level ozone, specifically by cutting precursor NOx emissions. The unique feature of this trading system is that it operates only from May to September, known as the 'ozone season'. Evolving from previous systems, the NOx budget program has only been operational for a few years and is therefore harder to analyse, but information to date shows that the system is functioning well and emission reduction targets are being met.

SOx AND NOx AND GREENHOUSE GAS EMISSIONS TRADING

The SOx and NOx trading systems have been characterised by high compliance rates and a comprehensive monitoring, reporting and verification process. However, it should be acknowledged that the abatement technologies that facilitated such large emissions reductions were already known to the relevant sectors when the legislation came into force. For example, one option would be to buy low-sulphur coal if a power station used coal, or to install scrubbers to remove pollutants. Similar options exist for carbon dioxide emissions from power plants, such as switching from coal to gas and the installation of scrubbers, even though the technology for these is less well developed.

Furthermore, the SOx and NOx trading systems were not perfect; it took time for the allowance markets to develop and mature. The NOx market experienced high volatility, and the role of exogenous factors and complimentary policies has yet to be fully examined.

The Acid Rain programme trading systems provide useful lessons for carbon trading. When comparing these emissions trading systems, some essential physical and political differences need to be noted.[3]

- While SOx and NOx only stay in the atmosphere for 30-60 days and cause acid rain in localised areas close to the emissions source, greenhouse gases can stay in the atmosphere for decades and have a global impact.
- The political context around carbon trading is more complex because of the urgency of the situation as well as the need for international action combined with highly sensitive equity considerations.
- The available technologies to abate SOx and NOx were well-known when the legislation came into force, whereas there is still some uncertainty around carbon abatement technologies (for example carbon capture and sequestration) and the likely cost of such technologies.

The true success of the Acid Rain Program and associated trading systems lies not only in the emissions reductions and relatively low compliance costs, but the precedent set by the establishment of a politically acceptable and economically viable emissions trading system, and the lessons that can be used to inform other emissions trading systems.

3 Labatt and white (2007)

ANNEX D: GLOBAL CARBON FINANCE MODEL

The Global Carbon Finance Model (GLOCAF) aims to provide estimates of costs and international financial flows that could arise under various post-2012 global deal scenarios.[1] GLOCAF models carbon markets by finding the equilibrium price of the credit supply curve (determined largely by marginal abatement cost curves) and the credit demand curve (determined largely by regional abatement targets). Like nearly all linear models, GLOCAF assumes the actors are rational in that the least cost abatement is pursued first within each sector of each region.

The cost of a particular abatement measure depends on what has happened in the past. Two of the main causes of this path dependency are:

- induced technological change – where the learning process means that future technological costs depend on current levels of investment; and
- investment lead-in times – the time taken for abatement to take place following major investments, for example, new power plants can take some time to come on stream; but once on stream the range of abatement options, and hence costs, looks very different.

To reflect this path dependency of marginal abatement costs, GLOCAF uses three sets of marginal abatement cost curves reflecting different levels of action in earlier years. By using these sets the model can generate the appropriate abatement costs for the level of action that has already taken place.

GLOCAF models the following main outputs by regions and sectors in five discrete years (2010, 2015, 2020, 2030 and 2050):

- abatement/mitigation costs;
- carbon prices; and
- financial flows to and from regions.

GLOCAF models only the costs relating to mitigation efforts in most sectors, including forestry mitigation costs. Costs relating to capacity building, extra technology costs beyond straightforward mitigation (for example extra early investment in CCS) and adaptation costs are excluded.

GLOCAF is a very flexible model as it allows the user to choose a large number of different inputs. The most relevant for this report are:

- Business as usual (BAU) emissions per region and sector.
- Marginal abatement cost (MAC) curve per region and sector.
- Emission abatement targets per region and also per sector if needed in each of the modelled years.

1 See www.occ.gov.uk/activities/gcf.htm

- Rules and features of international trading of cap and trade permits or allowances and CDM-like credits most relevant for this project are:
  - cap and trade permits and CDM-type credits: regions can participate in the market either through trading of cap and trade permits (when assuming binding targets) or through trading of CDM-like credits (when not assuming binding targets).
  - participation in the market: regions and sectors can specifically take part in the market or be excluded from it in each of the modelled years.
  - linking markets: regions can be fully or partially linked in each of the modelled years.
  - 'discounting' of credits: a discount factor can be applied to credits in such a way that for every tonne of abatement, less than one credit is awarded. This feature can be applied by region and sector in each of the modelled years.
  - 'supplementarity' limits: the maximum amount of credits or permits that regions are allowed to import to meet their target can be specified by region in each of the modelled years.

Global emission projections under business as usual and marginal abatement costs are attributed to 15 different geographical regions and 18 sectors. These sectors cover most global emissions, including international aviation. However emissions from international maritime and some industrial processes are not included.

GLOCAF can use different data sources for the BAU and MAC inputs. The BAU and MAC data used in this project were derived from models that are highly regarded internationally. The model POLES (calibrated to the International Energy Agency's World Energy Outlook 2008 report) was used for the energy sectors,[2] a Netherlands Environmental Assessment Agency model for the non-CO_2 sectors[3] and the models G4M and GLOBIOM[4] for the forestry sectors.

2 LEPII-EPE, CNRS Grenoble, http://upmf-grenoble.fr/iepe/textes/POLES12p_Jan06.pdf
3 Lucas et al (2007)
4 Gutsi, Havlik and Obersteiner (2008)

ANNEX E: CURRENT AND PROPOSED EMISSIONS TRADING SYSTEMS

EUROPEAN UNION

The EU Emissions Trading System (EU ETS) was the first international ETS for greenhouse gas emissions in the world. The cornerstone of EU climate change policy, it also currently accounts for the majority of the global carbon market. It covers over 11,500 energy-intensive installations across the EU, which represent around 40% of Europe's emissions of CO_2. Member States transfer part of the effort required to meet their Kyoto commitments onto the private sector entities directly responsible for those emissions. The installations may choose to reduce emissions internally or purchase EU allowances or international Kyoto credits. Norway, Iceland and Liechtenstein joined in 2008.

US

The Regional Greenhouse Gas Initiative (RGGI) is the first mandatory ETS in the United States. Set up in 2008, RGGI covers the power sector of ten north eastern and mid-Atlantic US states. The US administration has also stated its intention to create a federal ETS (or 'cap and trade') for the US. The Waxman-Markey Bill has set out potential elements of a US system. It would cover electricity generators, liquid fuel refiners and blenders, and fluorinated gas manufacturers starting in 2012. Offset credits would be included up to a limit of two billion tonnes, split evenly between domestic and international offsets to allow one billion tonnes each. Credits for reduced emissions from deforestation set against national-level baselines in developing countries would be included subject to appropriate safeguards.

NEW ZEALAND

New Zealand has launched a national ETS to cover all sectors in the economy and the six Kyoto GHGs. It will constitute New Zealand's core price-based measure for reducing greenhouse gas emissions and enhancing forest carbon sinks. The ETS will allow both sales to, and purchases from, international credit markets, with no planned credit import rule in addition to Kyoto requirements. This will reduce abatement costs, aid liquidity in its relatively small market and act as a safety valve on price. The forest sector was the first sector to enter the ETS; its first compliance period is from January 2008 until December 2009. This involves the devolution to landowners of both the credits for forest activities that lead to a removal of CO_2 from the atmosphere and the liabilities for subsequent release of CO_2 through deforestation. A new Government has indicated it will

review the design of the New Zealand ETS by late 2009, but has reaffirmed its commitment to the introduction of emissions trading.

SWITZERLAND

Companies in Switzerland that do not wish to pay a carbon tax for energy-related emissions may opt into an emissions trading scheme after agreeing a legally binding emissions target with the government. International credits may be used to cover a maximum of around 8 per cent of the target. Switzerland has indicated that its system could be linked to the EU ETS in the future.

AUSTRALIA

Australia has announced plans for an ETS under its Carbon Pollution Reduction Scheme. The CPRS will cover around 75 per cent of Australia's emissions and involve mandatory obligations for around 1000 entities. All six greenhouse gases under the Kyoto Protocol will be covered. The Scheme will have broad sectoral coverage including stationary energy, transport, fugitive, industrial processes, waste and forestry sectors. This will be achieved through a combination of placing Scheme obligations directly on some emitters, and, in other cases, placing obligations further 'upstream' in the production chain, as a way of cost-effectively capturing smaller sources of emissions.

OTHER PROPOSED EMISSIONS TRADING SYSTEMS

Japan introduced a voluntary ETS in October 2008. Canada is also considering a federal emissions trading scheme.

GLOSSARY OF KEY TERMS

Baseline and credit – a carbon market mechanism that issues credits to participants at the end of a period, based on how far (if at all) emissions have been lowered below a pre-determined baseline. The resulting credits can be sold to buyers in cap and trade mechanisms. Examples of baseline and credit mechanisms include the Clean Development Mechanism (CDM) and Sectoral Crediting.

Cap and trade – a carbon market mechanism that imposes a cap on the overall emissions of participants during a pre-determined period and assigns emissions allowances to participants at the beginning of the period. Participants must surrender sufficient allowances and credits to cover all of their emissions at the end of the period. Those participants with a surplus of allowances can sell them other participants. Examples of cap and trade systems include international emissions trading (IET), Sectoral Trading and Emissions Trading Systems (ETSs).

CDM benchmarking – a form of CDM in which a single pre-determined methodology for a sector or sub-sector is used for a country or region. The crediting baseline is set by reference to an efficient emitter in the sector (for example, at the first decile of efficiency among emitters) – hence the term 'benchmark' – rather than by reference to what would have happened in the absence of the particular project in question. CDM benchmarking is most suitable for sectors that produce a homogenous product (for example cement or aluminium).

Credit import limit – the maximum amount of allowances or credits from non-domestic sources that can be used to meet targets in the cap and trade system of a particular country or region. Sometimes also referred to as a 'supplementarity limit'.

Dual-level system – A system in which both the government and emitters based within the country in question participate in carbon trading. For example, at one level a government might have a national emissions target under Article 3 of the Kyoto Protocol and can trade allowances with other governments under Article 17. At another level the government might also create an ETS for emitters within its territory to help meet its national emissions target.

Emissions Trading System (ETS) – a cap and trade mechanism that is applied to emitters (rather than governments). Examples of ETSs include the EU ETS and the Regional Greenhouse Gas Initiative (RGGI) in some US states.

Emitter – A private entity (for example a company selling electricity) or public entity (for example a local council managing a landfill) that produces greenhouse gases.

Emitter-level carbon market mechanism – a carbon market mechanism in which emitters are responsible for meeting emissions targets and may trade emitter emissions allowances or credits with other emitters or governments (for example an ETS or the CDM).

Government-level carbon market mechanism – a carbon market mechanism in which the central government of a country is responsible for meeting an emissions target and may trade national emissions allowances or credits with other governments or emitters (for example IET or Sectoral Crediting).

Linking ETSs – Linking occurs when emissions allowances from one ETS are recognised and accepted for compliance purposes in another. Each ETS remains under the sovereign responsibility of the national/regional authority.

Non-market finance – used in this report to mean finance for developing countries to tackle climate change that does not include money derived from developing country governments or their emitters selling credits and surplus allowances to developed country governments or their emitters.

Sectoral Crediting – a baseline and credit mechanism where a government is responsible for surpassing a crediting baseline that is specific to a particular sector of the economy. If the crediting baseline is set below the level of business as usual (BAU) emissions, then the country performs domestic abatement action ('own action') representing the difference between BAU and the baseline.

Sectoral Trading – a cap and trade mechanism where a government is responsible for meeting an emissions target that is specific to a particular sector of the economy.

BIBLIOGRAPHY

AEA (2009) *Reducing the emissions of HFC-23 within and outside of the clean development mechanism*, May 2009, Oxfordshire, UK. Work commissioned by the Department of Energy and Climate Change

AEA Technology (2009) *Report on International Aviation and Maritime Emissions in a Copenhagen (post 2012) Agreement: Final Report*, AEA Technology, Oxfordshire

Ambrosi, P and Capoor, K (2009) *State and Trends of the Carbon Market 2009*, The World Bank, Washington DC

Anderson, J and Mehling, M (2009) *Linking the EU's emissions Trading System to any future US Emissions Trading Scheme*, European Parliament Policy Department Economic and Scientific Policy, European Parliament

Associated Press (2009) 'Automakers, Obama announce mileage, pollution plan', 19 May 2009

Associated Press (2009) 'Obama team debuts at U.N. climate talks', *Msnbc*, 29 March 2009

Australian Government (2008) *Carbon Pollution Reduction Scheme: Australia's Low Pollution Future*, White Paper Volume 1. Available at http://www.climatechange.gov.au/emissionstrading/index.html

Baalman, P and Schlamadinger, B (2008) *Scaling Up AFOLU Mitigation Activities in Non Annex Countries*. Background paper to Eliasch (2008)

Barrett, S, (2008) *'Climate Treaties and the Imperative of Enforcement'* in *Oxford Review of Economic Policy: Climate Change* Vol 24 No 2, Summer 2008

Broekhoff, D (2007) *Linking Markets for GHG Reductions: Can it be done?*, World Resources Institute, Washington DC

Buchner, B (2007) *The economic aspects of linking trading schem*es, 4th meeting of the ECCP working group on emissions trading, European Commission

Bugge , HC (1996) 'The principles of polluter pays in economics and law', in Eide E and van der Bergh R (eds) *Law and Economics of the Environmen*t, Oslo: Juridisk Forlag

Caisse des Depots et Consignation (2008) 'Tendances Carbone', *Mission Climat* Vol 26, June 2008

Carbon Trust (2009) *Global Carbon Mechanisms: Emerging lessons and implications*, Carbon Trust, London

Climate Strategies *(2009) Linkages among Emissions Trading Schemes and with Offset Projects,* Climate Strategies, Cambridge

Commission of the European Communities (2009) Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions: 'Towards a comprehensive climate change agreement in Copenhagen', 28 January 2009, Brussels

Congressional Budget Office (2008) *Issues in Designing a Cap-and-Trade Program for Carbon Dioxide Emissions* and *Containing the Cost of a Cap-and-Trade Program for Carbon Dioxide Emissions.* Available at http://www.cbo.gov/

Convery, De Perthuis and Ellerman (2008) 'The European Carbon Market in Action: Lessons from the First Trading Period Interim Report', MIT (CEEPR) http://tisiphone.mit.edu/RePEc/mee/wpaper/2008-002.pdf

Dargay, J, Goodwin, P and Hanly, M (2003) 'Elasticities of Road Traffic and Fuel Consumption with Respect to Price and Income: A Review' *Transport Reviews*, Vol 24, No 3, 275–292

DECC (2009a) *The Road to Copenhagen*, Department of Energy and Climate Change, London

DECC (2009b) *Investing in a Low Carbon Britain*, Department of Energy and Climate Change, London

Deloitte (2008) *Implications of linking emissions trading schemes on market*s Available at http://www.deloitte.com/dtt/cda/doc/content/ImplicationsLinkingEmissionsTradingSchemesMktParticipants_WPC_aug08%281%29.pdf

den Elzen, M and Höhne, N (2008) 'Reductions of greenhouse gas emissions in Annex I and non-Annex I countries for meeting concentration stabilisation targets – an editorial comment', *Climatic Change* 91: 249–274

Dröge, S (2009) *Tackling Leakage in a World of Unequal Carbon Prices,* Climate Strategies, Cambridge

Ecofys (2009) *Linking developing countries to carbon markets – Cost assessment of capacity building requirements*. New work commissioned for this report

Edenhofer, O, Flachsland, C and Marschinski, R (2007) *Towards a Global CO_2 Market? An economic analysis*, Expertise for the Policy Planning Staff in the Federal Foreign Office, Potsdam Institute for Climate Impact Research

Eliasch, J (2008) *Climate Change: Financing Global Forests: The Eliasch Review*, Office of Climate Change, Earthscan Publications, London

Ellerman, D (2003) *Emissions trading in the US*, Pew Centre on Global Climate Change, Arlington VA

EPA (2005) *Acid Rain Program 2004 Progress Report*, Environmental Protection Agency, Washington DC

EPA (2006) *Global Mitigation of Non-CO_2 Greenhouse Gases*, Environmental Protection Agency, Washington DC

Esty, D C (2006) *Good Governance at the Supranational Scale: Globalizing Administrative Law, The Yale Law Journal* 115, pp 1490-1562

European Commission (2009) *Towards a comprehensive climate change agreement in Copenhagen*, COM (2009) 39 final

European Parliament (2009) Regulation (EC) No 443/2009 of the European Parliament and of the Council, 23 April 2009

European Parliament and Council Directives: 2009/29/EC (23 April 2009); 2008/ 101/EC (19 November 2008) and 2004/101/EC (27 October 2004)

Evans, A and Steven D (2009) *An Institutional Architecture for Climate Change: A Concept Paper,* Center for International Cooperation (DFID commissioned report)

Fankhauser, S and Hepburn, C (2009) *Carbon Markets in Space and Time*, Vivid Economics. New work commissioned for this report

FAO (2006) (2006) *Global Forest Resource Assessment 2005: Progress toward sustainable forest management*, Food and Agriculture Organisation Forestry Paper, Rome

FAO (2008) 'Growing demand on agriculture and rising prices of commodities'. Available at: http://www.fao.org/es/esc/common/ecg/538/en/RisingPricesIFAD.pdf

Flachsland, C, Edenhofer, O and Steckel, J (2008) *Developing the International Carbon Market. Linking Options for the EU ETS* , Potsdam Institute for Climate Impact Research

Flachsland, C, Marschinski, R and Edenhofer, O (2009) 'Global trading versus linking: Architectures for international emissions trading', *Energy Policy* doi: 10.1016/j.enpol.2008.12.008

Gardner, S (2009) *EU ETS: Little support for carbon floor price*, ClimateChangeCorp, 6 May

Garnaut (2008) *The Garnaut Climate Change Review,* Cambridge University Press, Cambridge

Global Humanitarian Forum (2009) *Human Impact Report*, Global Humanitarian Forum, Geneva

Gusti, M, Havlik, P and Obersteiner, M (2008) Technical description of the IIASA model cluster, available at http://www.occ.gov.uk/activities/eliasch/Gusti_IIASA_model_cluster.pdf

Haites, E (2003) *Harmonisation between National and International Tradeable Permit Schemes: CATEP Synthesis Paper*, Organisation for Economic Co-operation and Development, Paris

Haites, E (2008) *Linking emissions trading schemes for international aviation and maritime emissions*, Climate Strategies, Cambridge

Harbury, C and Lipsey, R (1992) *First principles of economics*, Second Edition, Oxford University Press, Oxford

Harrison, D (2006) *Carbon Markets, Linking and Cost Containment,* NERA Economic Consulting, New York

Hoare et al (2008) *Estimating the cost of building capacity in rainforest nations to allow them to participate in a global REDD mechanism*. Background paper to Eliasch (2008)

Höhne, N et al (2008) *Sectoral approach and development.* Input paper for the workshop: Where development meets climate – development related mitigation options for a global climate change agreement, Ecofys, Cologne

Houghton, R A (2003) 'Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management 1850–2000', *Tellus B*, 55, 2, 378–390

IEA (2008) *World Energy Outlook*, International Energy Outlook/OECD, Paris, France

IMO (2009) Second GHG Study April 2009 (Buhaug et al) International Maritime Organization, London

IPCC (2006) '2006 IPCC Guidelines for National Greenhouse Gas Inventories', Prepared by the National Greenhouse Gas Inventories Programme, Eggleston, H, Buendia, L, Miwa, K, Ngara, T and Tanabe, K (eds), IGES, Japan

IPCC (2007) Fourth Assessment Synthesis Report, *Summary for Policymakers*, IPPC Fourth Assessment Report, Cambridge University Press, New York

IPCC (2007) Fourth Assessment Report of the Intergovernmental Panel on Climate Change, *Climate Change 2007: Mitigation*, Contribution of Working Group III (Metz, B, Davidson, OR, Bosch, PR, Dave, R and Meyer, LA (eds)), Cambridge University Press, Cambridge

Jaffe, J and Stavins, R (2007) *Linking Tradable Permit Systems for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges,* International Emissions Trading Association Report on Linking GHG Emissions Trading Schemes

Jaffe, J and Stavins, R (2008) *Linking a U.S. Cap-and-Trade System for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges*, Regional Markets Center working paper No 08-01

Jotzo, F and Betz, R (2009) *Linking the Australian Emissions Trading*, Environmental Economics Research Hub, Crawford School, ANU, Research Report No 14

Labatt, S and White, R (2007) *Carbon Finance: The Financial Implications of Climate Change*, Wiley Finance, US

Laboratoire d'Economie de la Production et de l'Intégration Internationale and Département Energie et Politiques de l'Environnement, CNRS Grenoble (2006) The POLES model: POLES State of the Art, available at http://upmf-grenoble.fr/iepe/textes/POLES12p_Jan06.pdf

Lucas, P, van Vuuren, DP, Olivier, JA and den Elzen, M (2007) 'Long-term reduction potential of non-CO2 greenhouse gases', *Environmental Science & Policy* 10 (2): 85-103

Mehling, M (2007) 'Bridging the Transatlantic Divide: Legal Aspects of a Link between Carbon Markets in Europe and the U.S.', *Sustainable Development Law & Policy*, VII-2

Mehling, M (2009) *Global Carbon Market Institutions: An Assessment of Governance Challenges and Functions in the Carbon Market.* New work commissioned for this report

Michaelowa et al (2008) *A Review of the current state and options for reform of the CDM*

Müller, B and Ghosh, P (2008) *Implementing the Bali Action Plan: What Role for the CDM?*, Oxford Institute for Energy Studies and Climate Strategies

NAO (2009) *Review of EU Emissions Trading Scheme*, National Audit Office, London

New Carbon Finance (2009) *EU ETS – Research Note*, 13 February 2009

New Carbon Finance (2009) *An assessment of the impact of banking and borrowing rules on linkages between ETS schemes*. New work commissioned for this report

North, DC (1990) *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, Cambridge

OECD (1960) *Convention on the Organisation for Economic Co-operation and Development*, Organisation for Economic Cooperation and Development, Paris. Available at: http://www.oecd.org/document/7/0,3343, en_2649_201185_1915847_1_1_1_1,00.html

OECD (2008) *What role for public finance in international climate change mitigation*, Organisation for Economic Cooperation and Development, Paris

OECD (2009) *Sectoral Approaches and the Carbon Market*, Organisation for Economic Cooperation and Development, Paris

Office of Climate Change (2008) Technology Project http://www.occ.gov.uk/publications/index.htm

Oko-Institut (2007) *Is the CDM fulfilling its environmental and sustainable development objectives? An evaluation of the CDM and options for improvement*, report prepared for WWF, Berlin, Germany

Penner, J E , Lister, D H, Griggs, D J, Dokken, D J and McFarland, M (eds) (1999) *Aviation and the Global Atmosphere,* IPCC Special Report

Pew Centre (2009) *USCAP blueprint for legislative action, EU Emissions Trading System side-by-side*, Pew Centre, Arlington VA

Philibert, C (2008) *Halving the costs of halving emissions*, International Energy Agency, Paris

Point Carbon (2008) *Carbon Market Transactions in 2020: Dominated by Financials?*, May 2008

Ricardo, B et al (2007) 'State of the Voluntary Carbon Markets 2007: Picking up the steam', *New Carbon Finance and Ecosystems Marketplace*

Russ, P et al (2009) *Economic Assessment of Post-2012 Global Climate Policies*, European Commission Joint Research Centre, Luxembourg

Samuelsohn, D (2007) 'International carbon traders pick apart Lieberman-Warner Proposal', *Earth news*, 11 September 2007

Schneider, L (2008) *A Clean Development Mechanism (CDM) with atmospheric benefits for post-2012 climate regime*, Öko-Institut, Berlin

Stern, N (2006) *The Economics of Climate Change: The Stern Review*, Cambridge University Press, Cambridge

Stern, N (2008) *Key elements of a global deal on climate change,* London School of Economics, London

Stern, N (2009) *A Blueprint for a Safer Planet: How to manage climate change and create a new era of progress and prosperity*, Bodley Head, London

Tietenberg, T (2006) *Emissions Trading: Principles and Practice*, Second Edition, Resources for the Future, Washington DC

UN (1992) 'United Nations Framework Convention on Climate Change'. Available at: http://unfccc.int/resource/docs/convkp/conveng.pdf

UNDP (2005) *MDG Carbon Facility – Mobilizing Carbon Finance for the Millennium Development Goals*, United Nations Development Programme, New York

UNFCCC (1998) 'Kyoto Protocol to the United Nations Framework Convention on Climate Change'. Available at: http://unfccc.int/resource/docs/convkp/kpeng.pdf

UNFCCC (2008) Annual compilation and accounting report for Annex B Parties under the Kyoto Protocol FCCC/KP/CMP/2008/9/Rev.1

Victor, D and Wara, M (2008) *A realistic policy on international carbon offsets*, Program on Energy and Sustainable Development Working Paper, No 74

Vivid Economics (2008) *Peer Review: Reform of the Clean Development Mechanism*, Vivid Economics, London

Waxman, Markey (2009) *American Clean Energy and Security Act of 2009*. Available at: http://www.govtrack.us/congress/billtext.xpd?bill=h111-2454

WBCSD (2004) 'IEA/SMP Model Documentation and Reference Case Projection'. Available at: http://www.wbcsd.org/web/publications/mobility/smp-model-document.pdf

World Bank (2009) *State and Trends of the Carbon Market*, World Bank, Washington DC

WRI (2005) *Navigating the numbers: Greenhouse Gas data and International Climate Policy*, World Resources Institute, Washington DC

Yamin, F and Depledge, J (2004) *The International Climate Change Regime Guide: A Guide to Rules, Institutions and Procedures*, Cambridge University Press

ISBN 978-0-11-706450-8

9 780117 064508