Growth in a carbon constrained global economy

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This report examines the impact of international mitigation policies on economic opportunities in developing countries. Understanding these impacts is important: so developed country policymakers can take these effects into account in their decision making; to help inform developing countries' negotiating strategies; and so developing countries can start now to position themselves to take advantage of new opportunities or protect themselves from new risks arising from mitigation.

A range of mitigation policies are considered, including: carbon taxes, border tax adjustments, emissions trading schemes, the Clean Development Mechanism, REDD+, liberalisation of trade in environmental goods and services, carbon labelling and technology transfer mechanisms. The potential economic impacts of these different policies are assessed, by examining the various transmission mechanisms, such as trade, foreign direct investment, aid and financial flows, rates of technological innovation and technology transfer, changes in consumer preferences, and private sector responses.

Three broad scenarios are then developed, based on: (1) high levels of international cooperation, (2) moderate levels of international cooperation, and (3) fragmented bilateral and regional cooperation. Each scenario consists of different packages of mitigation policy outcomes, in order to facilitate an illustrative assessment of the overall impact of different mitigation policy combinations on economic prospects in developing countries.

Mitigation impacts

Mitigation policies in the developed world will have a significant economic impact in developing countries, creating both threats and opportunities:

- The implementation of mitigation policies that drive down the price of oil and other fossil fuels will benefit net fossil fuel importers and be detrimental to net fossil fuel exporters;

- The imposition of a carbon tax by developed countries is likely to affect developing countries negatively, though this could be offset to some degree by trade and FDI opportunities generated by carbon leakage to the extent that developing countries can capitalise on them;

- The imposition of border tax adjustments could have a significant negative effect on developing countries which export affected products, but benefit importers of those products;

- Joining an emissions trading scheme would benefit MICs by reducing the cost of mitigation and stimulating trade and FDI;

- Reform of the CDM could bring major benefits, though the nature of the reforms would determine whether MICs or LICs would benefit most. MICs may continue to crowd out LICs from participating in the CDM;

- For developing countries, a phased approach to REDD+ could generate considerable benefits, greater than those available under a market based approach, at least until appropriate institutions and capacities facilitate integration into carbon markets;

- Liberalisation of trade in environmental goods and services will benefit developing countries to the extent they trade in them. Inclusion of agricultural products and biofuels would increase the benefits considerably. Liberalisation of environmental manufactured goods, and environmental services would yield limited benefits for most developing countries, especially LICs;

- Carbon labelling could either serve to exclude developing country producers, or could potentially benefit developing country exporters that produce goods in a relatively carbon efficient way, depending on the methodology used for assessing a product's carbon footprint, and whether developing countries have the institutions and capacity to obtain certification;

- The establishment of a multilateral technology fund could stimulate increased technological innovation and technology transfer to developing countries, strengthening mitigation and facilitating low carbon growth.

Although the combination of policies we have assumed under each scenario is extremely speculative, and many other outcomes are possible, our analysis suggests that a scenario in which there is a high degree of international cooperation may be more likely to result in a combination of international mitigation policies that will generate better outcomes for developing countries on average, compared with a scenario with low levels of international cooperation, and where mitigation is fragmented and ad hoc in nature.

However, MICs and LICs do not always have the same interests. In some cases MICs and LICs compete for new opportunities (for trade and investment) or for funding (e.g. through the CDM) and will thus have different priorities or interests in relation to mitigation policy outcomes. Within country income groupings, the impact of different mitigation policies will also vary considerably, depending on factors such as a country's trade patterns, carbon intensity of production, energy sources used, whether they are net oil importers or exporters, whether they have carbon assets such as forests, and the investment climate.

Policy responses

- For net **oil / fossil fuel exporters**, particularly MICs such as Nigeria and Indonesia who may take on emission reduction commitments in a future international agreement, the focus of mitigation effort is likely to be on reducing emissions associated with oil production e.g. through reducing gas flaring. In the longer term countries with the required capacity may want to invest in the development of carbon capture and storage technologies which may become an important export market in future, or alternatively may be able to position themselves (e.g. by introducing an appropriate policy and institutional framework) to obtain such investment through the CDM, if and when those technologies become available. Oil exporting countries may also want to pursue diversification strategies, so as to minimise the costs they face if mitigation drives down the price of oil and other fossil fuels in future.

- **Oil importing countries** may want to pursue policies that encourage the shift away from fossil fuel based energy production towards renewables, given that may generate significant win-wins by reducing dependence on imported oil, attracting new capital inflows through carbon markets, and perhaps increasing access to electricity through more decentralised forms of energy provision. This may be achieved through various measures such as establishing a clear policy framework which demonstrates the commitment to renewable energy, thus boosting expected returns from private investment in renewables, promoting a good investment climate, establishing investment incentives, developing public / private partnerships, and developing complimentary policies such as the establishment of suitable accompanying infrastructure;

- For **countries with carbon assets** such as forests, strategic positioning, policy development, and lobbying for financial support for mitigation and adaptation, may help to both influence the international agenda, and the development of international mitigation mechanisms, such as Reduced Emissions from Deforestation and Forest Degradation (REDD) and CDM, in their favour, both in terms of scope and scale. Forested countries that develop a rigorous, comprehensive, transparent and inclusive process around sustainable forest management may be more likely to secure international investments and future CDM benefits and turn them into successful alternative growth strategies.

- **Relatively industrialised countries**, especially those with a good investment climate, may gain from carbon leakage opportunities associated with mitigation efforts in other countries. This would strengthen the case against them introducing domestic mitigation policies. However, analysis of the potential scale of carbon leakage suggests it may be quite minimal, and it may be offset by border tax adjustments, so the gains could be limited. In the long run, growth through an influx of investment in dirty industries may in any case be undesirable, as it may store up significant potential mitigation costs for the future. Relatively industrialised countries stand to gain most from liberalisation of environmental goods and services, as well as reforms to the CDM which facilitate sectoral approaches, so have an interest in supporting such policies. Relatively agricultural countries on the other hand, have an interest in supporting reforms to the CDM and REDD that widen its scope to reduced emissions from agriculture, and the inclusion of agricultural goods (e.g. biofuels) in any agreement on the liberalisation of environmental goods and services.

- **Agricultural countries** may want to develop a better understanding, (and build awareness amongst farmers of) the potential effect of climate change mitigation on shifts in demand for agricultural produce e.g. through carbon labelling schemes, or changing consumer preferences. This will enable them to adapt to changing patterns of demand and take advantage of possible new growth opportunities.

- Developing countries with relatively **carbon intensive exports** may lose from any new carbon labelling scheme, while countries with relatively energy efficient exports may gain, though ultimately this will depend on the details of the scheme and methodology used. Developing countries for whom exports are important have an interest in understanding and influencing the development of such a scheme, and investing in the development of domestic certification schemes, which will ensure they can take advantage of any new opportunities that carbon labelling may bring. This is an area where the financial and political support of donors may be particularly important.

- Countries which are heavily dependent on **export led growth**, and which are thus more vulnerable to mitigation efforts in other countries, may want to diversify their sources of income, or try to develop alternative markets for their products. For example, countries such as Kenya, which have benefited from significant earnings growth from air freighted fresh fruit and vegetables in recent years, may be badly affected by the introduction of air transport taxes, so may want to focus on developing the market for their produce within the region, rather than focusing so much on markets that are further afield. Thus they may want to move into products that are more suited to regional patterns of demand, or start producing less perishable goods that can be shipped rather than air-freighted.

The ability to take advantage of new economic opportunities that mitigation presents will also depend on factors such as a country's investment climate, openness to and management of new trade and investment opportunities, macroeconomic and budgetary management of higher aid and capital inflows, and the institutional framework. Thus many of the policy prescriptions that were identified under the traditional growth agenda (e.g. around improving the investment climate, reducing the costs of doing business, tackling corruption, strengthening the rule of law etc.) remain just as important for achieving growth in a carbon constrained world.

Countries that identify, target and capitalise on new markets for environmental goods and services stand to benefit more from international mitigation. There is a role for government leadership to identify new sectors which may provide competitive advantage and employment growth going forward. New opportunities may be facilitated by support and funding from government and the international community, and may require the creation of an appropriate policy environment; provision of the necessary training/education; investment promotion and awareness raising; and collaborative partnerships between the public, private and NGO sectors.

Implications for donors

Not all developing countries will be able to obtain private finance for mitigation and adaptation. Thus increasing the availability of public finance will also be important in plugging gaps in funding left by market mechanisms, supporting developing countries' low carbon growth efforts, and compensating countries where they lose out from international mitigation efforts.

In addition the development community will have an important role to play in building understanding of the potential impacts of different mitigation policies on developing countries, so that developed country policymakers can take these effects into account in their decision making, and so developing countries can start now to position themselves to take advantage of new opportunities or protect themselves from new risks arising from mitigation.

1. Introduction

There is a growing body of literature assessing the impact of climate change on developing countries. But there is much less work exploring how developing countries' economies will be affected indirectly, by mitigation policies adopted by the international community.

Understanding these impacts is important:

- so developed country policymakers can take these effects into account in their decision making;
- to help inform developing countries' negotiating strategies;
- so developing countries can start now to position themselves to take advantage of new opportunities or protect themselves from new risks arising from mitigation.

This report examines the impact of a selection of international / developed country mitigation policies on developing countries' economies.

Mitigation policies considered include[1]:

1. Carbon taxes
2. Border tax adjustments
3. Emissions trading schemes
4. Clean Development Mechanism
5. REDD+
6. Liberalisation of trade in environmental goods and services
7. Carbon labelling
8. Technology transfer mechanisms

In section 2 we set out three scenarios: (1) high levels of international cooperation, (2) moderate levels of international cooperation, and (3) fragmented bilateral and regional cooperation, each consisting of different packages of mitigation policy outcomes, in order to facilitate an illustrative assessment of the overall impact of different mitigation policy combinations on economic prospects in developing countries.

In section 3 we discuss the potential economic impacts of these policy outcomes, by considering the various possible transmission mechanisms for these impacts, such as trade, foreign direct investment, aid and financial flows, rates of technological innovation and technology transfer, changes in consumer preferences, and private sector responses etc. Section 4 provides overall conclusions.

Annex 1 provides more detailed analysis of the various outcomes that are possible in relation to each mitigation policy and Annex 2 provides a more detailed analysis of their potential economic impacts.

While the level of emissions ceilings adopted by countries under an international agreement will clearly be a major factor in determining the economic impact of mitigation on those countries, the way in which the necessary emissions reductions or constraints will be achieved will also be important. Thus for the purposes of this report, it has been assumed that the global economy will in future be carbon constrained, and the focus of the analysis is on how the choice of mitigation policies used, will affect economic impacts in developing countries. Thus we have attempted to develop three internally consistent scenarios, which could potentially all deliver a broadly similar

[1] In order to keep it manageable, the study has focused on selected mitigation policies; particularly policies around where an internationally coordinated approach seems to have the most potential to develop. Thus other mitigation policies such as regulation have not been included, as the potential variants are huge and implementation is likely to vary to a large degree by country.

amount of global mitigation, but in different ways. Thus the impact of the different scenarios on climate change is assumed to be the same, so the impact of climate change itself is not factored in, as it is assumed to be similar across the various scenarios.

The scenarios by no means represent the only possible, or even necessarily the most feasible combinations of mitigation policies however. Nor should they necessarily be considered equally feasible. They are simply a device to facilitate comparison and explore the potential linkages between the different mitigation policy outcomes.

To make the analysis manageable, we have mainly considered the impact on countries in their broad groupings i.e. HICs, MICs and LICs. However, it is recognised that impacts may differ considerably across countries within these groupings, depending on their economic characteristics. This is discussed further in the conclusions section. It is also noted that some LICs may aspire to be MICs, and some MICs to be HICs within a reasonable timeframe, and thus their potential future classification may change their optimal growth and negotiating strategy.

2. Defining the Scenarios

In this section we describe three scenarios: (1) high levels of international cooperation, (2) moderate levels of international cooperation, and (3) fragmented bilateral and regional cooperation, and the different combinations of mitigation policy outcomes we have assumed take place under each scenario. More information about the various mitigation policy assumptions we have made, and how they relate to proposals currently on the table is provided in Annex 1.

2.1 Scenario 1 - High levels of international cooperation

In this scenario both HICs and MICs take on legally binding economy-wide absolute emissions targets post-2012. LICs do not take on any form of target but can participate in offsetting mechanisms. HICs are able to offset a relatively low proportion of their target, compared with scenario 2.

We have assumed that under scenario 1 HICs and MICs adopt coordinated policies on carbon taxation in order to achieve their emission reduction commitments. HICs and MICs also join an international Emissions Trading Scheme (ETS).

No border tax adjustments are imposed in scenario 1, as MICs are adopting mitigation measures as part of the global deal (commensurate with their emissions reduction commitments) and LICs don't often compete in the production of carbon intensive products, so the risks of carbon leakage and loss of domestic competitiveness are limited.

In the same spirit of international cooperation and goodwill, and in light of the shared objective of minimising the costs of mitigation, a WTO agreement on the liberalisation of trade in environmental goods and services is achieved. In order to secure MIC agreement to the global deal to tackle climate change, HICs agree to the inclusion of agricultural products such as biofuels in the WTO agreement on environmental goods and services (EGS).

Mandatory carbon labelling is also adopted in a coordinated manner by all HIC and MIC signatories to the international agreement, with substantial resources made available for LICs to develop national certification systems, so they can maintain access to markets. Because this is a coordinated international effort, considerable resources are devoted to developing and agreeing a relatively sophisticated Life Cycle Approach to assessing the carbon footprint of different products, which we assume is relatively favourable to developing country producers.

In order to secure MICs' agreement to the deal, HICs also agree to the establishment of a Multilateral Technology Fund under the UNFCCC, to provide a mechanism whereby financing from developed countries would be used to help transfer technologies to developing countries.

MICs can no longer receive CDM funding, as they have adopted their own targets, but can offset if they choose to, as can HICs. As LICs are now the only beneficiaries of CDM, greater emphasis is placed on reforming CDM to make it easier for LICs to benefit from it, i.e. by including new emissions sources / activities relating to land use (i.e. agriculture and forestry), and rule changes to make it easier to access CDM financing.

As the comprehensive international agreement has facilitated the fast development of carbon markets, and given the stronger focus on including land-based emissions reductions in CDM in this scenario, a REDD+ regime can be established with a market mechanism that is operational in the short-medium term, with REDD credits fully fungible with existing markets. As markets require adequate MRV to work, only countries with the capacity to undertake MRV are able to participate.

2.2 Scenario 2 - Moderate levels of international cooperation

In this scenario, only HICs take on legally binding economy-wide targets post-2012. MICs agree to take on (as yet undefined) targets from 2020. LICs do not take on any form of target. To achieve the same degree of mitigation as under scenario 1, it is assumed that HICs take on more ambitious targets, but are able to offset a much higher proportion of their own targets by funding mitigation in MICs and LICs compared with scenario 1.

In this scenario, only HICs adopt coordinated policies on carbon taxation in order to achieve their emission reduction commitments – MICs do not participate. Border Tax Adjustments are therefore imposed by HICs against imports from MICs.

Because they do not take on binding commitments, MICs are initially only involved in emissions trading through offsets (i.e. through the CDM), until 2020 when MICs take on targets themselves and hence also join the ETS. This combined with the higher degree of offsetting that is permitted under this scenario means there are strong incentives to widen the scope of CDM to permit more offsetting. The CDM is thus expanded to include sectoral approaches – in line with a wider introduction of sectoral approaches in carbon markets generally - which will allow more easily achievable mitigation and offset opportunities, particularly in MICs. However, this has the effect of reducing the focus of attention on reforms of the CDM designed to increase participation by LICs.

A REDD+ regime is established with a 'phased approach'. This means it will be funded at scale through innovative financial mechanisms and public funding, allowing countries to participate even if they do not have the necessary systems in place to measure emissions reductions and participate in carbon markets through REDD in the short to medium term.

There is also agreement at the WTO on the liberalisation of trade in EGS, but qualifying products include mainly manufactured goods and services, and exclude agricultural products such as biofuels.

A coordinated and mandatory carbon labelling system is adopted by HICs only, based on a standardised methodology for Life Cycle Analysis (LCA). Less assistance is made available to developing countries to meet certification requirements in light of the more protectionist dynamics created in this scenario.

No Multilateral Technology Fund is set up.

2.3 Scenario 3 - Fragmented bilateral and regional cooperation

In this scenario, no global deal is achieved. Thus countries fall back on voluntary actions and partnerships within and between countries / regions. Because there is less scope for haggling over burden sharing in the absence of an international framework, it is possible that such an outcome could result in greater and faster efforts at mitigation on a unilateral basis, than would a stalled process of international cooperation. For the purposes of this analysis, we assume it generates the same amount of mitigation as scenarios 1 and 2. However, it relies more on publicly funded mitigation efforts, and less on an international carbon market, which would arguably require a stronger international framework of cooperation in order to work effectively.

Under this scenario, there is no coordinated carbon taxation. However, some HICs and MICs still unilaterally adopt carbon taxation of various kinds. While there is no overarching international ETS in scenario 3, there are national and regional emissions trading schemes.

BTAs are imposed on a unilateral basis by some countries, against other HICs and MICs which are not undertaking much mitigation. Some countries impose BTAs in a blanket way, affecting imports from all countries including LICs. However, the legitimacy of the use of BTAs is challenged at the WTO, so their enforceability is unclear.

There is no multilateral agreement on the liberalisation of EGS, though there is some liberalisation through bilateral and regional agreements, with a focus mainly on manufactured EGS. There is no coordinated approach to carbon labelling, but private initiatives are adopted on a voluntary basis by major retailers, most often based on simple metrics such as mode of transportation, or distance travelled.

There is considerable uncertainty around the future price of carbon, which means there are weak incentives for R&D, innovation and technology transfer. But as an alternative to multilateral action, voluntary agreements are made between groups of countries, and more public funding is made available to underpin technological innovation and diffusion.

The CDM ceases to exist in its current form, but similar mechanisms are implemented separately by the EU and the US, to meet national, unilateral commitments. They are designed slightly differently however, based on their own interests and priorities, which increases the transactions costs compared with an internationally coordinated scheme.
The mechanisms continue to have a fairly limited scope and coverage as under the current situation. A REDD+ regime is established, but given the underdevelopment of private market mechanisms due to lack of international coordination, most funding is voluntary public funding by HICs and some MICs, consisting mainly of aid transfers and voluntary 'markets', with an emphasis on highly projectised and small-scale REDD in LICs.

A summary of the mitigation outcomes assumed under each scenario is given in Annex 1.

3. The economic impacts of mitigation policies

The potential impact of the various mitigation policies on income, welfare and growth in developing countries will depend on various transmission mechanisms, such as:

- Trade i.e. through the impact on the price of imports and on export opportunities;
- Capital flows i.e. Foreign direct investment or portfolio investment which contribute to capital accumulation and (in the case of FDI) spillover effects such as technology transfer, which can contribute to growth;
- Aid / development finance;
- Impact on technological innovation and technology transfer.

The main effects of each mitigation policy are summarised below. A more in-depth analysis is provided in the Annex.

3.1 Carbon taxes

A carbon tax (or indeed, any mitigation policy that drives up the price of carbon) on developed country production will increase the cost of carbon intensive imports into developing countries from developed countries with potentially negative welfare impacts in the short run at least – though the long run impact will depend on import patterns in developing countries, the degree of possible substitution between imports and domestically produced products, and the degree of substitution between different kinds of imports.

The imposition of carbon taxes may result in carbon leakage, with production moving to developing countries without a tax instead (in order to avoid paying the tax), potentially generating new FDI inflows and exports, which would contribute to jobs and growth. This is likely to mainly benefit MICs (if not part of the deal) and LICs with the best investment climate. But it will also generate an increase in dirty industries in those countries which might generate long term problems.

However, some have argued that the potential extent of carbon leakage will actually be very low, as a carbon tax would represent only a small proportion of costs, for most industries at least. Nonetheless, there is a strong lobby to prevent any such carbon leakage, and offset any potential loss in competitiveness associated with a carbon tax by the imposition of border tax adjustments – see below.

A carbon tax would also generate shifts in comparative advantage. These shifts may benefit countries with large endowments of labour rather than capital – and thus be in the interests of some developing countries - but would need to be assessed on case by case basis (e.g. by sector and country).

Box 1: Impacts on comparative advantage

By raising the cost of carbon, mitigation policies may cause a shift in the structure of production, (i.e. in the most efficient combination of factors of production required to produce a product), meaning that patterns of comparative advantage across countries, and hence patterns of trade, may change.

Assume, for example, there is a kind of agricultural crop that can either be produced using *labour* intensive methods, or it can be produced using machinery, which constitutes a relatively *capital* intensive method, and which uses fossil fuel. Assume country x is relatively well endowed with capital, while country y is relatively well endowed with labour, and that country x initially enjoys a comparative advantage in the production of this agricultural crop. If there is an increase in the cost of carbon, which pushes up the price of fossil fuel, this will make the capital intensive method of production less efficient than it was, in comparison with the labour intensive method of production. This may mean that country x loses its comparative advantage in producing the crop, while country y may find that its comparative advantage shifts towards such agricultural production and it can exploit new opportunities for trade.

A carbon tax or any other mitigation policy which leads to lower oil prices (compared to what would have been the case in the absence of the policy) will generate welfare benefits for oil importers and welfare losses for oil exporters. But in the long term it may reduce incentives for green growth in oil importers, with negative implications for future growth dynamics.

If a carbon tax or other mitigation measure reduces global growth rates, this may also reduce demand for developing country exports generally, with negative welfare consequences.

All of these factors combined will impact on overall FDI inflows to developing countries and incentives for low carbon production, which will determine overall impacts on technology transfer and growth. If countries with a carbon tax allocate some of the revenues to developing countries, this could generate a welfare gain for recipient countries.

Box 2: Air transport taxes

Air transport taxes, or passenger duties, are a form of indirect carbon tax that is being discussed, and has been introduced in some countries, including the UK. They may be aimed at reducing the number of flights, or increasing incentives for fuel efficiency, so as to reduce energy consumption and emissions. Their efficacy has been questioned however, with some arguing[2] that the price elasticity of demand for flights is low, in which case it would generate considerable revenue, without resulting in any significant reduction in flights. If they do reduce the demand for long haul flights, however, then developing countries which previously benefited from tourism from the developed world could suffer economic losses.

The impact will vary depending on a country's location, and scope to benefit from any shifts in demand. For example, while holiday destinations in the Caribbean may suffer a drop off in demand from vacationers from Europe, this may be offset to some degree by an increase in demand from Americans, as they reduce their demand for long-haul flights to more distant holiday destinations. Holiday destinations which are more isolated, or a long way from the richest markets, such as French Polynesia or Mauritius, may suffer the most.

Similarly, if air transport taxes affect the cost of air freight then developing countries which export goods by air (e.g. perishable goods such as fresh fruit and vegetables) could also find their exports become less competitive, which could reduce demand for their produce, potentially reducing growth in this sector.

The impacts of such policies on developing countries as a whole are considered to be relatively small however, so they have not been included in the scenarios.

In scenario 1, the carbon tax is imposed in a coordinated way by both HICs and MICs, so the negative impact of the increase in the cost of carbon intensive imports into developing countries is likely to be greatest under this scenario. The downward pressure on the price of fossil fuels (whose impact will depend on whether a country is a net fuel importer or exporter), will also be greatest under scenario 1.

However, there is greater scope for new trade and FDI opportunities through carbon leakage to LICs (especially those with a good investment climate), in scenario 1 compared with scenario 2, as no BTAs are imposed, and as MICs will be imposing their own carbon tax, so there will be leakage opportunities arising from both HICs and MICs. In scenario 2, leakage opportunities will mainly arise from HICs, and less so from MICs, as they do not impose their own carbon tax, although there may still be some leakage from MICs because of the BTAs they face in exporting to HICs.

In scenario 3, the scope for carbon leakage will be greater still, though the pattern this takes will depend on which countries choose to unilaterally adopt a carbon tax. It is likely, however, that more carbon leakage opportunities will go to non-mitigating HICs and MICs, and LICs will see little of the benefits. So in terms of carbon leakage for LICs, scenario 1 may generate the best outcome, while scenario 3 the smallest positive outcome.

[2] Oxford University (2005). "Predict and Survive: Aviation, Climate Change and Policy", Report. Greener by Design (2006 – 2007). "Air Travel" Annual Report.

Summary Table

Carbon taxation	Scenario 1	Scenario 2	Scenario 3
Changes in terms of trade	Major cost	Medium cost	Low cost
Carbon leakage opportunities - LICs	Potentially significant benefits	Moderate benefits	Limited benefits
Carbon leakage opportunities - MICs	No opportunities	Minimal opportunities	Some opportunities

3.2 Border Tax Adjustments

BTAs will increase the costs of imported energy intensive products in countries which impose them, and are thus likely to reduce demand and hence prices received by exporters of these products (depending on the elasticity of supply). BTAs will thus reduce welfare in developing countries which export energy intensive products. However, by shifting the global demand curve to the left, and thus reducing the global market price for such goods, this would increase welfare in countries which import these products but do not impose BTAs (unless exporters can price discriminate between countries).

Chemicals, iron and steel, cement, glass, lime, pulp and paper, and non-ferrous metals are the sectors which are considered to be most affected by a carbon tax, and hence by any sectorally targeted BTAs.[3] In this case, developing countries which export these kinds of products will likely suffer the biggest losses as a result of BTAs. This is likely to include MICs such as China, Brazil, Russia and South Africa.

LICs may well be exempted from many kinds of BTAs, but even if they are not, MICs are likely to be much more affected by BTAs than LICs, since LICs are primarily agricultural societies with a generally low level of energy intensity, and they produce and export much less of the kind of energy intensive products that will be targeted by BTAs.

To some extent BTAs may only be offsetting an artificial competitive advantage that was being given to developing countries as a result of mitigation policies such as carbon taxes in HICs, thus generating a neutral impact in combination. But in practice the overall impact will depend on how accurately the BTA offsets the mitigation measures.

BTAs mean that developing countries will be prevented from benefiting from any new export markets that might have been created through carbon leakage, thus reducing potential increases in FDI and exports with associated growth benefits. It will also generate a net loss where, for example, the developing country is unilaterally pursuing mitigation policies which are pushing up the costs of its own energy intensive industries.

The exact impact will depend on how the BTA is implemented, whether it is by sector, and whether it is imposed across the board or whether LICs are exempt etc. MICs are likely to be most affected by BTAs as they are most likely to export carbon intensive products, and LICs may be exempt anyway. By generating a more protectionist global dynamic BTAs will potentially reduce overall global growth and welfare.

Thus many developing countries – especially MICSs - are likely to lose out considerably from the coordinated imposition by HICs of BTAs in scenario 2, especially exporters of carbon intensive products, and countries that may otherwise have benefited from carbon leakage (so MICs are likely

[3] Though more analysis is needed, for example, see Quirion (2008): http://www.enseignement.polytechnique.fr/economie/chaire-business-economics/091508/Presentation%20Philippe%20Quirion.pdf

to be particularly badly hit). They will also lose out to some extent from scenario 3, depending on the extent to which BTAs are imposed, and least of all from scenario 1.

While LICs are exempted from BTAs in the coordinated response envisaged under scenario 2, and hence may be able to benefit from some degree of carbon leakage, they may not be exempted under scenario 3, at least in relation to some countries' policies. In scenario 3 they may also suffer from BTAs imposed by MICs, not just HICs. So for LICs, scenario 3 is likely to be the most disadvantageous. Scenario 1 – the absence of BTAs - is likely to be the best from their point of view, as there is scope for them to benefit from carbon leakage from both HICs and MICs, though their ability to benefit from this will depend on their investment climate and business environment.

Box 3. The rationale for border tax adjustments

Empirical evidence for OECD countries shows that the cost increase associated with a $100 per ton carbon tax is usually fairly small, within the range of around 1 – 5% of production value (see Table below). Thus the impact of a carbon tax on international competitiveness is likely to be limited. This may undermine the case for border tax adjustments, which would be detrimental to developing countries.

Selected OECD countries' cost Increases from a tax of US$100/ton carbon (as % of production value)

	Total energy intensive industries	Iron and steel	Non ferrous metal	Chemical	Pulp and paper
USA	2.8	2.3	3.1	2.8	3.2
Canada	4.1	6.2	3.7	4.1	5.0
Japan	1.2	2.0	0.7	1.0	0.6
Australia	5.2	5.8	11.4	1.7	2.6
France	1.4	2.4	1.4	1.3	0.6
Germany	1.6	2.6	1.2	1.4	1.0
UK	1.6	3.6	1.9	1.2	1.2
Italy	1.4	2.0	1.1	1.3	0.7
Belgium	2.3	7.3	40.8	1.6	0.6

Only countries which are net importers of the products affected by BTAs, and which stood to gain little from carbon leakage anyway (which is perhaps most likely to be the case for some LICs, though probably only a minority) may gain overall because of reduced import prices in scenario 2 (and to a lesser extent from scenario 3) compared with scenario 1.

Summary Table

	Scenario 1	Scenario 2	Scenario 3
MICs (on average)	No loss as no BTAs	Major loss from BTAs	Some loss from BTAs
LICs (on average)	No loss as no BTAs	Minor loss from BTAs	Major loss from BTAs

3.3 Emissions trading schemes

By capping emissions at a certain level, and issuing emissions permits that can be traded, emissions trading schemes (or 'cap and trade' schemes) are an alternative to carbon taxation as a means to drive up the price of carbon. Thus many of their effects are also the same as a carbon tax. However, because they allow trade in emissions permits between companies or countries, and thus facilitate the efficient allocation of abatement opportunities, (rather than requiring the same degree of abatement effort across all companies or countries regardless of the associated costs), they provide a way to reduce compliance costs associated with emissions stabilizing policies. We thus consider their impact only in terms of this additional benefit, of reducing compliance costs, as the impact of carbon pricing has already been discussed in relation to carbon

taxation above. Thus an ETS reduces the welfare cost associated with mitigation in participating countries.

Box 4: The impact of an emissions trading scheme on the costs of mitigation

Those countries participating in an Emissions Trading Scheme (ETS) can expect a given level of mitigation to cost less than if they were outside the ETS. ODI has examined the potential scale of this using a CGE model, by running a scenario in which Annex I countries commit to keep over time the same level of emissions as agreed under the Kyoto Protocol, and non Annex I countries stabilize emissions in 2035 at the 2025 level. The results show that consumption in low income countries is reduced by more as a result of mitigation, in the absence of a global emissions permits market.	
Loss of consumption from mitigation policies in 2055	
Kyoto constraint for Annex I countries forever. Developing countries stabilize emissions in 2035 at 2025 levels	**Loss of consumption for low Income countries**
No implementation of a global emissions permits market	2%
Implementation of a global emissions permits market	0.4%

Source: ODI (2009)

An ETS also facilitates the distribution of mitigation to the cheapest abatement opportunities – this means that more mitigation is likely to take place in MICs when they are part of an ETS, (especially where they have a good investment climate), but paid for by HICs. However, they could also block this to some extent, preferring to finance these low cost abatement activities themselves, rather than allowing external investors to buy up all the 'low hanging fruit', and leaving them to do more expensive mitigation. On the other hand, they are likely to welcome the capital and technology that ETS induced foreign direct investment brings. The overall impact will also depend on the level at which the emissions ceiling is set. If it is set fairly low then there may be enough abatement opportunities to satisfy both domestic and foreign demand.

Overall, participation in an ETS is likely to result in at least some increase in FDI for participating countries, which may well have positive growth impacts through increased capital and technology spillovers etc.

In addition, Annex I countries could use a share of their gains (or reduced costs) from emissions trading to provide financial aid to developing countries for adaptation or low carbon growth purposes.

The introduction of domestic emissions trading schemes by large MICs such as China could drive up the price of carbon, by creating domestic demand for carbon credits. A higher carbon price would strengthen incentives for low carbon technologies and innovation globally. However, the overall impact on demand and supply of carbon credits will once again depend on how low the emissions ceiling is set.

Summary Table

	Scenario 1	**Scenario 2**	**Scenario 3**
MICs (on average)	Major gain from increased FDI and trade	No gain	Moderate gain, size of which depends on participation in regional ETS
LICs (on average)	Neutral. Though if revenues are spent on aid may gain.	Neutral. Though if revenues are spent on aid may gain.	Neutral. Though if revenues are spent on aid may gain.

3.4 Clean development mechanism

The CDM generates increased trade (in CERs) and FDI into recipient countries, which should imply increased financial inflows, capital accumulation and spillovers, including skills and technology transfer, all of which can stimulate growth.

Countries with high levels of carbon assets and abatement opportunities eligible for funding under the CDM, and with good investment climates, are likely to benefit most from the CDM. Thus MICs are likely to benefit from CDM most, until it is reformed to cover more of the kinds of abatement opportunities that LICs have, and to reduce the costs of those abatement opportunities.

Scenario 1 generates the most benefits for LICs, as most emphasis is placed on widening the coverage and reforming the rules of the CDM in a way which will facilitate greater LIC benefit. Scenario 2 generates most benefits for MICs as emphasis is placed on reforming CDM to facilitate sectoral approaches which benefit MICs most, but this crowds out LICs. Scenario 3 generates moderate benefits, but with higher transactions costs. LICs continue to be crowded out by MICs.

Box 5: The impact of reforming the CDM

If the CDM remains as a project-based system with no reforms, there appears to be some consensus that its overall penetration will remain a relatively low proportion of overall emissions reductions. According to the World Bank (2008) trade in CERs remains very small compared to what is needed to avoid dangerous climate change: volumes traded are only around 4% of what is needed, of which CERs issued through the CDM account for around half. Various impediments currently limit the scale of the CDM.

In 2007, the CDM saw primary transactions worth US$7.4 billion and was estimated to have leveraged US$33 billion (€24 billion) in additional investment for clean energy (Capoor and Ambrosi 2008). However, as of August 2008, over half of all registered projects were based in either India (30%) or China (22%) with only 2% located in sub-Saharan Africa. Thus the impact of the CDM could be enhanced by reform.

Changing the rules that govern how projects are approved and carried out should facilitate greater investment through the CDM, by reducing existing barriers such as the time taken for projects to reach registration and high transaction costs in implementing complex methodologies. It will also open up more opportunities for LICs to benefit from FDI and technology transfer through the CDM. However, there is currently no reliable information on how much of a barrier these rules currently are, so it is not possible to estimate the extent of these changes.

The expansion of the scope of CDM eligible activities could open up opportunities for private investment in both MICs and LICs. The inclusion of REDD, SFM and soil carbon might be expected to have the largest impact. If they were to be included, LICs with high deforestation/degradation rates would be expected to attract most investment, as would those with high soil carbon.

Sectoral CDM approaches could generate significant gains for those countries active in the sectors covered. Sectors that would be most likely to be included are: cement, iron and steel, aluminium, pulp and paper, refineries, electric power, upstream emissions of oil and gas production (e.g. gas venting and flaring), and possibly transport. Thus at least in the medium term, such approaches will be particularly appropriate for countries with large scale heavy industries, and therefore much more likely in emerging economies such as China and India.

Emissions in these sectors are very high, so there is substantial technical potential to use the CDM as an investment option. Thus if sectoral CDM approaches are adopted, these may swamp alternative CDM opportunities, and thus crowd out smaller, more expensive investment opportunities of the kind that may be available in LICs (particularly if land-use sources and sinks – which may be the cheapest and largest of the abatement opportunities in LICs - remain excluded from the CDM). Thus sectoral CDM may benefit MIC recipients to the detriment of LIC recipients of CDM funding.

Summary table

	Scenario 1	**Scenario 2**	**Scenario 3**
MICs (on average)	No inflows from CDM,	Major benefits from	Moderate benefits from

	but can offset through CDM into LICs	CDM through trade and FDI	CDM
LICs (on average)	Potentially major benefit from CDM through increased trade and FDI.	Some benefit from CDM, though largely crowded out by MICs	Minor benefit from CDM

3.5 REDD+

Financing for REDD will either come through financial flows from carbon markets, or from public investment, or aid spending. Thus recipient countries will enjoy increased trade, investment and financial inflows.

Scenario 2 will deliver financial flows through REDD through the use of innovative financing mechanisms and public money, even before monitoring and market mechanisms have been developed, so will generate more immediate and inclusive gains for MICs and LICs.

Scenario 1 assumes a more market based approach, so is better for MICs than LICs as they will be better placed to take advantage of market mechanisms, with the greater capacity requirements they entail.

Scenario 3 – with more limited reform and development of REDD - is worse for MICs as compared with other options, though how it compares with scenario 1 for LICs is unclear, as they may benefit more from the public funding available in this scenario than from market based funding in scenario 1.

Summary table

	Scenario 1	**Scenario 2**	**Scenario 3**
MICs (on average)	Moderate benefits – for MICs who can take advantage of carbon markets	Major benefits – as facilitates financial flows earlier through public funding	Low benefits
LICs (on average)	Low benefits – as LICs too capacity constrained to access carbon markets, at least in the short / medium term.	Major benefits – as facilitates financial flows earlier, through public funding	Low benefits

Box 6: The likely distribution of gains from REDD+

REDD+ has the potential to generate significant financial inflows for certain developing countries, which if used judiciously, could contribute to higher levels of growth and welfare. Public investment will be motivated primarily by the need to achieve demanding targets and hence will focus on countries able to deliver forest-sector emissions reductions on a large scale and at low risk. Private sector investments will be motivated by price, risk and transaction costs. This implies a bias against smallholder / community activities on both counts. Investors will be drawn to low governance / high-risk environments only as a cut-price option; thus relatively low risk countries, with larger forest related opportunities in South America or East Asia are likely to benefit more than higher risk countries in Africa or South East Asia.

As the CDM has shown, any fungibility between MIC and LIC implementation will be to the detriment of LICs. Annex 1 investors are likely, if given the choice, to favour MIC over LIC investments, and hence MIC eligibility for any available finance can be predicted to have a negative effect on LIC uptake, unless the LIC price is substantially more attractive.

3.6 Liberalisation of trade in environmental goods and services

The liberalization of trade in EGS could generate benefits for developing countries both in terms of new export markets and cheaper imports (and associated technology transfer from those imports)

which would contribute to growth, and would be particularly helpful in achieving low carbon growth, which would help minimise future mitigation costs.

Modelling of EGS liberalisation (excluding most agricultural EGS from the definition) is estimated to generate overall gains from trade, though such benefits are identified mainly for larger middle income importers and exporters of such products. Most LICs neither import nor export much in the way of EGS currently; though with reduced prices arising from liberalisation their demand for EGS may rise.

Scenario 1 would be likely to deliver the most gains to developing countries, as it would enable them to increase both imports and exports of agricultural EGS such as bioethanol, which are likely to be of most interest to both MICs and LICs. Scenario 2 would be likely to deliver some gains, although mainly to MICs who can either export, or have effective demand for manufactured EGS. Scenario 3 could potentially deliver more liberalization of EGS of interest to MICs and LICs than scenario 2, if it resulted in a higher level of liberalization of agricultural EGS through bilateral and regional agreements than scenario 2 delivered through a multilateral agreement focused mainly on manufactured EGS. The exact pattern of liberalization would determine its overall impact however.

Summary table

	Scenario 1	**Scenario 2**	**Scenario 3**
MICs (on average)	Major benefits – as liberalisation of agricultural EGS benefits MICs more.	Moderate benefits	Depends on extent of bilateral and regional agreements
LICs (on average)	Major benefits – as LICs both produce and consume more agricultural EGS.	Low benefits – as LICs neither produce nor consume many manufacturing EGS	Depends on extent of bilateral and regional agreements

Box 7: Developing countries as exporters of EGS

In general, most developing countries are net importers of environmental goods, though there are some areas where developing countries are major producers and exporters, most notably:

- China and India are leading producers of wind energy and wind energy manufacturing equipment;
- China is a major exporter of solar photovoltaic technologies; and
- Brazil is a world leader in the manufacture of biofuels and related technologies, such as 'flex-fuel' engines and vehicles.

Liberalization of trade in these goods could generate significant gains for developing countries which produce them. Brazil regards improved market access for green products such as biofuels, as contributing to poverty alleviation through income generation and job creation for local populations. It also points out that improved market access for products derived from incorporating cleaner technologies, such as "flex-fuel" engines and vehicles, could encourage the use of environmentally efficient products and be supportive of the developmental concerns of developing countries, as these vehicles would use fuels obtained from the processing of natural resources in developing countries.

Sources: ICTSD (2008b) and World Bank (2007a)

3.7 Carbon labelling

The impact of a carbon labelling system on developing countries will depend on how it affects their export opportunities. If it creates an additional barrier to trade for developing country exporters, this will reduce welfare and income in those countries. Alternatively, it may create new export market opportunities, if developing country goods are less carbon intensive (i.e. under the measure adopted) than other countries' exports. The extent of assistance that is provided to developing countries to enable them to meet the certification requirements will also determine the impact.

The impact carbon labelling has on a country's market opportunities will determine welfare and growth impacts. If carbon labelling increases incentives for trade in low carbon products, it may generate increased transfer of green technologies.

If, as we have assumed[4], a carbon labelling scheme accurately captures the carbon footprint of a product through a life-cycle assessment, and if this means that on average developing country produce is measured as being less carbon-intensive than competing developed country products (perhaps because they are produced using more labour intensive production processes, rather than mechanised processes requiring the use of fossil fuels), then scenario 1 is the most beneficial to developing countries, as their exports will be viewed most favourably by consumers seeking to make low carbon purchases under a carbon labelling scheme, which will push up demand for their produce relative to more carbon intensive substitutes, and they will also have the assistance they need to obtain certification.

Under scenario 2 the opportunities developing countries have through LCA carbon labelling may be lost to some degree, especially for LICs, by their lack of capacity to obtain certification. MICs may find that more protectionist leanings under this scenario, in the design of the labelling scheme etc., will undermine their ability to take advantage of any new export opportunities brought by carbon labelling.

Under scenario 3, developing countries are most likely to lose out because simplistic labelling schemes (such as 'food miles') are employed which are likely to mitigate against their exports, and little finance is available to help them offset these challenges e.g. by developing labels and certification schemes of their own.

Box 8: Comparing carbon efficiency of production

Developing countries with a hot climate may be able to produce certain agricultural products with lower carbon emissions than countries with a cooler climate. One study examined the carbon emissions associated with rose production in Kenya and the Netherlands. It showed that Kenya is a more carbon-efficient location for rose production than the Netherlands, even if the emissions associated with airfreight are included. Thus if carbon labelling focuses on the overall carbon impact of production, rather than 'food miles' it may benefit some developing countries, by demonstrating their products to be greener, thus making them more attractive to environmentally conscious consumers.

Carbon efficiency in rose production – GHG emissions comparison:

Supply chain section	**Kenya**	**Netherlands**
Production	300	36,900
Packaging	110	160
Transport to airport	18	0
Airfreight emissions	5600	0
Transport to distribution centre	5.9	50
Total	**6,034**	**37,110**

Note: Emissions are shown as Global Warming Potential (GWP) expressed in kg of CO2 equivalents using the IPCC (2001) conversion factors. GWP and CO2 emissions from Kenya include the IPCC altitude factor.
Source: Keane et al. (2010), adapted from Edwards-Jones et al. (2008).

Summary table

	Scenario 1	**Scenario 2**	**Scenario 3**
MICs (on average)	Major benefits from increased export opportunities	Moderate benefits – protectionist tendencies undermine	Major costs from reduced export opportunities
LICs (on average)	Major benefits from increased export opportunities	Limited benefits – protectionist tendencies undermine and certification problems	Major costs from reduced export opportunities

[4] though these are big assumptions, about which there remains much uncertainty and so may or may not prove to be correct in practice.

3.8 Technology Transfer

Policies to promote green technology transfer will enable developing countries to benefit from new technologies more quickly, and potentially more cheaply, than they might otherwise have done. This should contribute to the achievement of low carbon growth.

We assume the gains for developing countries reflect the overall level of technological innovation and diffusion generated by each scenario. This will be determined by the clarity of the carbon price, international openness to trade and investment, and also by incentives and policies adopted specifically to stimulate technological innovation and transfer.

Box 9: The role and determinants of the carbon price

A key determinant of incentives to undertake research and development in green technologies will be the carbon price going forward. If the price is low, or is highly unstable, this will reduce incentives for innovation as it reduces the potential return on investment. There has been considerable volatility in the carbon price in the recent past, with EUA's spot prices at 10 Euros per tonne (e/t) of CO2 in January 2005, 22e/t CO2 in June 2005, 13e/t CO2 in the second half of 2006 and below 1e/t CO2 in June 2007 (ECX, 2008). The fall of the carbon price to 8 e/t CO2 in March 2009 induced some to call for a minimum floor price for carbon to be introduced, in order to maintain incentives for green investment and technological innovation. Stringent emissions caps would help to keep the carbon price high, but many other factors (such as economic conditions, climatic conditions and energy prices) can also affect the carbon price, potentially causing considerable volatility. The introduction of domestic emissions trading schemes by MICs with significant abatement opportunities such as China could help matters as it may result in the substantial redirection of China's supply of carbon projects to satisfy domestic demand, leading to a shortage of carbon credits in Europe, which would drive up the price.

On the other hand, recent evidence suggests that without stringent emissions targets in developed countries, there is a significant risk of oversupply of carbon credits on the international market post 2012, which would result in low carbon prices (4-13 US$/tCO2 by 2020), thus undermining incentives for technological innovation. If REDD credits were to be allowed on the international carbon market this would significantly exacerbate the problem.

Sources: ECX, (2008), Berk (2009).

The gains are likely to be greatest in scenario 1, where the carbon price is clear, where MICs have strong incentives to undertake innovation themselves given they face binding emission reduction commitments, and where a Multilateral Technology Fund (MTF) is established under the UNFCCC to fund and assist technology transfer to lower income countries. The gains are lowest in scenario 2, where no such fund exists, and where MICs have less incentive to undertake innovation themselves. In scenario 3, moderate gains are made as more voluntary, bilateral technology agreements are made as an alternative to a multilateral solution.

Under this set of assumptions, it seems likely that scenario 1 will generate the most technology transfer. It is possible that scenario 2 generates the least, with scenario 3 somewhere in between as a result of greater voluntary, bilateral, coordination.

Summary table

	Scenario 1	**Scenario 2**	**Scenario 3**
MICs (on average)	Major benefits in terms of tech transfer from clear carbon price and MTF	Low benefits due to limited incentives, lack of MTF and protectionist sentiment	Moderate benefits from voluntary cooperation agreements
LICs (on average)	Major benefits in terms of tech transfer from clear carbon price and MTF	Low benefits due to limited incentives, lack of MTF and protectionist sentiment	Moderate benefits from voluntary cooperation agreements

Table 1 below summarises the findings with regard to the economic impacts of each mitigation policy under the three scenarios.

Table 1: Positive and negative impact of mitigation on developing countries. (Best outcome for developing countries in green, worst outcome in red for each mitigation policy.)

		Scenario 1	Scenario 2	Scenario 3
Carbon tax	Changes in terms of trade	Major cost	Medium cost	Low cost
	Carbon leakage opportunities - LICs	Potentially significant benefits	Moderate benefits	Limited benefits
	Carbon leakage opportunities - MICs	No opportunities	Minimal opportunities	Some opportunities
BTAs	MICs (on average)	No loss as no BTAs	Major loss from BTAs	Some loss from BTAs
	LICs (on average)	No loss as no BTAs	Minor loss from BTAs	Major loss from BTAs
ETS	MICs (on average)	Major gain from increased FDI and trade	No gain	Moderate gain, size of which depends on participation in regional ETS
	LICs (on average)	Neutral. Though if revenues are spent on aid may gain.	Neutral. Though if revenues are spent on aid may gain.	Neutral. Though if revenues are spent on aid may gain.
CDM	MICs (on average)	No inflows from CDM, but can offset through CDM into LICs	Major benefits from CDM through trade and FDI	Moderate benefits from CDM
	LICs (on average)	Potentially major benefit from CDM through increased trade and FDI.	Some benefit from CDM, though largely crowded out by MICs	Minor benefit from CDM
REDD	MICs (on average)	Moderate benefits – for MICs who can take advantage of carbon markets	Major benefits – as facilitates financial flows earlier through public funding	Low benefits
	LICs (on average)	Low benefits – as LICs too capacity constrained to access carbon markets, at least in the short / medium term.	Major benefits – as facilitates financial flows earlier, through public funding	Low benefits
EGS	MICs (on average)	Major benefits – as liberalisation of agricultural EGS benefits MICs more.	Moderate benefits	Depends on extent of bilateral and regional agreements
	LICs (on average)	Major benefits – as LICs both produce and consume more agricultural EGS.	Low benefits – as LICs neither produce nor consume many manufacturing EGS	Depends on extent of bilateral and regional agreements
Carbon labelling	MICs (on average)	Major benefits from increased export opportunities	Moderate benefits – protectionist tendencies undermine	Major costs from reduced export opportunities
	LICs (on average)	Major benefits from increased export opportunities	Moderate benefits – protectionist tendencies undermine and certification problems	Major costs from reduced export opportunities
Technology transfer	MICs (on average)	Major benefits in terms of tech transfer from clear carbon price and MTF	Low benefits due to limited incentives, lack of MTF and protectionist sentiment	Moderate benefits from voluntary cooperation agreements
	LICs (on average)	Major benefits in terms of tech transfer from clear carbon price and MTF	Low benefits due to limited incentives, lack of MTF and protectionism	Moderate benefits from voluntary cooperation agreements

4. Conclusions and policy implications

4.1 Mitigation impacts

Mitigation policies in the developed world will have a significant economic impact in developing countries, creating both threats and opportunities. Our analysis suggests that a scenario in which there is a high degree of international cooperation may be more likely to result in a combination of international mitigation policies that are likely to generate better outcomes for developing countries on average, compared with a scenario with low levels of international cooperation, and where mitigation is fragmented and ad hoc in nature.

However, the mitigation policy outcomes that are associated with what might be considered the most cooperative outcomes (as defined in our scenarios), may not always generate the best outcome for developing countries, though they do in many cases. However, as noted previously, the combination of policies we have assumed under each scenario is extremely speculative, and many other combinations of policies are also possible, so it is more informative to focus on the impact of specific mitigation policies in different states of the world, rather than on the overall scenario outcomes.

The key impacts of the mitigation policies analysed are as follows:

- The implementation of mitigation policies that drive down the price of oil and other fossil fuels will benefit net fossil fuel importers and be detrimental to net fossil fuel exporters;
- The imposition of a carbon tax by developed countries is likely to affect developing countries negatively, though this could be offset to some degree by trade and FDI opportunities generated by carbon leakage to the extent that developing countries can capitalise on them;
- The imposition of border tax adjustments could have a significant negative effect on developing countries which export affected products, though it could benefit countries which import those products;
- Joining an emissions trading scheme would benefit MICs by reducing the cost of a given level of mitigation, and stimulating trade and FDI;
- Reform of the CDM could bring major benefits, though the nature of the reforms would determine whether MICs or LICs would benefit most. MICs may continue to crowd out LICs from participating in the CDM;
- For developing countries, a phased approach to REDD+ could generate considerable benefits, greater than those available under a market based approach, at least until appropriate institutions and capacities are in place to facilitate integration into carbon markets;
- Liberalisation of trade in environmental goods and services will benefit developing countries to the extent they trade in them. Inclusion of agricultural products and biofuels would increase the benefits considerably. Liberalisation of environmental manufactured goods, and environmental services would yield limited benefits for most developing countries, especially LICs;
- Carbon labelling could either serve to exclude developing country producers, or could potentially benefit developing country exporters that produce goods in a relatively carbon efficient way, depending on the methodology used for assessing a product's carbon footprint, and whether developing countries have the institutions and capacity to obtain certification;
- The establishment of a multilateral technology fund could stimulate increased technological innovation and technology transfer to developing countries, strengthening mitigation and facilitating low carbon growth.

For low income countries it appears that the mitigation policies likely to have the biggest potential effects on their economic prospects (positive or negative) are:

- The future development of CDM – depending on whether it is reformed in a way that makes it easier for LICs with abatement opportunities to access it, and whether they continue to compete with MICs for funding through the CDM;
- The future development of REDD – depending on whether it is introduced using a phased approach which allows LICs with carbon assets such as forests to benefit from significant flows of public funding or innovative financial mechanisms even if they do not have the capacity to engage in market mechanisms;
- Liberalisation of trade in environment goods and services - which could yield major benefits for some LICs if agricultural products and biofuels are included in the list of goods liberalised;
- Carbon labelling – which could be a significant threat or opportunity for LIC exporters of affected products, depending on the methodology adopted, the relative carbon intensity of LIC exports, and the capacity LICs have (or extent of assistance received) to obtain certification;

It is clear from the analysis that MICs and LICs do not always have the same interests. In some cases MICs and LICs compete for new opportunities (for trade and investment) or for funding (e.g. through the CDM) and will thus have different priorities or interests in relation to mitigation policy outcomes.

For LICs that may be able to achieve MIC status and MICs that may become HICs within a reasonable timeframe, their potential future income classification may change their optimal strategy. For example, some LICs may recognise that they will need to mitigate if they graduate into MICs, and hence could try to adopt low carbon growth paths even if they are not required to do so as a LIC, in order to avoid undermining their competitiveness when they become a MIC in future.

Within country income groupings, the impact of different mitigation policies will also vary considerably, depending on factors such as a country's trade patterns, carbon intensity of production, energy sources used, whether they are net oil importers or exporters, whether they have carbon assets such as forests, and the investment climate. As countries all have different combinations of characteristics, it is difficult to derive a clear typology of countries, whereby each individual country fits neatly into one category. However, Table 2 below shows how the impacts of the different mitigation policies are likely to affect countries with different characteristics. By reviewing the data on countries' economic characteristics, such a table could be populated with actual countries to show which countries stand to gain and lose most from different mitigation policies and scenarios. Box 10 provides some illustrative examples of the ways in which each of the mitigation policies examined will affect different countries.

4.2 Possible Policy responses

The best way for countries to respond to international mitigation efforts in order to minimise risks and capitalise on potential opportunities, will thus depend on the economics of the country in question. In other research, ODI has undertaken a review of low carbon growth and climate resilient growth strategies that a range of countries have adopted, which reflect quite varying policy responses depending on the economic characteristics of the country, the level of income and carbon emissions, and the main sources of production and growth in their economy.

This suggests the following possible policy responses to international mitigation efforts, for the different groups of countries identified in Table 2 below:

Box 10: Country examples of mitigation policy impact

Carbon tax or ETS drives down oil price: All else being equal, this would reduce income from oil exports received by oil producing countries such as Nigeria and Indonesia, and would generate net welfare gains for oil importers such as Ethiopia who would now pay lower prices for their fuel. However, in practice this effect may be offset by dwindling oil supplies, and by other mitigation policy measures, which may both drive up the price of oil.

Border tax adjustments: MICs such as China, Brazil, Russia and South Africa which export energy intensive products are likely to suffer the biggest losses as a result of BTAs, which will reduce the competitiveness of their exports, though in the absence of BTAs they may also stand to gain the most from the opportunities generated by carbon leakage (in terms of new trade and FDI opportunities) if they do not adopt mitigation policies themselves.

Clean development mechanism: Currently, the CDM is mostly benefiting players with large, cheap, industry-related mitigation opportunities such as China, by generating increased FDI, with its associated spillovers, such as technology transfer etc. Over time, and with further development and reform, the CDM could benefit a much wider selection of countries, including countries with carbon assets such as forests, (especially those with a strong institutional framework for sustainable forest management such as Guyana), and those dependent on agricultural production, such as Ethiopia.

If sectoral CDM approaches are developed, they could generate significant gains for those countries active in the sectors covered. At least in the medium term, such approaches will be particularly appropriate for countries with large scale heavy industries, and thus are likely to benefit mostly emerging economies such as China and India.

REDD+: If a market led approach is developed for REDD+ the capacity requirements will imply that low risk, relatively developed middle income countries such as Brazil and Guyana stand to gain most, through trade and FDI from carbon markets. If a phased approach is adopted, with more public funding early on, then lower income agricultural and forested countries such as Rwanda and Ethiopia may be able to gain more from the development finance that will be available.

Liberalisation of Environmental Goods and Services (EGS): As currently defined, i.e. with a focus on environmental services and manufactured goods, the liberalisation of EGS would have most impact on MICs, such as China and India which are leading producers of wind energy and wind energy manufacturing equipment, and who may thus gain from opened up export markets, as well as cheaper imports of EGS. LICs don't currently trade in these EGS very much. However, if agricultural products such as biofuels were included, then many more countries including LICs such as Ethiopia (as well as MICs such as Brazil, which is a leading producer of biofuels), could potentially benefit significantly from both increased market access and lower import prices.

Carbon labelling: The impact of carbon labelling depends very much on what kind of methodology is used. If simple proxies such as air miles are used, it could significantly reduce market access for certain developing country exporters such as Kenya, (which air-freights a lot of fresh fruit and vegetables to the European market), whereas if life-cycle approaches were used, it could benefit those developing countries if they proved to be less carbon intensive in production than competing products from other countries.

Technology transfer: This will occur through various mechanisms, including through spillovers from trade and FDI stimulated by carbon markets, which will mainly benefit those countries most active in carbon markets, such as China and Brazil. The introduction of a Multilateral Technology Fund could help to assist technology transfer to lower income countries, including those which may struggle to attract private investment due to a relatively poor investment climate, such as Bangladesh and Zambia.

- For **net oil / fossil fuel exporters**, particularly MICs such as Nigeria and Indonesia who may take on emission reduction commitments in a future international agreement, the focus of mitigation effort is likely to be on reducing emissions associated with oil production e.g. through reducing gas flaring. In the longer term countries with the required capacity may want to invest in the development of carbon capture and storage technologies which may become an important export market in future, or alternatively may be able to position themselves (e.g. by introducing an appropriate policy and institutional framework) to obtain such investment through the CDM, if and when those technologies become available.

  Oil exporting countries may also want to pursue diversification strategies, so as to minimise the costs they face if mitigation drives down the price of oil and other fossil fuels in future. On the other hand, the oil price may not fall if oil reserves run down, and the growth in demand for oil outstrips the shift away from oil based energy production. In that case, pursuing a growth strategy that is based on oil production may remain the best option for some countries at least in the medium term. However, diversification remains a good way to ensure reasonable economic prospects, given the uncertainties around the future evolution of the oil price.

- **Oil importing countries** may want to pursue policies that encourage the shift away from fossil fuel based energy production towards renewables, given that may generate significant win-wins by reducing dependence on imported oil, attracting new capital inflows through carbon markets, and perhaps increasing access to electricity through more decentralised forms of energy provision. This may be achieved through various measures such as establishing a clear policy framework which demonstrates the commitment to renewable energy, thus boosting expected returns from private investment in renewables, promoting a good investment climate, establishing investment incentives, developing public / private partnerships, and developing complimentary policies such as the establishment of suitable accompanying infrastructure;

- For **countries with carbon assets** such as forests, strategic positioning, policy development, and lobbying for financial support for mitigation and adaptation, may help to both influence the international agenda, and the development of international mitigation mechanisms, such as Reduced Emissions from Deforestation and Forest Degradation (REDD) and CDM, in their favour, both in terms of scope and scale.

  Forested countries that develop a rigorous, comprehensive, transparent and inclusive process around sustainable forest management may be more likely to secure international investments and future CDM benefits and turn them into successful alternative growth strategies. Guyana is an example of a country that has set out a clear mitigation strategy in relation to its forests, and is trying to influence international policymaking in order to obtain the kind of mechanisms that will enable it to capitalise on its forestry assets.

- **Countries without carbon assets**, and with few other mitigation opportunities, stand to gain relatively little from carbon markets. Such countries may have to rely more on public and donor money to fund the necessary investment to achieve low carbon growth, and to offset any costs they face as a result of international mitigation. Such countries may need to be strategic in positioning themselves to attract public finance. For example, the development of a 'Climate Change Fund'/multi-donor trust fund, and an appropriate policy framework e.g. a NAPA, NAMA, and/or a low carbon growth strategy, can help to convince donors that climate change is taken seriously in that country, and that any funding will be spent transparently and effectively.

- **Relatively industrialised countries**, especially those with a good investment climate, may gain from carbon leakage opportunities associated with mitigation efforts in other countries. This would strengthen the case against them introducing domestic mitigation policies. However, analysis of the potential scale of carbon leakage suggests it may be quite minimal, and it may be offset by border tax adjustments, so the gains could be limited. In

the long run, growth through an influx of investment in dirty industries may in any case be undesirable, as it may store up significant potential mitigation costs for the future.

Relatively industrialised countries stand to gain most from liberalisation of environmental goods and services, as well as reforms to the CDM which facilitate sectoral approaches, so have an interest in supporting such policies;

- **Relatively agricultural countries** on the other hand, have an interest in supporting reforms to the CDM and REDD that widen its scope to reduced emissions from agriculture, and the inclusion of agricultural goods (e.g. biofuels) in any agreement on the liberalisation of environmental goods and services.

  Agricultural countries may want to develop a better understanding, (and build awareness amongst farmers of) the potential effect of climate change mitigation on shifts in demand for agricultural produce e.g. through carbon labelling schemes, or changing consumer preferences. This will enable them to adapt to changing patterns of demand and take advantage of possible new growth opportunities.

  For agricultural countries, the development of improved agronomic practices, and water, soil and fertiliser management would potentially be a focus for mitigation, although the absence of mechanisms to measure such mitigation currently constrain the ability of carbon markets to reward this, so incentives are limited. Thus agricultural countries have an interest in supporting the development of mechanisms to address this.

- Developing **countries with relatively carbon intensive exports** may lose from any new carbon labelling scheme, while countries with relatively energy efficient exports may gain, though ultimately this will depend on the details of the scheme and methodology used. Developing countries for whom exports are important have an interest in understanding and influencing the development of such a scheme, and investing in the development of domestic certification schemes, which will ensure they can take advantage of any new opportunities that carbon labelling may bring. This is an area where the financial and political support of donors may be particularly important.

- **Importers of carbon intensive products** may find that import prices increase as a result of mitigation efforts in other countries. Thus they may want to source from elsewhere, or look at developing substitute products locally, or switching to less carbon intensive products, or products which can be imported from markets not affected by mitigation.

- **Countries which are heavily dependent on export led growth**, and which are thus more vulnerable to mitigation efforts in other countries, may want to diversify their sources of income, or try to develop alternative markets for their products. For example, countries such as Kenya, which have benefited from significant earnings growth from air freighted fresh fruit and vegetables in recent years, may be negatively affected by the introduction of air transport taxes which could drive up the relative cost of their exports, so may want to focus on developing the market for their produce within the region, rather than focusing so much on markets that are further afield. Thus they may want to move into products that are more suited to regional patterns of demand, or start producing less perishable goods that can be shipped rather than air-freighted. Similarly, countries which are heavily dependent on tourism may wish to build links with markets within the region. For example, Caribbean countries may want to increase their marketing effort targeted at American tourists, and away from the European market in future.

The ability to take advantage of new economic opportunities that mitigation presents will also depend on factors such as a country's investment climate, openness to and management of new trade and investment opportunities, macroeconomic and budgetary management of higher aid and capital inflows, and the institutional framework. Thus many of the policy prescriptions that were identified under the traditional growth agenda (e.g. around improving the investment climate,

reducing the costs of doing business, tackling corruption, strengthening the rule of law etc.) remain just as important for achieving growth in a carbon constrained world.

Countries that identify, target and capitalise on new markets for environmental goods and services stand to benefit more from international mitigation. For example, Brazil's development of biofuels production and associated technologies such as bioethanol fuelled vehicles, stand it in good stead to benefit from future growth in global demand for such products and associated know-how.

There is a role for government leadership to identify new sectors which may provide competitive advantage and employment growth going forward. The development of new opportunities may be facilitated by support and funding from government and the international community, and may require the creation of an appropriate policy environment; provision of the necessary training/education; investment promotion and awareness raising; and collaborative partnerships between the public, private and NGO sectors.

4.3 Role of donors and further research priorities

The analysis shows that not all developing countries will be able to obtain private finance for mitigation and adaptation. Thus increasing the availability of public finance will also be important in plugging gaps in funding left by market mechanisms, supporting developing countries' low carbon growth efforts, and compensating countries where they lose out from international mitigation efforts.

In addition the development community will have an important role to play in building understanding of the potential impacts of different mitigation policies on developing countries, so that developed country policymakers can take these effects into account in their decision making, and so developing countries can start now to position themselves to take advantage of new opportunities or protect themselves from new risks arising from mitigation.

There is very little quantitative evidence available on the impact of different mitigation policy outcomes on developing countries. Areas where further research could be valuable include:

- Analysis of the shifts in comparative advantage or changing trade patterns that are likely to take place as a result of international mitigation policies such as cap and trade schemes or a carbon tax;
- Analysis of the impact of different methods for carbon labelling on trading patterns and export opportunities for developing countries;
- Analysis of the impact of different countries' / regions' inclusion in an international emissions trading scheme;
- Analysis of the impact of an air transport tax on countries dependent on tourism, and on air freight;
- Analysis of the impact of different proposals for border tax adjustments on trading patterns and welfare in developing countries;
- Analysis of the impact of different outcomes for CDM and REDD+ i.e. which countries will benefit most from the different proposals on the table;
- Analysis of the impact of liberalisation of environmental goods and services, comparing the impact when different lists of qualifying products are included.

Finally, it would be useful to populate the 'categorisation of countries' set out in Table 2, by reviewing the data (e.g. on import / export patterns, carbon intensity of production, carbon assets, abatement opportunities, governance and IC indicators etc.) in order to categorise specific countries and assess how they are likely to be affected by different mitigation policies and scenarios. Such analysis would enable developing countries to assess more easily the opportunities and threats they face from international mitigation, and respond accordingly.

Table 2: Towards a Typology of Countries

	Carbon tax or ETS drives down oil price	**BTAs**	**CDM**	**REDD+**	**EGS liberalisation**	**Carbon labelling**	**Technological innovation and transfer**
Net oil importer / net oil exporter	Good / bad		Neutral / maybe good if CDM funds CCS projects				
Has carbon assets / doesn't	Good / neutral		Good / may lose out as focus on LICs with abatement opportunities	Good / neutral			
Relatively industrialised / relatively agricultural	Good because of potential for carbon leakage opportunities / neutral	Bad as may affect exports / neutral	Good if reforms help with industrial abatement opps / good if reforms help with agricultural abatement opps	Neutral / good if covers other land use emissions	Good / good – especially if agriculture or biofuels liberalised		
Relatively carbon intensive exports / relatively energy efficient exports						Bad / good through impact on comparative advantage	
Net importer of carbon intensive products / Net exporter of carbon intensive products	Bad, as pushes up import prices / good as increases comparative advantage (unless BTAS imposed	Good as may push down import prices / bad as constrains new export opportunities					
Relatively good governance, investment climate and institutions / poor governance etc.	Good because of potential for carbon leakage opportunities / neutral		Good as most attractive CDM projects / bad as benefit little from CDM	Good / neutral	Good if can take advantage of new export opportunities / neutral	Neutral / bad as certification systems hard to achieve	Good as transfer more likely and adoption of technologies easier / neutral

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Annex 1: Possible Policy Outcomes

This Annex provides an analysis of each mitigation policy in turn, discussing the nature of the policy proposal/s on the table, and explaining the assumptions we use in the scenarios.

Carbon taxes

Carbon taxes are a key way that countries can achieve their emissions reduction commitments. By taxing carbon to bring the price of carbon more into line with the social cost associated with carbon emissions, policymakers create economic incentives to reduce carbon emissions.

- **Possible Policy Outcomes**

Carbon taxes are imposed on fossil fuel use, but there are various ways of implementing them. For example, they can be imposed on retail consumers, industrial consumers, or fossil fuel producers, and different types of fossil fuel use can be targeted e.g. fuel used for travel versus domestic and industrial electricity usage etc.

There is currently little discussion of an internationally coordinated carbon tax, though some (especially European) countries have introduced or are exploring different types of tax incentives at the national level, to reduce carbon use. But though this policy option has received considerable attention in recent years, it has not been applied by very many countries. This is partly because of concerns about carbon leakage (see below). However, in the context of an international agreement to reduce carbon emissions to which many countries have signed up, the scope for carbon leakage is less, and a coordinated carbon tax policy is more feasible.

Air transport taxes, or passenger duties, are a form of indirect carbon tax that is being discussed, and has been introduced in some countries, including the UK. They are aimed at reducing the number of flights, so as to reduce energy consumption and emissions. There have also been some proposals for the introduction of a bunker fuel tax on shipping. However, as the effects of these transport taxes are relatively narrow compared with some of the other mitigation policies we have reviewed, we have not included them in the scenarios, although the potential economic impacts of such taxes on developing countries are discussed in the Annex.

- **Scenario assumptions**

It would be beyond the scope of the study to examine differences in carbon tax implementation in different countries, and at this aggregate level of analysis the international economic impacts are broadly similar anyway. As most countries will have to adopt policies of one form or another to disincentivize carbon use, the broad impacts on international economic outcomes can be proxied by assuming a coordinated carbon tax.

Thus for the purposes of the scenarios, we have assumed that a coordinated carbon tax on fossil fuels is introduced by those countries signing up to binding emissions reductions commitments i.e. HICs and MICs in scenario 1, and just HICs in scenario 2. There is no coordinated carbon tax response in scenario 3, although we have assumed many countries still unilaterally impose a carbon tax of some kind.

Emissions trading schemes

By capping emissions at a certain level, and issuing emissions permits that can be traded, emissions trading schemes (or 'cap and trade' schemes) are an alternative to carbon taxation as a means to drive up the price of carbon. Thus many of their effects are also the same as a carbon tax. However, because they allow trade in emissions permits between companies or countries, and thus facilitate the efficient allocation of abatement opportunities, (rather than requiring the same degree of abatement effort across all companies or countries regardless of the associated costs), they provide a way to reduce compliance costs associated with emissions stabilizing policies. We thus consider their impact only in terms of this additional benefit, of reducing compliance costs, as the impact of carbon pricing has already been discussed in relation to carbon taxation above.

- **Possible policy outcomes**

Currently, under the Kyoto Protocol, for the 5-year compliance period from 2008 until 2012, nations that emit less than their quota will be able to sell emissions credits to nations that exceed their quota. In addition, the EU has also established an emissions trading scheme (ETS), which includes 15 European countries participating in the Kyoto trading system, and is the largest such scheme in the world. Australia is also planning to introduce a cap and trade emissions permits market in 2011. Other schemes exist in New Zealand and North America, and there is the Climate Change Exchange (CCX) which covers North America and Brazil. China is also now developing a national emissions trading scheme, and India is moving in that direction. The more countries that are involved in emissions trading, the lower the costs of mitigation will be.

If MICs adopt commitments (as under scenario 1) they may be able to establish their own ETS, or join with other countries' schemes. Given that membership of an ETS reduces compliance costs of stabilisation policies, it seems likely that MICs would want to pursue this, and some have raised this possibility.

In practice there is likely to be scope for partial engagement in trading e.g. by countries taking on targets for particular sectors of their economies or taking on non-binding or 'no-lose' targets[5]. However, for the purposes of the scenarios, and for clarity and simplicity, we have focused on the most extreme outcomes, relating to full participation (or not) by all HICs and MICs in an emissions trading scheme, as this allows us to focus on the main message: that efficiency in mitigation is maximised through the use of emissions trading schemes.

- **Scenario assumptions**

For the purposes of the scenarios we have assumed that:

Under Scenario 1, where MICs adopt binding commitments, they will join HICs in an international emissions trading scheme.

[5] See: http://www.decc.gov.uk/media/viewfile.ashx?filepath=what we do/global climate change and energy/tackling climatechange/emissionstrading/lazarowiczreport/1_20090803173145_e_@@_8368tsoglobalcarbontradingnewbkmk.pdf&filetype=4

Under Scenario 2, an emissions trading scheme is established amongst all HICs, but because MICs do not adopt binding commitments until 2020, they are unable to participate, apart from through CDM, until that time.

Under Scenario 3, there is no international ETS, as there is no international agreement on emissions reductions. However, we assume a scenario in which many HICs and MICs unilaterally commit to reducing emissions and some of these adopt a domestic cap and trade system. Some of these countries also establish regional ETS amongst themselves.

Border Tax Adjustments

Border Tax Adjustments (BTAs) are not a mitigation policy per se; however they may be introduced alongside mitigation policies such as carbon taxes or emissions trading schemes, as a way to offset the potential negative impact on international competitiveness that such mitigation policies may imply for domestic firms vis-à-vis foreign firms that are not subject to such policies.

Thus they are supposed to level the playing field between domestic and foreign producers.by relieving exported products of some or all of the tax charged in the exporting country (effectively a subsidy) and / or charging an import tax on imported products. Thus they could be in the form of either taxes or subsidies.

- **Possible policy outcomes**

BTAs are increasingly being discussed in relation to climate change mitigation policy. Proposals are motivated by competitiveness concerns (they are helpful to placate domestic business and therefore garner political support for mitigation efforts) and the need to minimize carbon leakage, and hence ensure maximum global mitigation takes place. The threat of BTAs is also being used to encourage trading partners to adopt similar emission reduction targets and related national regulations. Both the US and the EU are proposing to include BTAs in their legislation – this is discussed further in the Annex.[6]

The EU legislation would impact on all other countries regardless of whether they had signed up to emissions reductions commitments or not, but exports from LDCs are exempted under the proposed US legislation.

[6] The Waxman-Markey bill has been proposed by the US House of Representatives, but a further bill has been proposed by the Senate, the 'Kerry-Boxer' bill. This bill proposes a more aggressive emission reduction target (20% below 2005 emissions compared to 17% in the Waxman-Markey bill). In addition a price ceiling for carbon prices under the cap and trade scheme has been proposed, set initially at $28 a ton in 2012, rising each year and a floor price of $11 per ton (compared to $10 in the Waxman-Markey bill). The bill calls for the Commodity Futures Trading Commission to set regulations that would provide federal oversight for the carbon trading market. Border Tax Adjustments have not yet been provided for in detail in the current legislation. Though Section 765 on international trade states that: there will be trade provisions, including a border measure that is consistent with international obligations of the United States and designed to work in conjunction with provisions that allocate allowances to energy-intensive and trade-exposed industries. See: http://www.boston.com/news/politics/politicalintelligence/09.30.09%20Kerry%20Boxer%20Section%20by%20Section%20summary.pdf

It has been argued that the legality of introducing these policies in a way that affects countries (such as China) which are signatories to the Kyoto Protocol, and fully compliant with it - as it does not currently require any legally binding commitments from Non-Annex 1 countries - would be questionable[7]. The legality of these measures under the WTO is also unclear.

- **Scenario assumptions**

For the purposes of the scenarios we have assumed the following:

Under scenario 1, where both HICs and MICs sign up to binding emission reduction targets which are achieved through both a coordinated carbon tax and emissions trading, we have assumed that no BTAs are introduced, as there is less need to do so, as MICs are also pursuing mitigation policies, and LICs rarely compete in affected markets, so the extent of potential carbon leakage is minimal.

Under scenario 2, where MICs do not sign up to binding emissions reductions targets, and thus do not participate in coordinated carbon taxation or emissions trading, we assume that BTAs are introduced by HICs against MICs. This is done in a coordinated way, and LICs are exempted. There is agreement at the multilateral level that BTAs, related to climate change mitigation, are legitimate trade defence instruments. This is agreed by MICs as part of the deal.

Under scenario 3, where there is an uncoordinated policy response, BTAs are imposed by many HICs and MICs, in an ad hoc manner. In some cases they are imposed only against countries that do not sign up to commitments, but in others all countries are affected, including LICs. There is uncertainty as to their legality at the WTO level and risks of retaliation, which could spark trade wars (as well as increase tendencies towards using environmentalism as disguised protectionism). This uncertainty also further reduces the effectiveness of BTAs in offsetting carbon leakage.

Clean development mechanism

The Clean Development Mechanism (CDM) is a key mechanism to facilitate private financing of mitigation from developed to developing countries. It has benefited MICs the most so far, and the scope of offsetting it has permitted to date has been relatively narrow compared with its potential. Thus several ways to widen the definition of abatement opportunities covered, and to make it easier to access funding through it, are currently being considered.

- **Possible policy outcomes**

There are a range of different proposals on the table for the reform of the CDM. These include:

1. changing the rules that govern how projects are approved and carried out, thus making it easier to access CDM project funding (e.g. by changing the emissions threshold limits at which small-scale projects become eligible, and further simplification of methodologies) or by increasing the scope of activities that are eligible, e.g. relating to for example:

[7] Cosbey 2008:5

i. land-use sources and sinks: Specifically, reduced emissions from deforestation and degradation; wetland restoration; sustainable forest management (SFM); soil carbon; and revegetation.
ii. Carbon capture and storage.
iii. Nuclear power

Expansion of the scope of the CDM in these ways is unlikely to be achievable in the short term, because of technical complexities, but may be more feasible in the medium term e.g. post 2017.

2. Expanding the CDM to include sectoral approaches, in which emissions reductions from whole sectors (as opposed to individual projects) can generate carbon credits. Other sector-based approaches include 'no-lose targets' for developing countries, and mechanisms to focus on technology transfer and avoided deforestation (REDD). Nationally Appropriate Mitigation Actions (NAMAs) could be funded by sectoral crediting mechanisms, and / or include project-based CDM systems.

   Limited sectoral crediting may be possible in some sectors in the commitment period from 2012, with expansion of sectors after 2017.

The detailed rules surrounding the CDM are not the only aspect governing possible policy outcomes in the long term. Another aspect that needs to be considered is how the CDM is incorporated into future emissions trading systems (ETS). As discussed in the section on ETS, more ETS are likely to be established in HICs in the next few years, and there is a possibility (as described under scenario 1) that MICs will establish ETS in the medium term (2015-2020). All of these systems could create greater demand for CDM credits from LICs, depending on how their rules are set.

- **Scenario assumptions**

For the purposes of the scenarios we have assumed that:

With low levels of international agreement (scenario 3), the CDM ceases to exist in its current form, but similar mechanisms are implemented separately by the EU and the US, to meet national, unilateral commitments. They are designed slightly differently however, based on their own interests and priorities, which increases the transactions costs compared with an internationally coordinated scheme.

With medium levels of international agreement (scenario 2), where MICs do not sign up to emissions reductions commitments until 2020, hence continue to receive CDM funding, and where HICs take on higher emissions reductions commitments in return for greater levels of offsetting being permitted through flexibility mechanisms such as CDM: there is pressure from both HICs and MICs to increase the scope of CDM offsetting possible, through the adoption of sectoral approaches, which, due to their industrial nature, are likely to open up significant new opportunities, mostly in MICs. This is assumed to start slowly in 2012 with just a few sectors covered by sectoral approaches, but with considerable expansion in the number of sectors covered after 2017.

With high levels of international agreement (scenario 1), both HICs and MICs adopt binding emissions reductions commitments and MICs cannot now receive funding through the CDM. They may benefit from carbon trading through Joint Implementation but could also block this to

some extent[8], instead financing abatement activities themselves. At the same time, the CDM is reformed through rule changes to make it easier to access CDM financing from 2012, and in the medium term, i.e. after 2017, it is also reformed to include new emissions sources / activities relating to land use. The new international emissions trading scheme allows offsetting through the CDM. All of these factors open up significant new opportunities for LICs to benefit from the CDM, especially in the medium term.

REDD+

There is still much debate about how carbon emissions from deforestation, degradation and other land use emissions (REDD+) may feature in a post-2012 climate regime, although there is a high degree of consensus that emissions from the sector need to be urgently addressed.

- **Possible policy outcomes**

Currently, the main debates about the future of REDD+ surround:

- The scope of REDD mechanisms: Whether mechanisms are narrow, for example including only deforestation (RED), or whether they are broader, including: degradation (REDD); or whether they are broader still, include also conservation of forest, and enhancement of forest carbon stocks (REDD+) – the scope was kept broad in the recent Copenhagen negotiations;
- The financial systems used to fund REDD+: In particular, whether and how carbon markets can be used to support REDD+ actions, how much public money will be made available, and what innovative financial mechanisms can be used;
- The form of monitoring, reporting and verification (MRV) systems: This includes questions about the methodologies used to assess emissions reductions, how MRV of actions is assessed (whether actual emissions reductions are measured or only proxies from emissions reductions, such as policy implementation efforts) and MRV of support from developed countries;
- How to set reference levels by which to judge performance: There are debates about whether to use historical deforestation rates as a reference upon which to judge future performance in reducing rates of deforestation and degradation. Alternatively projected reference levels based on modelling could be used.

There are trade-offs within each of these different dimensions, particularly in terms of which countries may benefit from REDD+ systems, which are the reason why agreement is difficult to reach. Nevertheless a few possible policy scenarios can be defined which include assumptions about how each of the above issues are resolved in the context of broader international agreement on climate change.

A. Business as usual: In this outcome there is agreement on the need for REDD+ but no agreement on coordinated international approaches for supporting REDD+. Actions

[8] The reasons countries may want to block joint implementation are that it could result in external investment buying up all of the 'low hanging fruit' through a JI system. They may also be concerned about sovereignty issues related to carbon markets (e.g., as is the case in Brazil), or have anti-market ideologies (e.g., as in Bolivia's existing concerns about markets for reduced emissions from deforestation and degradation).

remain voluntary, including some relatively small investments through the voluntary carbon markets; bilateral funding at scales only slightly higher than current ODA to the sector; and some regional trading schemes or offset deals. Forestry and REDD+ continue to be excluded from the EU emissions trading scheme (ETS).

B. Compromise deal: REDD+ is introduced in 2012 through the 'phased approach'. This is because REDD+ can only be used in market mechanisms once countries have passed certain eligibility criteria relating to systems they have to accurately account for emissions reductions. This means that most will only be able to trade in the longer term ~ 2020. But under the phased approach, REDD is still funded at scale in the interim period through other means, including public funding and innovative funding mechanisms, though it does not contribute to HIC emissions reduction targets.

   Large scale funding is mainly sourced from 'innovative' financial mechanisms in the short term (to 2020), such as auctioning emissions allowances. Mechanisms are broad in scope to include deforestation, degradation and stock conservation. REDD+ credits cannot be traded in international ETS schemes until 2020. Performance measures are based on 'proxies' for emissions until 2020 (i.e. inputs such as policy implementation effort rather than direct measurements of emissions reductions themselves) and on emissions from 2020.

C. 'Fast track' to markets deal: REDD+ is introduced in 2012 as a fully fledged market system in which credits from REDD+ are fully fungible in carbon markets. As markets require adequate MRV to work, only countries with the capacity to undertake MRV will be able to participate.

   Offsetting of Annex 1 emissions can occur. In MICs this is through joint implementation if REDD+ is not funded domestically by MICs with caps. In LICs this would be through some sectoral offsetting mechanism similar to the CDM but functioning at the national level (i.e. with MRV over all land use sinks and sources) or through 'nested' approaches in which project investments can be funded directly by the private sector. REDD+ credits can be traded in all existing ETS in 2012 including the EU ETS.

- **Scenario assumptions**

For scenario 3 – low international cooperation – we assume a business as usual outcome for REDD, as discussed under A above.

The possible outcomes for REDD described under both B and C above, are potentially consistent with both scenarios 1 and 2: a phased approach could be implemented in either situation, as could a more immediately market-led approach.

However, in order to generate an interesting comparison, we assume that a more market-led approach for REDD (outcome C described above) is achieved under scenario 1, as greater global cooperation may facilitate the faster development of international carbon markets. This means that most countries could only benefit from REDD in the medium to long term. We then assume that under scenario 2, a phased approach is adopted, which means that more countries can benefit from REDD in the short term.

Trade in Environmental Goods and Services (EGSs)

The demand for environmental goods and services (EGS) is expected to grow rapidly over time, as the global community takes on increasingly stringent emissions reductions commitments. The liberalization of trade in EGS in the WTO is seen as an important goal and could generate major benefits for developing countries both in terms of new export markets, and cheaper imports which will help facilitate low carbon growth.

- **Possible policy outcomes**

There are ongoing discussions at the WTO on the potential liberalization of EGS, and the Doha Development Agenda mandate states an objective to reduce or eliminate tariff and non-tariff barriers to EGS. However, the status of the trade negotiations remains uncertain, and there is currently no consensus on which goods and services should be included in the definition of EGS. A number of approaches have been suggested in order to define them. These lists tend to focus on manufactured goods, and to exclude the products (such as bioethanol) of most interest to large agricultural exporters (such as Brazil), perhaps because they are products which major developed countries also produce and want to continue to protect. The intended development benefits of liberalization of EGS currently listed has therefore been questioned.

As noted by the ICTSD (2008a) the challenge for EGS negotiations is to include products of export interest to developing countries: the perception so far has been that EGS - being capital and technology intensive - are of export interest only to developed countries and a few middle income developing economies. Imports of such products into developing countries are also relatively low. Despite this, the EU and US have proceeded to liberalize some environmental goods unilaterally. Whether this sets a precedent and is reciprocated remains to be seen. The US and EU have already committed to zero tariffs by 2013 of the 43 EGs identified by the World Bank (2007b).[9]

- **Scenario assumptions**

For the purposes of the scenarios we have assumed the following:

Under scenario 1, where both HICs and MICs sign up to binding emissions reductions targets, we have assumed that there is a WTO agreement on the liberalisation of trade in EGS, incl. manufactured and agricultural goods such as biofuels, the latter agreed by HICs as part of a deal in which major biofuels producers such as Brazil agree to sign up to legally binding emissions targets.

Under scenario 2, where MICs do not sign up to binding emissions reductions targets until 2020, we assume that there is a WTO agreement on the liberalisation of trade in EGS, but the focus is mainly on manufacturing EGS and excludes biofuels.

Under scenario 3, where there is an uncoordinated policy response, we assume a bilateral and regional approach to liberalisation of EGS. Some HICs agree to liberalise mostly manufactured EGS. Some MICs define and liberalise EGS on a bilateral and regional basis, including manufactured and agricultural goods.

[9] See Mandelson and Schwab (2007) and http://useu.usmission.gov/Dossiers/Environment/Nov3007_USTR_Environment.asp

Carbon Labelling

Carbon labelling, narrowly defined, provides information through a product label, on the carbon emissions associated with the product. More broadly defined, it could also include proxies for this, such as labels which provide information on aspects of the product indicating likely associated carbon emissions e.g. the energy efficiency of the product, or the 'airmiles' associated with a product, denoting how far a product has travelled, and by which mode of transport.

By giving consumers information that enables them to compare the carbon emissions / climate change impact associated with different products and potentially alter their purchasing decisions accordingly, carbon labelling can facilitate shifts in demand towards lower carbon products. However, like other standards and labels, carbon labelling may also represent a barrier to market access for some producers.

- **Possible policy outcomes**

Carbon labelling could either be made mandatory through regulation, or could be voluntarily adopted by businesses to achieve competitive advantage, and / or as part of their commitment to corporate social responsibility. Examples of both already exist in different contexts and countries, including for example, the EU's mandatory energy efficiency labelling on electrical appliances, and efforts by some supermarkets to measure and label the carbon emissions associated with some of their products.

However, there are some methodological difficulties associated with carbon labelling. There are different ways to measure the carbon impact of a product. First, there is the 'lifecycle approach' which attempts to calculate the carbon emissions generated throughout a product's life, from the production of inputs, to the final consumption and disposal of waste. As noted by Brenton et al. (2008) the methodological difficulties of turning this intuitively appealing idea into practice are significant and the lack of standardised methods heavily influences the usefulness and comparability of existing studies.

A slightly simpler approach to assessing carbon impact, generating what are sometimes referred to as carbon footprint estimates, is to estimate emissions related to production and final consumption, but not to attempt to calculate the carbon emissions associated with inputs.

Given the complexities associated with either of these approaches, however, other proxies may sometimes be used. One example of this is the use of the 'food miles', concept whereby information about the method of transportation and distance travelled is provided. Some supermarkets simply indicate whether a product is air-freighted, with the implication that this is likely to be more carbon intensive than other forms of transportation. However, evidence suggests this implication may be incorrect.

See Table below, for example, which shows that Kenya is considerably more carbon efficient in producing roses than the Netherlands, even taking into account the emissions associated with air freight.[10] Thus a carbon label based on method of transportation has the potential to be misleading.

[10] The transportation of horticultural products is usually not undertaken as a solo journey, but with charted tourist flights; the marginal additional carbon emissions that result from the air freight of horticultural produce has therefore not been accounted for in this analysis.

Table 3: GHG Emissions from different sections of the supply chain of roses from Kenya and the Netherlands to the UK

	Country	
Supply chain section	**Kenya**	**Netherlands**
Production	300	36,900
Packaging	110	160
Transport to airport	18	0
Transport to RDC (air)	5,600	0
Transport to RDC from airport	5.9	50
Total	6,034	37,110

Note: Emissions are shown as Global Warming Potential (GWP) expressed in kg of co2 equivalents using the IPCC (2001) conversion factors. GWP and CO2 emissions from Kenya include the IPCC altitude factor.
Source: Edwards-Jones at al. (2008)

At the present time, due to the lack of an agreed standard and methodology, the application of carbon labelling across products by retailers, manufacturers and governments, is very much in a 'pilot phase.'[11]

The EC has proposed legislation that includes mandatory requirements for measuring the carbon footprints of biofuels. This is to ensure that only certified biofuels which meet environmental sustainability criteria are used to fulfil national renewable energy targets. The sustainability criteria require that the GHG emission saving from the use of biofuels and other bioliquids must be at least 35%, applicable from 1 April 2013 (EC 2008a). The European Commission (EC) will report on the requirements of a 'sustainability scheme' for biomass energy uses by 31 December 2010 (ODI 2008a).[12]

- **Scenario assumptions**

For the purposes of the scenarios we have assumed the following:

Under scenario 1, where both HICs and MICs sign up to binding emissions reductions targets, and where we have assumed there is a WTO agreement on the liberalisation of trade in environmental goods and services, we also assume that carbon labelling is adopted by all signatories to the new international agreement. A standardised methodology is developed and agreed, based on Life Cycle Analysis (LCA), as part of the agreement on liberalisation of EGS. Significant resources are made available for developing countries to help them develop national certification systems.

Under scenario 2, where only HICs sign up to binding emissions reductions targets until 2020, and where we assume that there is a WTO agreement on the liberalisation of trade in mainly manufacturing EGS and excluding biofuels, we assume that carbon labelling is adopted by HICs

[11] For example, the UK Carbon Trust is working with Tesco's to pilot carbon labelling based on LCA on a limited number of product lines.

[12] At the same time there has been a shift from food-competing biomass to non-food-competing biomass production. Whilst ensuring that increased use of biofuels does not have an adverse impact on food prices, it is undesirable to introduce a mandatory rule that disadvantages those developing country producers that are able to expand their production of first-generation biofuels without compromising food security. Arguably it serves to increase the protection afforded to European producers (who have easier access to second-generation technology); see ODI (2008a).

as part of the international agreement, again based on a standardised LCA methodology. However, given the more protectionist sentiment that may exist in a world of more limited international cooperation (as evidenced also by the use of border tax adjustments against non-signatory countries as discussed previously), such labelling may be more likely to be used as a trade barrier (e.g. accompanied by efforts to encourage consumers to buy local produce rather than imports etc.). Less finance is made available to assist developing countries to develop national certification systems.

Under scenario 3, where there is an uncoordinated policy response, we assume there is no internationally agreed carbon labelling system. Instead, carbon labelling is adopted voluntarily by major retailers, using various different methodologies, based mainly around simple proxies such as distance travelled or mode of transportation. Again, there may be a focus on encouraging consumers to buy local produce. As few use LCA approaches, there is less need for national certification systems, so less financial assistance is made available to developing countries for this purpose.

Technological innovation and diffusion

Technological change will have a key role to play in mitigating climate change and facilitating low carbon growth. Much technological innovation is likely to take place in developed countries, which have the capacity and finance to undertake more research and development. So policies and arrangements facilitating cross-border technology transfer will be important in enabling developing countries to take advantage of new technologies as they develop low carbon growth strategies. Some developing countries are also responsible for important innovations in certain areas, and stand to gain considerably from new market opportunities associated with such innovation.

- **Possible policy outcomes**

The establishment of a clear carbon price will determine to a large extent the incentives for technological innovation facing the private sector. The higher and more stable this price is, the stronger the incentives. However, it has been low and unstable in recent times (discussed further in the Annex). Thus the establishment of a carbon price floor has been suggested by some, to help strengthen incentives for innovation.

The effectiveness and scale of carbon markets will also determine the extent of technological innovation and diffusion that occurs (e.g. through emissions trading, or the CDM), as will the degree of international openness to trade and investment. Thus under a more protectionist regime, if for example the imposition of border tax adjustments results in a trade war with other countries raising barriers to trade in response, technology transfer could be considerably reduced.

Other policies that could promote technological innovation and diffusion include public funding of research and development, coordinated approaches and international cooperation on research and technological diffusion, public / private partnerships to develop or introduce new technologies, co-funding or risk sharing mechanisms, and reform to rules on intellectual property rights.

The Clean Technology Fund (CTF), one of two Climate Investment Funds operated by the multilateral and regional development banks, is designed to provide financing for the demonstration, deployment and transfer of low-carbon technologies with significant potential for long-term greenhouse gas emissions savings, in developing countries.

The G-77 countries want to create an institutional arrangement to facilitate technology transfer and development under the rubric of UNFCCC, such as a Multilateral Technology Fund, which may provide a mechanism whereby financing from developed countries would be used to help transfer technologies to developing countries. However, other countries such as the EU and the US do not agree on the need for such a mechanism under the UNFCCC, and favour other mechanisms such as 'voluntary co-operative technology-oriented agreements'.

One such agreement – which could potentially provide a model for future cooperation - is the Asia-Pacific Partnership, which includes Australia, Canada, China, India, Japan, the Republic of Korea and the United States, and was set up with the aim of accelerating the development and deployment of clean energy technologies related to climate change, energy security and air pollution. The Partnership focuses on expanding investment and trade in cleaner energy technologies, goods and services, and has set up taskforces and projects in 8 key sectors. The aim is to collaborate to promote and create an enabling environment for the development, diffusion, deployment and transfer of existing and emerging cost-effective, cleaner technologies and practices. In addition, the Partners will share experiences in developing and implementing national sustainable development and energy strategies, and will work together to identify opportunities to reduce further the greenhouse gas intensities of their economies.

There is also debate on the role of intellectual property rights (IPR), with China arguing that the existing IPR system does not match the need to accelerate the development, transfer and deployment of green technologies to tackle climate change. They are asking for innovative IPR sharing arrangements to jointly develop green technologies, and criteria for compulsory licensing for patented technologies. Developed countries on the other hand, want stronger IPR enforcement and protection in the developing world, arguing that will strengthen incentives for technology diffusion.

This is a debate about who will own and control the processes that deliver green technological progress. It is not currently clear which path is likely to deliver the fastest rate of green technological innovation and diffusion, and is an area where further analysis is needed.

Some have suggested learning lessons from the WHO Global strategy on health, innovation and intellectual property, which emphasized multiple incentive approaches including prize funds, public funding, patents, patent pools, as well as other non-exclusive rights approaches that aim for short development cycles through open and collaborative research and development, as well as broad follow-on research and open access to research results and information.

- **Scenario assumptions**

In scenario 1 a clearer carbon price is established, as an international agreement is achieved specifying an overall carbon emissions ceiling for both HICs and MICs. In scenario 2, the global carbon price is less clearly defined, as the amount of mitigation that may be undertaken in MICs is unclear. Under scenario 3 there is even less certainty around the future price of carbon.

To the extent that CDM also facilitates technology transfer, this is likely to be greater under scenarios 1 (for LICs) and scenario 2 (for MICs and LICs, with MICs likely benefiting the most).

In scenario 1 there is also a more cooperative outcome, and less likelihood of trade protectionism, which should facilitate more technological diffusion than under the other two scenarios. A protectionist outcome is perhaps most likely under scenario 2 as HICs collectively impose BTAs against MICs.

We assume that under scenario 1, a Multilateral Technology Fund is established under the UNFCCC in order to obtain the agreement of China, India and other MICs to the overall global deal. No such fund is established under scenario 2, due to HIC opposition. Under scenario 3 however, we assume that more voluntary agreements are made between groups of countries, along the lines of the Asia-Pacific Partnership, as an alternative to a multilateral solution. We also assume that more public funding is made available to underpin technological innovation and diffusion.

Under this set of assumptions, it seems likely that scenario 1 will generate the most technology transfer. It is possible that scenario 2 generates the least, with scenario 3 somewhere in between as a result of greater voluntary, bilateral, coordination.

Summary of scenario outcomes

A summary of the mitigation outcomes assumed under each scenario is shown in Table below:

Table 4: Summary of scenario outcomes

Three scenarios varying by degree of coordination between HICs, MICs and LICs. Expected to generate broadly equal levels of mitigation, sufficient to stabilise temperature increases at 2 degrees Celsius	1. High levels of international cooperation: HICs and MICs take on legally binding targets	2. Moderate levels of international cooperation: only HICs take on legally binding targets	3. No global deal, hence uncoordinated mitigation response
Description	In this scenario both HICs and MICs take on legally binding economy-wide absolute emissions targets post-2012. LICs do not take on any form of target but can participate in offsetting mechanisms. HICs are able to offset a relatively low proportion of their target, compared with scenario 2.	In this scenario, only HICs take on legally binding economy-wide targets post-2012. MICs agree to take on (as yet undefined) targets in 2020. LICs do not take on any form of target. To achieve the same degree of mitigation as under scenario 1, HICs take on more ambitious targets, but are able to offset a much higher proportion of their own targets by funding mitigation in MICs and LICs compared with scenario 1.	In this scenario, no global deal is achieved. Thus countries fall back on voluntary actions and partnerships within and between countries / regions.
Carbon taxes	Coordinated carbon tax imposed by HICs and MICs as key part of global deal, to achieve reduction commitments.	Coordinated carbon tax imposed by HICs only, as key part of deal, to achieve reduction commitments.	Uncoordinated carbon tax imposition. However, many HICs and MICs still unilaterally adopt carbon tax of various kinds.
Border tax adjustments (BTAs)	No need to impose BTAs, as MICs part of deal, and BTAs are not imposed against LICs as they are usually unable to outcompete domestic HIC and MIC industries.	Imposition of BTAs by HICs on MICs that have not signed up to international agreements to limit their emissions, in order to prevent carbon leakage. General agreement at the multilateral level that BTAs, related to climate change mitigation, are legitimate trade defence instruments, agreed by MICs as part of deal.	Imposition of BTAs on unilateral basis, sometimes also against LICs. Lack of agreement at the multilateral level so legitimacy of BTAs challenged at the WTO.

Emissions trading	ETS between HICs and MICs, with LICs only involved through offsets		Emissions trading between HICs only until 2020, with MICs and LICs only involved through offsets. MICs join ETS in 2020 when they take on targets themselves.	Some regional emissions trading schemes established on ad hoc basis, but fewer countries overall involved in emissions trading.
CDM	MICs can no longer receive CDM funding, but can offset if they choose to, as with HICs. CDM is reformed to include new emissions sources/activities relating to land use, plus rule changes to make it easier to access CDM financing. This enables LICs to benefit more from CDM.		Until 2020, much higher levels of HIC offsets allowed, which MICs can still benefit from. CDM reformed and expanded to include sectoral approaches. These mainly benefit MICs and crowd out LICs.	The CDM ceases to exist in its current form, but similar mechanisms are implemented separately by the EU and the US, to meet national, unilateral commitments. They are designed differently which increases the transactions costs. The mechanisms have a fairly limited scope and coverage. MICs continue to be the main beneficiaries.
REDD+ implementation	REDD+ regime established, with market mechanism operational in the short-medium term. REDD credits fully fungible with existing markets, without major depressive effect on carbon price, because of stiff emissions targets.	REDD+ regime established with 'phased approach'. Can only be used in market mechanisms once countries have necessary systems to measure emissions reductions so most can only trade in the longer term from around 2020. In interim it is funded at scale through innovative financial mechanisms and does not contribute to HIC emissions reduction targets.		REDD+ regime established, but given underdevelopment of private market mechanisms due to lack of international coordination, most funding is voluntary public funding by HICs and some MICs i.e. consists mainly of aid transfers and voluntary 'markets'. This benefits LICs (relative to MICs) more, compared with market based mechanisms. Accent on highly projectised and small-scale REDD in LICs.
Liberalisation of trade in environmental goods and services (EGS)	WTO agreement on the liberalisation of trade in EGS, incl. manufactured and agricultural goods such as biofuels, agreed by HICs as part of global deal. Agreement on certification requirements, with resources made available for LICs to develop national certification systems.	WTO agreement on the liberalisation of trade in EGS, but focus is mainly on manufacturing related EGS and excludes biofuels.		Bilateral and regional approach to liberalisation of EGS. Some HICs agree to liberalise, mostly manufactured EGS. Some MICs define and liberalise EGS on a bilateral and regional basis, including manufactured and agricultural goods.

Carbon labelling	Carbon labelling adopted by all HIC and MIC signatories to the international agreement, and with substantial resources made available for LICs to develop national certification systems.	Carbon labelling adopted by HICs only, based on a standardised methodology for Life Cycle Analysis (LCA) Less assistance made available to LICs to meet certification requirements.	Carbon labelling adopted by major retailers through private initiatives, based on simpler metrics such as mode of transportation.
Technological innovation and transfer	Clear carbon price established through international agreement, creates stronger incentives for R&D / innovation. A Multilateral Technology Fund is established under the UNFCCC in order to secure MIC agreement to global deal.	The global carbon price is less clearly defined, as the amount of mitigation which will happen in MICs is unclear, which creates weaker incentives for R&D / innovation. No Multilateral Technology Fund is established.	Considerable uncertainty around the future price of carbon means weak incentives for R&D / innovation. But as an alternative to multilateral action, voluntary agreements are made between groups of countries, and more public funding is made available to underpin technological innovation and diffusion.

Annex 2: Economic effects of mitigation policies on developing countries

Mitigation policies – designed to reduce emissions – will constitute a key component of global efforts to tackle climate change and achieve low carbon growth going forward. While the appropriate global distribution of mitigation efforts is a very contentious issue, it is clear that the largest emitting developing countries, such as China, India and Brazil, will need to undertake mitigation if we are to avoid what is often referred to as 'dangerous levels' of climate change.

The potential impact of domestic mitigation policies on growth is unclear. The literature is mixed, and modelling results depend enormously on the particular assumptions that are used. Constraints on emissions raise the cost of energy which, in turn, reduces the output that can be achieved with a given set of inputs. No consensus exists on the costs of mitigation however, which will depend on the efficiency and nature of the policies adopted, and the extent of technological innovation achieved. And mitigation could also generate new growth opportunities, which would offset those costs.

This could be the case if, for example, there is fast growth in demand for environmental goods and services. Significant co-benefits associated with mitigation could also occur if there are strong synergies between green technology change and industrial technological progress, which is a key source of growth. Policies designed to promote green technological innovation and technology transfer could thus also potentially increase growth. In addition, some mitigation policies generate revenues (e.g. carbon taxes) and provide opportunities to stimulate growth through the judicious use of the revenues raised. Thus the design of national mitigation policies and the way incentive mechanisms for low carbon growth are created will determine overall growth effects.

For many low income countries however, domestic mitigation efforts may be less important, as emissions are already low, and as they have contributed little to the problem of climate change in the first place. They may still be affected by international mitigation efforts however, and by mitigation policies adopted in other countries, and it is these effects that are the main focus of this study.

International mitigation policies will generate significant opportunities and threats for developing countries. Many of the most cost effective mitigation opportunities are in the developing world, and this could allow some developing countries to capitalise on potentially large new sources of finance through carbon markets and other mitigation mechanisms. An appropriate policy framework will be important in securing both public and private finance through such mechanisms. If used well these financial inflows could contribute to higher growth rates in those countries. These international mitigation mechanisms would need to be developed, reformed and scaled up significantly, however.

The way that revenues from international mitigation efforts are used will also be important. For example, if auction revenue raised from permit sales in carbon cap-and-trade schemes is then used to finance mitigation or adaptation in developing countries, this could generate significant gains for recipient countries.

Some developing countries are, therefore, positioning themselves to take advantage of the opportunities afforded by international mitigation efforts. But not all countries will be able to do this, such as those without carbon assets, or with few existing sources of emissions to mitigate.

And even countries with the required assets may find it hard to capitalise on these opportunities, because of the same kinds of issues that have constrained growth in general, such as: low human capital, poor investment climate, market failures, lack of institutional capabilities, organisational challenges, and lack of access to finance.

International mitigation policies may also pose a threat to some existing sources of growth in developing countries. For example, if mitigation policies succeed in driving down the demand for oil, and thereby its price, this will generate a net loss for oil exporting countries (though conversely a net gain for oil importers). As discussed further below, air transport taxes might reduce demand for tourism or for air freighted exports such as fruit and vegetables. And border taxes may be introduced to discourage the import of carbon intensive products, which could reduce export income from certain industries. The impact of these policies will vary significantly by country, depending on their sectoral composition.

In this Annex we consider each mitigation policy in turn, and look at the potential economic impacts. We assess the economic effects of each mitigation policy on growth in low-income countries using a sequential approach (causal chain analysis). First we specify the policy measures that are being analysed. The policy measure will alter incentives through changes in price and other mechanisms. We then assess how these incentives affect the key economic transmission belts between the countries that implement mitigation policies and low-income countries at the receiving end. These transmission channels include:

- Trade (e.g. through changes in comparative advantage and knock on impacts transmitted via real exchange rate changes);
- Private capital flows (e.g. FDI)
- Development Finance (e.g. ODA, innovative financing mechanisms)
- Technology flows

This will then affect trade, production and technological patterns differently in different countries. The economic effects will vary by country depending on:

- Economic structures (e.g. share of trade and investment in the national economy);
- Environmental profile (oil production, carbon intensity of production structure, etc)

The ultimate impact then depends on:

- Complementary policies (e.g. ability to introduce labelling; ability to use imports efficiently, ability to increase production of environmental goods); and
- Complementary institutions (e.g. investment climate, flexibility in adapting to change).

A summary table is provided at the end of the section.

The report excludes consideration of issues such as official development assistance, as that is not a mitigation policy as such, although we do consider the economic impact of publicly funded financial flows made available through REDD+ for example. Going forward, ODA may be increased both for adaptation and mitigation purposes, though it may also be diverted away from traditional development objectives, and may be made contingent on developing countries' own mitigation efforts and commitments.

The report also excludes analysis of migration as a possible transmission mechanism. This is because the existing literature mainly relates migration to the impact of climate change itself, rather than mitigation policies; it would be difficult to hypothesise about how mitigation policies may affect migration in any meaningful way.

Carbon taxes

A carbon tax raises the cost of fossil fuel based energy usage, thus shifting patterns of demand towards relatively environmentally friendly and energy efficient technologies. A general carbon tax on fossil fuels will raise production costs, particularly for energy intensive industries. Thus a carbon tax on developed country production will increase the cost of carbon intensive imports into developing countries from developed countries.
This could have negative welfare consequences.

For example, it could potentially drive up the cost of steel and cement (both of which are energy intensive products), which would raise the cost of construction in developing countries which import these goods, making infrastructure development more expensive. However, if in developing countries there is a high elasticity of substitution between energy intensive and non energy intensive goods. A carbon tax in abating countries that is reflected in higher prices for energy intensive products may shift the import mix towards non energy intensive goods sectors. Or if there is a high elasticity of substitution between domestically produced and imported goods in developing countries, a carbon tax in abating countries will push up domestic production in developing regions. (More detailed quantitative modelling could be undertaken to examine these effects more closely.)

So this represents both a risk and an opportunity for developing countries. While it will push up import costs, thus reducing welfare in some countries, it may also shift comparative advantage towards developing countries, as they become relatively more competitive than developed countries who have imposed the tax.

Thus there is scope for ‘carbon leakage’ (where mitigation measures in some countries cause an increase in carbon usage in other countries) to occur, whereby production of goods – particularly energy intensive goods - shifts to countries which are not imposing the carbon tax, and whose production costs are therefore lower. This implies that energy intensive industries may relocate to countries without a carbon tax, in order to avoid becoming uncompetitive.

For developing countries which do not face stiff emissions reductions requirements and thus do not need to impose a carbon tax, such carbon leakage may represent an opportunity for increased exports and FDI, with the associated beneficial economic spillovers this brings. However, it would also imply an increase in the proportion of ‘dirty’ industries in these countries, which may store up problems for the longer term, including increased pollution, and higher future mitigation requirements. In a world where low carbon growth paths are becoming increasingly important, and where the international community is likely to design various economic incentives to reward it, a growth strategy based around carbon leakage-driven FDI in dirty industries may not represent the best option in the long term.

The wider the coalition of countries adopting a carbon tax, however, the lower the scope for this kind of carbon leakage. The evidence on the potential scale of such carbon leakage provides a very wide range of estimates of the likely impact, as it depends on a large number of factors and assumptions. It is most likely to affect energy intensive industries for whom the price of carbon

will be a larger proportion of overall costs, such as aluminium, cement and steel, though it will also depend on how easy it is for such industries to relocate to other countries. Some studies suggest that as carbon costs are in fact a relatively small proportion of overall costs, the potential incidence of carbon leakage is relatively limited.

It is possible that border tax adjustments (BTAs) would be introduced by countries alongside a coordinated carbon tax (or other mitigation policies that would reduce the competitiveness of domestic industry), to prevent such carbon leakage (see next section). This would reduce the competitiveness of exports from countries which had benefited from carbon leakage, thus offsetting the potential economic benefits.

If dirty industries do decide to relocate to avoid the imposition of a carbon tax, they will aim to move to countries where production costs are lowest. Thus countries with a poor investment climate, and high cost of doing business are unlikely to attract much of this new FDI. It is likely to go to countries with a reasonably good investment climate – which is most likely to be MICs, or the best performing LICs. Thus the benefits of carbon leakage-driven FDI could be concentrated in a few developing countries – the ones with the most business-friendly economic environment.

Of course, carbon taxes and other mitigation policies will potentially affect patterns of comparative advantage in a myriad ways. By raising the cost of carbon, mitigation policies may cause a shift in the structure of production, (i.e. in the most efficient combination of factors of production required to produce a product), which means that some countries gain a comparative advantage in the production of that product where they didn't previously have one. For example, if agricultural production is more carbon intensive in country x because it relies on mechanised production processes requiring fuel, then an increase in the cost of carbon may cause a shift in the most efficient method of production towards less mechanised, more labour intensive methods. This means that country y, which is better endowed with cheap labour than country x, may find it can now outcompete country x in the production of that good. In general, countries will enjoy an increased comparative advantage for products in which local production is less energy or emission-intensive than production of the same good in other countries, and reduced comparative advantage where local production is more emission-intensive.

This will have knock on impacts on other sectors of the economy, through the impact on the real exchange rate. If, ceteris paribus, there is lower demand for emission-intensive exports, this will result in a real effective exchange rate depreciation[13]. This could generate benefits for other export-oriented and import-competing industries by improving their competitiveness.

However, such market impacts must be assessed on a case by case basis, as the potential impact will depend on a range of factors. For example, it may be that in some markets, labour intensive methods of production are more energy efficient than capital intensive forms of production. If that is the case then the introduction of carbon taxes or other mitigation measures will shift comparative advantage in the production of these goods to countries which are better endowed with labour as compared with countries who are better endowed with capital. In this situation, developing countries which are relatively well endowed with labour could potentially

[13] If the exchange rate is floating this will occur through a change in the exchange rate, but if the country has a fixed exchange rate, this will occur through domestic price changes – either way the effect is the same. However, under fixed exchange rates, central banks may need to intervene directly on the foreign exchange market in order to keep the exchange rate fixed in the face of these changes in comparative advantage.

gain new export markets, which could facilitate expansion in domestic production, generate new jobs and sources of foreign exchange, and underpin growth.

For example, this may happen in relation to some agricultural markets, where highly mechanised forms of production may be highly dependent on fossil fuels. When the price of oil rises, the cost of producing a crop in this way may become higher than the cost of producing it in a more labour intensive way. Where that is the case, countries with lots of cheap labour may find they can now undercut similar products from countries which use capital intensive methods of production.

According to a report by the Environment Department of the OECD (2001)[14], the impact of a carbon tax will vary depending on various factors including:

- The market structure / degree of monopoly power that exists in an industry
- The price elasticity of demand associated with goods affected
- The ease with which a firm can shift to low carbon fuel sources thus avoiding the tax
- The extent to which carbon tax revenues are used to subsidise affected companies, or subsidise green inputs, or reduce other taxes, in which case the impact of the carbon tax could be neutralised.
- The proportion of costs that the carbon tax represents. Carbon taxes tend to be higher for sectors and countries showing the highest carbon and energy intensity, but empirical evidence for OECD countries shows that the cost increase associated with a $100 per ton carbon tax is usually fairly small, within the range of around 1 – 5% of production value (see Table 1).

Table 1: Selected OECD countries' cost Increases from a tax of US$100/ton carbon (as % of production value)

	Total energy intensive industries	**Iron and steel**	**Non ferrous metal**	**Chemical**	**Pulp and paper**
USA	2.8	2.3	3.1	2.8	3.2
Canada	4.1	6.2	3.7	4.1	5.0
Japan	1.2	2.0	0.7	1.0	0.6
Australia	5.2	5.8	11.4	1.7	2.6
France	1.4	2.4	1.4	1.3	0.6
Germany	1.6	2.6	1.2	1.4	1.0
UK	1.6	3.6	1.9	1.2	1.2
Italy	1.4	2.0	1.1	1.3	0.7
Belgium	2.3	7.3	40.8	1.6	0.6

Source: OECD 2001

Another potential impact arising from the imposition of a coordinated carbon tax (or other significant mitigation measures) by some countries, relates to the reduced demand for fossil fuels this will generate, which will drive down the price of fossil fuels. This will benefit net fossil

[14] "Environmentally Related Taxes in OECD Countries: Issues and Strategies" OECD, 2001

fuel importers, but will generate a loss of income for net fossil fuel exporters. By reducing the price of fossil fuels, carbon taxes and other mitigation measures will permit an increase in the consumption of fossil fuels, especially in fossil fuel importing countries which do not have these carbon taxes or other mitigation measures in place. This represents another form of 'carbon leakage'. In this case, the wider the coalition of countries adopting a carbon tax, the greater the potential downward impact on fossil fuel prices and the greater the welfare benefits for non participating countries. A lower energy price in these countries will generate a short run welfare gain, though it may also reduce incentives for energy efficiency and green energy technologies, which could have detrimental long run growth impacts.

A carbon tax also generates revenue for the government. How this is used will also determine the overall economic impact of a carbon tax. For example, if a decision was taken to spend all or some of the money that was generated by an internationally coordinated carbon tax on a fund for adaptation, mitigation or low carbon growth policies in developing countries, this could clearly generate significant development gains. However, the hypothecation of taxes in this way is very unlikely. Nonetheless, the fact that tax based mitigation measures generate revenue for government unlike some other forms of mitigation policy, is an important factor to be considered when governments are choosing between alternative policy packages.

Transportation taxes

Air transport taxes, or passenger duties, are a form of indirect carbon tax that is being discussed, and has been introduced in some countries, including the UK. They may be aimed at reducing the number of flights, or increasing incentives for fuel efficiency, so as to reduce energy consumption and emissions.

Their efficacy has been questioned however, with some arguing[15] that the price elasticity of demand for flights is low, in which case it would generate considerable revenue, without resulting in any significant reduction in flights.

If they are effective, or set very high, and adopted on a wide basis so as to significantly reduce the demand for long haul flights, then developing countries which previously benefited from tourism from the developed world could suffer economic losses as a result of these mitigation policies.

The impact will vary, however, depending on a country's location, and scope to benefit from any shifts in demand. For example, while holiday destinations in the Caribbean may suffer a drop off in demand from vacationers from Europe, this may be offset to some degree by an increase in demand from Americans, as they reduce their demand for long-haul flights to more distant holiday destinations. Holiday destinations which are more isolated, or a long way from the richest markets, such as French Polynesia or Mauritius, may suffer the most.

Similarly, if air transport taxes affect the cost of air freight then developing countries which export goods by air (e.g. perishable goods such as fresh fruit and vegetables) could also find their exports become less competitive, which could reduce demand for their produce, potentially reducing growth in this sector.

[15] Oxford University (2005). "Predict and Survive: Aviation, Climate Change and Policy", Report. Greener by Design (2006 – 2007). "Air Travel" Annual Report.

A number of global aviation industry associations have recently made a commitment to several targets to improve fuel efficiency, stabilise carbon emissions by 2020, and cut carbon emissions in half by 2050 compared with 2005. They are seeking recognition of their targets and the agreement of governments to a global sectoral approach under the leadership of the International Civil Aviation Organization (ICAO) and in coordination with the UNFCCC.

They are also requesting that the industry has access to global carbon markets to offset their emissions, until technology can provide the ultimate solution. It is possible that this self regulating approach is being promoted by the industry as an alternative to a government mandated carbon tax.

There have also been some proposals for the introduction of a bunker fuel tax on shipping. Raising the cost of shipping could at the margin reduce the overall volume of trade. However, the overall impact would depend on the way in which the revenue raised was used. Denmark's recent proposal for a bunker fuel tax was based on the premise that all proceeds should be spent on mitigation and adaptation activities in developing countries, as well as research and development projects focusing on increasing the energy efficiency of shipping[16].

Emissions trading schemes

As noted in the main report, emissions trading schemes are an alternative to carbon taxation as a means to drive up the price of carbon. As they are to a large extent different ways to achieve the same objective, many of their effects are also the same as a carbon tax. However, because they allow trade in emissions permits, and thus facilitate the efficient allocation of abatement opportunities, (rather than requiring the same degree of abatement effort across all companies or countries regardless of the associated costs), they provide a way to reduce compliance costs associated with emissions stabilizing policies.

So those countries participating in an Emissions Trading Scheme (ETS) can expect a given level of mitigation to cost less than if they were outside the ETS. It is this marginal impact of an emissions trading scheme that we consider here, as the main direct impacts of carbon pricing have already been considered above in relation to carbon taxation.

All countries participating in emissions stabilizing policies will gain from trade as compared with a situation in which all countries are committed to reduce emissions but cannot trade. The distribution of those gains between countries will depend on the pattern of emissions, the national emissions caps, and the abatement cost structure.

For a given level of overall global mitigation, the existence of an ETS also means that more mitigation will take place in countries which have relatively low abatement costs. Thus it seems likely that if MICs (which tend to have lower abatement costs than HICs) become part of an ETS, then more mitigation will take place inside their borders (because it is being paid for by other countries who are buying emissions permits from them) than would otherwise be the case.

(As LICs are unlikely to sign up to binding commitments in the medium term, they are unlikely to be able to join an ETS. If MICs join an ETS, it is possible that this would increase HIC-funded abatement in MICs, to the detriment of HIC-funded abatement in LICs through the CDM.

[16] See http://www.lloydslistdcn.com.au/archive/2009/may/weekly-edition-7th-of-may-2009/denmark-floats-idea-of-global-bunker-fuel-tax

However, this may be offset by the increased focus on reforming CDM for the benefit of LICs, given that MICs will no longer be part of it, and may be looking for offsetting opportunities themselves. In the scenario analysis, we have assumed the latter effect dominates.)

The impact of this greater mitigation on growth is unclear. Mitigation can create a growth stimulus e.g. if there is fast growth in the demand for environmental goods and services for example, or if there are strong synergies between green technological change and general technological progress (a key source of growth). It will also generate greater FDI inflows, with associated benefits through spillovers and capital accumulation.

Economic benefits (in terms of lower mitigation costs) deriving from the emissions permits market, may be reduced if the market does not work well. For example, asymmetric information and transactions costs (such as the cost of searching of commercial partners, and the cost of monitoring the market), could reduce the efficiency of market outcomes.

As noted earlier in the report, emissions stabilizing policies generate a gain for fossil fuel importers and a loss for fossil fuel exporters in a world with an open economy, as they dampen demand for fossil fuels and hence drive down the price. When an emissions permits market is created, abatement costs are lower and this leaves more resources available for other economic activity, thus partially mitigating the energy price fall. Thus fossil fuel exporters lose less than they otherwise would, and fossil fuel importers gain less than they otherwise would.

Table 6: Consequences of the introduction an emissions permits market for developing countries – estimates from various papers

	% Welfare impacts for energy importing developing countries, where there is no emissions trading among Annex I regions	% Welfare impacts for energy importing developing countries, where there is emissions trading among Annex I regions	% Welfare impacts for energy exporting developing countries, where there is no emissions trading among Annex I regions	% Welfare impacts for energy exporting developing countries, where there is emissions trading among Annex I regions
Babiker, Really and Jacoby	0.55	0.52	-10.80%	-7.34
Bernstein et al.	+0.02	-0.03	-1.39%	-1.06
Burniaux and Truong	0.24	0.18	-1.00	-0.55
Boringer and Loschel	0.45	0.33	-0.54%	-0.10

Source: Galeotti and Buchner (2004)

A global emissions trading market involving both Annex I and non Annex I countries generates a benefit for all countries if compared to a scenario in which an emissions permits market is not introduced. For illustrative purposes, we ran a simulation based on the RICE99 (Nordhaus and Boyer) model. The emissions permits market is introduced by an algorithm as in Bosetti et al. (2006). Assuming a scenario in which Annex I countries commit to keep over time the same level of emissions as agreed under the Kyoto Protocol, and non Annex I countries stabilize emissions in 2035 at the 2025 level, the results show that consumption will be reduced by 2% in low income countries, in the absence of a global emissions permits market, whereas it will only fall by 0.4% if there is an emissions permits market (see Table 2).

Table 2: Loss of consumption from mitigation policies in 2055

Kyoto constraint for Annex I countries forever. Developing countries stabilize emissions in 2035 at 2025 levels	Loss of consumption for low Income countries
No implementation of a global emissions permits market	2%
Implementation of a global emissions permits market	0.4%

Source: ODI (2009)

One possibility that has been proposed is that Annex I countries could use a share of their gains (in terms of reduced costs of mitigation) from emissions trading to provide financial aid to developing countries for adaptation or low carbon growth purposes. This would clearly alter the overall distribution of gains from an ETS.

The inclusion of large MICs such as China in emissions trading schemes could have significant impacts on the price of carbon. China recently announced that it plans to introduce a domestic emissions trading scheme. Until now, China has been a seller of carbon credits, allowing western companies and nations to offset their emissions by buying up the credits generated by environmental schemes in China. But under a domestic emissions trading scheme, China's supply of carbon projects could be substantially redirected to satisfy domestic demand, and this could lead to a shortage which would increase the price of carbon credits in Europe[17]. A higher carbon price would strengthen incentives for low carbon technologies and innovation globally, as discussed further below.

Border tax adjustments

As noted previously, BTAs are not mitigation policies per se; they are introduced alongside mitigation policies such as carbon taxation and emissions trading schemes, to offset any negative impact on domestic competitiveness. Below we consider the impact of a BTA as compared with a situation in which mitigation policies are introduced without accompanying BTAs.

The impact of BTAs will depend on how they are designed and implemented. Table 3 below shows the current proposals being made by the EU and USA for BTAs.

Table 3: US and EU proposed BTAs related to climate change mitigation policy

Country	Legislation proposed	BTAs included	Sectoral coverage/ Exemptions	Effective from
US	US Clean Energy and Security Act 2009 (Waxman-Markey House Bill)	Requires some importers of heavily traded energy-intensive products to purchase emissions allowances, a measure tantamount to a tariff. Energy intensive and trade exposed industries are allocated a percentage of total allowances (free) from 2014 (to be further reviewed in 2025).	Sectoral coverage: Criteria developed which includes energy intensity and trade exposure. Exemptions include: • Exports from LDCs; • Countries that account for less than 0.5% of global emissions (so long as they account for less than 5% of US imports in the sector in question; If the GHG or	2014 – 2025, if agreed

[17] The Palestine Telegraph, 28 September 2009, available at: http://www.paltelegraph.com/economics/world-economics/2427-china-and-emissions-trading

		The US House of Representatives inserted a provision in its draft climate bill that allows the country to impose a 'border adjustment' after 2020 on certain products from countries which do not limit their global warming emissions (including non Annex 1 countries).	energy intensity of the sector of imported product is equal to or less than the US; and / or • If 85% of the product comes from a country with a binding emissions target or lower energy intensity than the US.	
EU	Energy and Climate Change Package inc. revisions to the EU-ETS 2008	The allocation of free carbon permits, post 2012, for industries considered to be at risk of carbon leakage.	Those industries that are considered to be at "significant risk" of carbon leakage i.e. if the sum of direct and indirect additional costs induced by the implementation of the EU ETS directive would lead to an increase in production costs exceeding 5% of its Gross Value Added; and if the total value of its exports and imports divided by the total value of its turnover and imports exceeds 10%.	Effective from 2013, if agreed

Source: ICTSD (2009), EurActiv (2009)

BTAs will increase the costs of imported energy intensive products in countries which impose them, and are thus likely to reduce demand and hence prices received by exporters of these products (depending on the elasticity of supply). BTAs will thus reduce welfare in developing countries which export energy intensive products. However, by shifting the global demand curve to the left, and thus reducing the global market price for such goods, this would increase welfare in countries which import these products but do not impose BTAs (unless exporters can price discriminate between countries).

To some extent the imposition of BTAs may only be offsetting an artificial competitive advantage that was being given to developing countries as a result of mitigation policies in HICs. But in some cases it will be generating a net loss (for example, where the developing country is unilaterally pursuing mitigation policies which are pushing up the costs of its own energy intensive industries). BTAs will also prevent developing countries from benefiting from any new export markets that might have been created through carbon leakage.

It has also been argued that the potential impact of leakage and loss of competitiveness are exaggerated (OECD 2009, Groser 2009, Wilcoxen and McKibbon 2008). Typically studies show that only around 0.5-2% of post-industrial countries' national GDP are exposed to significant increases in production costs from the imposition of a carbon cost; this suggests that loss of competitiveness arising from mitigation may not be an especially large problem for developed countries (OECD 2009b[18]). However, analysis within a general equilibrium framework overlooks the potential impact of leakage on a particular sector and firms within it, (as well as their political

[18] OECD (2009b) Competitiveness, Leakage and Border Adjustment: Climate Policy Distractions? Round Table on Sustainable Development, http://www.oecd.org/dataoecd/23/20/43441650.pdf

clout). Claims that firms will struggle with impaired competitiveness as a result of government policies are not new and have frequently led to a dilution of political ambition and reduced the effectiveness of climate policies (OECD 2006[19]).

Cosbey (2008)[20] posits that the following types of sectors will be the most vulnerable to climate change related BTAs:

- those that use large amounts of energy in the production process;
- those for which there are easy substitutes, either in the form of imports of the same good or in the form of different goods that can serve the same purpose; and
- those for which there are no cost-effective alternative technologies available, i.e. it is not easy to substitute existing methods of production and technology.

The following sectors are considered the most vulnerable: chemicals, iron and steel, cement, glass, lime, pulp and paper, and non-ferrous metals.[21] Thus developing countries which export these kinds of products will likely suffer the biggest losses as a result of BTAs. This is likely to include MICs such as China, Brazil, Russia and South Africa.

LICs may well be exempted from many kinds of BTAs, but even if they are not, MICs are likely to be much more affected by BTAs than LICs, since LICs are primarily agricultural societies with a generally low level of energy intensity, and they produce and export much less of the kind of energy intensive products that will be targeted by BTAs. The existence of BTAs would, as intended, prevent non mitigating countries from benefiting from carbon leakage i.e. new FDI opportunities in energy intensive industries that would otherwise be looking to relocate to countries with less mitigation-related regulation and taxation. The poor investment climate of many LICs is also likely to minimize these kinds of carbon leakage opportunities anyway.

Scenario 2 is likely to be more disadvantageous for MICs than scenario 3, as all HICs are imposing BTAs against them in a coordinated fashion, whereas in scenario 3 the BTAs are imposed in a more ad hoc fashion, and not all HICs impose them, and there is some uncertainty relating to their legitimacy under the WTO. Whether or not scenario 1 is better or worse for MICs than scenario 2 depends on whether the costs of mitigation exceed the costs of the BTAs. This is a complex question with many unknown parameters, which will vary considerably by country. However, more detailed modelling could potentially establish the threshold level of mitigation that would be required to make scenario 2 more advantageous for MICs than scenario 1.

While LICs are exempted from BTAs in the coordinated response envisaged under scenario 2, and hence may be able to benefit from some degree of carbon leakage, they may not be exempted under scenario 3, at least in relation to some countries' policies. In scenario 3 they may also suffer from BTAs imposed by MICs, not just HICs. So for LICs, scenario 3 is likely to be the most disadvantageous. Scenario 1 is likely to be the best from their point of view, as there is scope for them to benefit from carbon leakage from both HICs and MICs, though their ability to benefit from this will depend on their investment climate and business environment.

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[19] OECD (2006) The Political Economy of Environmentally Related Taxes, http://www.oecd.org/dataoecd/26/39/38046899.pdf

[20] With reference to the OCED (2006) and Carbon Trust (2004).

[21] Though more analysis is needed, for example, see Quirion (2008): http://www.enseignement.polytechnique.fr/economie/chaire-business-economics/091508/Presentation%20Philippe%20Quirion.pdf

Only countries which are net importers of the products affected by BTAs, and which stood to gain little from carbon leakage anyway (which is perhaps most likely to be the case for some LICs) may gain overall from the imposition of BTAs in scenario 2 (and to a lesser extent in scenario 3), because of reduced import prices.

Clean Development Mechanism

Offsetting through the Clean Development Mechanism (CDM) can take two basic forms: arms-length trade of Certified Emission Reductions (CERs) or direct production of CERs through FDI (or other forms of equity investment) in CDM projects. In the case of arms-length trade, low-income countries might gain from the improved environmental management this incentivises (e.g. through the implementation of forest management schemes to get the credits) and more energy efficient production, whilst the foregone revenues, e.g. from not using the forest for logging, will be outweighed by the increases in finance it receives from selling the CERs to countries with emission reduction targets. In the case of direct production of CERs through FDI, there are also benefits associated with increased investment, capital accumulation, and technology transfer and productivity spillovers, which can stimulate growth. The degree of technology transfer depends on a range of things including the type of FDI, the extent to which local labour and suppliers are used, the level of human capital in the country, and the ability of the host country to absorb and replicate those technologies.

The abatement opportunities in a particular country will clearly have a significant impact on the extent to which they are able to benefit from increased trade and capital inflows through the CDM. The extent to which CDM-funded abatement opportunities are taken up in particular countries will also depend on the openness and investment climate in that country, which will determine the potential return to investment on CDM projects. Thus countries with high levels of carbon assets and abatement opportunities eligible for funding under the CDM, and with good investment climates, are likely to benefit most from the CDM.

MICs tend to have more and cheaper abatement opportunities and larger eligible projects, than LICs. They also tend to have a better investment climate than LICs. For all these reasons they are currently benefiting the most from CDM funding.

LICs will be able to benefit more if the scope of the CDM is widened to include abatement opportunities which they have relatively more of (e.g. land-use sources and sinks). But even if the coverage is widened, the extent to which any new abatement opportunities are taken up, will depend on their attractiveness (in terms of rate of return, and carbon credits) vis-à-vis other existing abatement opportunities. Thus just extending the coverage of the CDM by itself may not be enough to ensure much greater benefit to LICs, until other more lucrative abatement opportunities in MICs are exhausted.

If MICs sign up to emissions reductions targets themselves, and are no longer eligible for CDM funding, (as envisaged in our scenario 1), this may not necessarily result in increased CDM funding for LICs, as HICs could continue to offset through Joint Implementation in MICs, thus benefiting from the same, relatively low cost abatement opportunities in MICs that were previously available through the CDM. However, if MICs block Joint Implementation because they want to use these low cost abatement opportunities themselves, then HICs are likely to be looking for more offsetting possibilities through LICs, and thus there is likely to be more

pressure to reform CDM in order to increase the coverage in LICs' favour. This may be the best outcome for LICs in terms of CDM benefits.

Outcome 1: CDM business as usual

If the CDM remains as a project-based system with no reforms, there appears to be some consensus that its overall penetration will remain a relatively low proportion of overall emissions reductions. According to the World Bank (2008) trade in CERs remains very small compared to what is needed to avoid dangerous climate change: volumes traded are only around 4% of what is needed, of which CERs issued through the CDM account for around half. The significant difference between what is needed to be mitigated and traded is largely due to various impediments that currently limit the scale of the CDM in its current modality (and for the first commitment period of the Kyoto protocol). Thus the impact of the CDM could be enhanced greatly by the kinds of reforms discussed above.

In 2007, the CDM saw primary transactions worth US$7.4 billion and was estimated to have leveraged US$33 billion (€24 billion) in additional investment for clean energy (Capoor and Ambrosi 2008). As of August 2008, over half of all registered projects were based in either India (30%) or China (22%) with only 2% located in sub-Saharan Africa. The UNFCCC reviewed the technology transfer claims of the existing CDM and found that 36% of the 3296 registered and proposed CDM projects claim some technology transfer, representing 59% of annual emissions reductions (Seres 2008).

Thus it is clear that while CDM is increasing private mitigation finance, impact is much less than it could be with reform of the CDM. MICs are currently benefiting the most, through both capital inflows and technology transfer. LICs stand to gain relatively little from the CDM going forward, unless it is reformed to widen the scope of activities covered, and make to it easier to access project funding.

Outcome 2: Reforms to the rules governing what activities can be carried out under the CDM

Changing the rules that govern how projects are approved and carried out should facilitate greater investment through the CDM, by reducing existing barriers, such as the time taken for projects to reach registration and high transaction costs in implementing complex methodologies. It will also open up more opportunities for LICs to benefit from FDI and technology transfer through the CDM. However, there is currently no reliable information on how much of a barrier these rules currently are, so it is not possible to estimate the extent of these changes.

The expansion of the scope of CDM eligible activities could open up opportunities for private investment in both MICs and LICs. The inclusion of REDD, SFM and soil carbon might be expected to have the largest implications depending on the rules of operation that are established. If they were to be included, LICs with high deforestation/degradation rates would be expected to attract most investment (though other factors such as governance would play a role in the likelihood of investment), as would those with high soil carbon.

If some REDD, SFM and soil carbon abatement opportunities are cost-efficient compared to other CDM options, then depending on how low the limits to offsetting by Annex 1 countries are set, there will either be an overall increase in CDM funding provided, or there will be some shift in investment away from CDM recipient countries that currently have high numbers of CDM projects, to countries with these land-use-related abatement opportunities.

Outcome 3: Sectoral CDM

The types of sectors that could be included in sectoral CDM approaches will govern the distribution of investment. In the short to medium term (to 2025) such approaches will be particularly appropriate for countries with large scale heavy industries, and therefore much more likely in emerging economies such as China and India. Sectors that would be most likely to be included are: cement, iron and steel, aluminium, pulp and paper, refineries, electric power, upstream emissions of oil and gas production (e.g. gas venting and flaring), and possibly transport. As the quality of measurement, reporting and verification systems improves, other sectors could be included.

Emissions in these sectors are very high, so there is substantial technical potential to use the CDM as an investment option. Thus if sectoral CDM approaches are adopted, these may swamp alternative CDM opportunities, and thus crowd out smaller, more expensive investment opportunities of the kind that may be available in LICs (particularly if land-use sources and sinks – which may be the cheapest and largest of the abatement opportunities in LICs - remain excluded from the CDM). Thus sectoral CDM may benefit MIC recipients to the detriment of LIC recipients of CDM funding.

It is unlikely that forestry (REDD) and agricultural sectors will be included in market-based sectoral-crediting approaches in the short term, given the complexities of establishing reference levels and measurement, reporting and verification procedures.

Outcome 4: Fragmented CDM type mechanisms

Under such an outcome, different CDM type mechanisms would be implemented by different regions, each with slightly different design which would increase the transactions costs of engaging with them, and reduce their efficiency in terms of allocating mitigation. The overall scale of impact would depend on the way they were designed.

REDD+

REDD+ has the potential to generate significant financial inflows for certain developing countries, which if used judiciously, could contribute to higher levels of growth and welfare. However, the long term domestic economic and distributional impacts of these inflows will depend heavily on the way the funds are used, and on standards of governance in each individual country. Large financial inflows can also create risks of Dutch Disease, which should be mitigated through careful macroeconomic management.

In terms of the likely international distribution of financial flows generated by REDD+ the following observations can be made:

Under REDD+, public investment will be motivated primarily by the need to achieve demanding targets and hence will focus on countries able to deliver forest-sector emissions reductions on a large scale and at low risk. Private sector investments will be motivated by price, risk and transaction costs. This implies a bias against smallholder / community activities. Investors will be drawn to low governance/high-risk environments only as a cut-price option; the low risk options are more likely to be in S. America or E.Asia than Africa or SE Asia.

As the CDM has shown, any fungibility between MIC and LIC implementation will be to the detriment of LICs. Annex 1 investors are likely, if given the choice, to favour MIC over LIC investments, and hence MIC eligibility for any available finance can be predicted to have a negative effect on LIC uptake, unless the LIC price is substantially more attractive.

Rules such as limits on the trading of forestry credits in emissions trading schemes, and on measurement, reporting and verification systems and reference levels, will also affect the level and pattern of supply of REDD projects.

A: Business as usual

Under this scenario, finance into the sector is likely to be only slightly higher than today, so this is the least positive outcome for MICs, and probably also for LICs. Because of the low levels of finance, it is unlikely that forest governance in most low governance REDD+ countries will be substantially reformed. More likely is further erosion of access rights of poor people to tropical forests, with (as now) rent-seeking by officials often substituting for environmental change. Politically important countries may be exceptions to the rule (Brazil, Indonesia, Uganda and Ghana, for instance), and they could draw in a relatively high proportion of the available funds. However, overall this would contribute to a general decline in the importance of the industrial forest sector, and its potential for value added.

With the continued pressure on industrial logging, there could be some potential for community-based ecolabelled forest enterprise to develop with REDD finance, though only as a small-scale niche market.

B: Compromise deal

The main difference between this and a market led deal (policy outcome C) is that funding is provided at scale from an early stage through public (or market-linked) financial sources and mechanisms. Thus the eligibility requirements for accessing REDD+ funding are likely to be less stringent and the scope of the mechanism may be broader. This could facilitate participation across a wider set of countries.

The prospect of significant financial inflows for REDD+, combined with the increasingly unfavourable market for native timbers from old growth forests, moves governments of forest-rich countries to consider other policy options than traditional industrial logging under state-managed tree tenure. Under this scenario, REDD+ offers the prospect of sufficient finance to cover potentially transformational investment programmes.

The LIC reformers: In some cases, there could be major incentives for radical tenurial reforms leading to increased investment on the land, and incentives to conserve and plant trees on-farm and in fallows. This could give a real stimulus to the national economy and to pro-poor growth. A spin-off effect would be that these societies become more favourable for aid funding, due to their much improved governance, though the implications of this would depend on the extent of aid diversion towards climate change and away from traditional development assistance. Overall, this would be best for adaptation too, in that LICs are predominantly agrarian societies that would benefit from the improved condition of the forest.

The reformers are most likely to be countries which are towards the centre of the Forest Transitions Curve (i.e. approaching crisis). Those to the left of the curve (forests not under great threat) are unlikely to see much need for change, and will probably be able to achieve adequate performance without it.

The Non-reformers: In other cases, the impact is more repressive, leading to increased corruption, limited financial flows to the actual forest managers, and possible exclusion of poor people from forests. In this case, the forest sector continues to provide an unfavourable environment for external investment. Carbon markets largely avoid these countries as they are deemed too risky. Cash transfers provide limited compensation, and have major inflationary tendencies. The gap between reformers/non-reformers could well increase, both in terms of economic performance and financial inflows.

MICs: The main beneficiaries could well still be MICs, with LICs experiencing fewer major transformational effects. This is because finance may still be likely to be concentrated in MICs which can deliver substantial emissions reductions in the short term and at minimal cost. The MIC group could also increasingly be split between the forest-rich (e.g. Brazil and Indonesia) and the rest. MICs that meet eligibility requirements to access market systems (such as Brazil) may also benefit more in the medium term from higher levels of finance associated with market mechanisms.

There are risks associated with the potential impact of significant flows of new financial resources into countries with sizeable carbon assets. Resource rich commodity exporters may experience ‘Dutch Disease’ if they are unable to absorb and effectively use significantly increased flows of funds. This is because the inflows of foreign currency could lead to an exchange rate appreciation, which would reduce the competitiveness of tradable goods, thus damaging prospects in some sectors of the economy.

The negative effects of Dutch Disease can be avoided by spending the money wisely e.g. through judicious economic management that focuses on diversifying the economy, investing in human and physical capital, and a certain amount of capital ‘sterilisation’. Unfortunately, many emerging economies experiencing major windfall gains from the discovery and subsequent export of ‘new’ resources have economic management systems that are too weak to mitigate the negative effects of Dutch Disease. In such cases, the discovery of such ‘new’ resources can become more of a curse than a blessing.

This suggests that particular attention should be paid to the development of mechanisms for accountability and transparency in the use of funds generated through mechanisms such as REDD+, along with sound macroeconomic and public expenditure frameworks for countries which are likely to benefit from these kinds of large inflows.

C: 'Fast track' to markets deal

The main factors that affect engagement in market systems will be the ability to accurately monitor and report on emissions reductions, and the degree of investment risk. This means that REDD+ under this scenario is likely to be significantly to the advantage of MICs. By and large, LICs with large forest cover lose out on carbon markets (as they suffer from poor governance and hence are too risky), and have to depend largely on fairly low-level aid transfers, (as they do at present), both official and non-official (private/NGO voluntary offsets and other NGO).

REDD+ may have higher positive impacts in LICs with more limited forest cover but better governance (Ghana, East African countries, etc.), though the key issue in several cases will be whether the incentive effect is enough to encourage governments to undertake the major tenurial reforms that are needed to address DD problems. With only medium financial flows, this is unlikely. There may be some potential for REDD+ to support sustainable forest management, but within the overall industrial model.

Because of the lower abatement costs associated with REDD+ actions, carbon market investments may shift from MICs that currently benefit most from the CDM (India and China) towards MICs with high emissions reduction potential from forests, though this depends on the overall targets and the ability to supply compliance grade REDD+ credits.

Because it is difficult to monitor emissions reductions from degradation, soil carbon etc. it is likely that the scope of REDD+ remains focused on deforestation for at least ten years in most countries. Countries that may have potential to benefit from trading other emissions sources from the land use sector (e.g., soil carbon) would be left out of such systems.

Thus it appears that scenario 2 is best for both MICs and LICs, as it facilitates financial flows through REDD even before monitoring and market mechanisms have been developed. Scenario 1 is better for MICs than LICs as they will be better placed to take advantage of market mechanisms, with the greater capacity requirements they entail. Scenario 3 is worse for MICs as compared with other options, though how it compares with scenario 1 for LICs is unclear.

Liberalising trade in environmental goods and services

The liberalization of trade in environmental goods and services (EGS), could generate benefits for developing countries both in terms of new export markets and cheaper imports which will help facilitate low carbon growth.

In general, most developing countries are net importers of environmental goods, though there are some areas where developing countries are major producers and exporters, most notably[22]:

- China and India are leading producers of wind energy and wind energy manufacturing equipment;
- China is a major exporter of solar photovoltaic technologies; and
- Brazil is a world leader in the manufacture of biofuels and related technologies, such as 'flex-fuel' engines and vehicles.

[22] See ICTSD (2008b).

Liberalization of trade in these goods could generate significant gains for developing country producers. Brazil regards improved market access for products with a low environmental impact, such as biofuels, as contributing to poverty alleviation through income generation and job creation for local populations. It also points out that improved market access for products derived from incorporating cleaner technologies, such as “flex-fuel” engines and vehicles, could also encourage the use of environmentally efficient products and be supportive of the developmental concerns of developing countries, as these vehicles would use fuels obtained from the processing of natural resources in developing countries[23].

As noted by Kirkpatrick (2006), environmental services are considered to mostly concern exports from developed countries; developing countries are generally unclear about where their export interests lie in environmental services, although temporary movement of environmental consultants at least for the more advanced countries could be an area of opportunity.

Developing countries do of course stand to gain from reduced import prices of EGS, to the extent that they import them. However, as noted by Jha (2008), demand in developing countries for EGS imports is currently fairly limited, although liberalisation to reduce the price of such imports, and mitigation policies which raise demand for those imports, could both serve to increase demand in future. Complementary policies would help to maximize the benefits from liberalization – for example, regulatory policies which maximized the transfer of skills and technologies to the local population. Modelling of EGS liberalisation (excluding most agricultural EGS from the definition) is estimated to generate overall gains from trade, though such benefits are identified mainly for larger middle income importers and exporters of such products.

Scenario 1 would be likely to deliver the most gains to developing countries, as it would enable them to increase both imports and exports of agricultural EGS such as bioethanol, which are likely to be of most interest to both MICs and LICs. Scenario 2 would be likely to deliver some gains, although mainly to MICs who can either export, or have effective demand for manufactured EGS. Scenario 3 could potentially deliver more liberalization of EGS of interest to MICs and LICs than scenario 2, if it resulted in a higher level of liberalization of agricultural EGS through bilateral and regional agreements than scenario 2 delivered through a multilateral agreement focused mainly on manufactured EGS. The exact pattern of liberalization would determine its overall impact however.

[23] World Bank (2007a)

Box A1: The impact of US and EU biofuels policy on mitigation and development

The impact of global biofuels policy on mitigation and development is complex. While the promotion of biofuels is often touted as a mitigation measure by the EU and US, it is also motivated by the desire to protect jobs in the agricultural sector, as evidence by the degree of protection afforded to the sector, despite the fact that biofuels production within the EU and US is relatively energy intensive compared with developing countries such as Brazil. This means that mitigation through the protection and promotion of biofuels will be less effective than that promoted through liberalisation.

In addition, subsidized biofuel production in the US and EU contributed to the high food price crisis of 2007, by reducing the proportion of food stuffs sold onto global markets which in turn pushed up prices (Mitchell 2008, Rosenberg 2008, World Bank 2009b). Other papers, however, suggest that the impact of food production for environmental uses was a minor cause of the rise in food prices (Leturque and Wiggins, 2009). Nonetheless, if policy continues to protect EU and US production of biofuels, this makes it more likely that greater biofuel use will result in food prices that are higher than they otherwise would be with significant welfare costs for developing countries.

'Developing countries are heavily affected by global biofuels policies, both as potential producers (for their own use or export) and as consumers (of crops displaced by biofuels and of energy). Because Europe is a major producer of biofuels, with an estimated 10% share of world bioethanol, its policies can have a significant effect on them. Current EU policy, outlined in the Renewable Energy Roadmap, is to promote the use of biofuels and other renewable fuels for transport. But schemes for biofuels will not automatically mitigate climate change, since production also adds to greenhouse gases. If the production of biofuel crops requires heavy use of nitrogen fertilisers or if forests are felled to grow biofuel crops, the net effect could be negative. Similarly, the net effect on any producing country will depend on whether biofuels displace other crops (and which ones) or damage the local environment (ODI, 2007). Even when the net impact is positive there will be distributional effects favouring some producers over consumers (and possibly producers of displaced crops).' (ODI Briefing Paper 32, 2008).

Carbon labelling

The impact of a carbon labelling system on developing countries will depend on how it affects their export opportunities, and how it affects the price of goods in their own markets. If it creates an additional barrier to trade for developing country exporters, this will reduce welfare and income in those countries. This could be the case for exporters of fresh fruit and vegetables from African countries such as Kenya if, for example, 'air freighted' labels are used, and that creates a switch away from such products by consumers (though there is no evidence to date that it does affect consumer behaviour in this way).

Alternatively, it may create new export market opportunities, if developing country goods are less carbon intensive (i.e. under a life cycle approach (LCA) to assessing carbon footprint) than other countries' exports. This may be possible if, for example, labour intensive production methods generate less carbon than capital intensive methods, which developing countries may benefit from to the extent they are relatively well endowed with labour compared with capital. It may also be the case if developing country agricultural production benefits from climatic advantages that make it easier to grow some produce without the need for artificial heating and lighting.

However, as experience with other standards and labels has shown, stringent and complex certification requirements may prove a barrier to market access for developing countries (particularly LICs), unless sufficient assistance is provided to enable them to obtain and maintain certification effectively. In addition, such compliance requirements - to the extent that there are scale economies and upfront costs - may well prove easier or more worthwhile for

large producers to meet, at the expense of small ones, so there may be distributional consequences.

If some developing countries introduce carbon labelling themselves, this may serve to push up costs, to the extent it generates a switch to more expensive but lower emission production methods, or creates barriers to cheaper imports.

Thus the impact of carbon labelling on developing countries will depend on a range of factors including[24]:

- the measure and methodology used to assess carbon impact;
- the carbon intensity of their exports using that measure;
- their ability to calculate and prove their carbon intensity in order to qualify for the label;
- their ability to adapt to changing consumer preferences if necessary; and
- the impact that labelling has on consumer behaviour.

There is little evidence or analysis of the implications of LCA and other measures of carbon impact for trade patterns currently available. However, we assume, as seems possible, that the LCA approach mitigates in favour of developing country exports, whereas the more simplistic approaches tend to mitigate against. If that is the case, then scenario 1 is clearly the most beneficial to developing countries, as their exports will be viewed most favourably under a carbon labelling scheme, and they will also have the assistance they need to obtain certification. For MICs, who would also be implementing a carbon labelling scheme under scenario 1, consumption costs may rise.

Under scenario 2 the opportunities developing countries have through LCA carbon labelling may be lost to some degree, especially for LICs, by their lack of capacity to obtain certification. MICs may find that more protectionist leanings under this scenario, in the design of the labelling scheme etc., will undermine their ability to take advantage of any new export opportunities brought by carbon labelling.

Under scenario 3, developing countries are most likely to lose out because simplistic labelling schemes are employed which are likely to mitigate against their exports, and little finance is available to help them offset these challenges e.g. by developing labels and certification schemes of their own.

Technological innovation and diffusion

Green technological innovation and technology transfer will reduce the cost of mitigation, and make low carbon growth more achievable for developing countries. The impact of green technological progress and transfer on overall growth depends on the synergies between the two. If they are significant, then green technology is itself likely to stimulate general economic growth, as well as making it less carbon intensive.

[24] More detailed scenario analysis and modelling of these particular issues and the impacts on specific developing countries would be possible, based on more detailed analysis of their export profile and methods of production.

Technological progress may also assist with adaptation. This could reduce the cost of climate change for developing countries, thus facilitating future growth and welfare at levels higher than would otherwise have been possible.

A key determinant of incentives to undertake research and development in green technologies will be the carbon price going forward. If the price is low, or is highly unstable, this will reduce incentives for innovation as it reduces the potential return on investment.

There has been considerable volatility in the carbon price in the recent past, with EUA's spot prices at 10 euros per tonne (e/t) of CO2 in January 2005, 22e/t CO2 in June 2005, 13e/t CO2 in the second half of 2006 and below 1e/t CO2 in June 2007 (ECX, 2008). The fall of the carbon price to 8 e/t CO2 in March 2009 induced some to call for a minimum floor price for carbon to be introduced, in order to maintain incentives for green investment and technological innovation. Stringent emissions caps would help to keep the carbon price high, but many other factors (such as economic conditions, climatic conditions and energy prices) can also affect the carbon price, potentially causing considerable volatility. As noted earlier, the introduction of domestic emissions trading schemes by MICs with significant abatement opportunities such as China could help matters as it may result in the substantial redirection of China's supply of carbon projects to satisfy domestic demand, leading to a shortage of carbon credits in Europe, which would drive up the price.

However, there are many other barriers to technological innovation and diffusion, including market barriers (e.g. lack of financial resources and high investment costs), policy barriers (e.g. the existence of laws that are not compatible with mitigation strategies), technical barriers (e.g. shortfall of the necessary equipment to utilise technologies that are developed or transferred), human capacity (e.g. education and training), and institutional barriers (e.g. lack of appropriate policy framework, and of coordination between relevant institutions and organisations).

Some developing countries –especially the MICs - are already undertaking innovation, (e.g. solar photovoltaics in China, bioethanol production and associated technologies in Brazil) and benefiting from it in terms of the export and investment opportunities it generates. However, for other developing countries, especially the LICs, the scope to undertake innovation is much more limited.

The scope to replicate or benefit from spillovers from foreign technological solutions is also likely to be much more limited for the poorest countries, given their limited capacity to adopt, copy or adapt technologies for their own benefit, their likely poor investment climate, and inadequate policy framework which may deter investment into the country in the first place.

HICs are likely to face the strongest incentives to undertake technological innovation, given that they will be facing stronger emissions reductions requirements. Thus it can be argued that for some developing countries, it might make sense to free ride on the innovation undertaken by richer countries, and position themselves to capitalise on these innovations by creating a good investment climate, rather than spending too much money and effort attempting to achieve innovation themselves.

On the other hand, successful innovations could prove very valuable – particularly in a world where the gains from such innovation are protected by intellectual property rights – in terms of securing a new source of comparative advantage, yielding substantial new export markets and investment opportunities, and creating new employment opportunities in green sectors.

It may also be the case that local innovation is likely to be more suited to the level of development and national characteristics experienced in poorer countries, compared with innovation undertaken in much richer countries, which may require higher levels of physical and human capital, and assume different energy sources and infrastructural characteristics.

Under the 3 scenarios, we assume the gains for developing countries reflect the overall level of technological innovation and diffusion generated by each scenario. Thus the gains are greatest in scenario 1, where MICs have strong incentives to undertake innovation themselves given they face binding emission reduction commitments, and where a Multilateral Technology Fund is established under the UNFCCC to fund and assist technology transfer to lower income countries. The gains are lowest in scenario 2, where no such fund exists, and where MICs have less incentive to undertake innovation themselves. In scenario 3, moderate gains are made as more voluntary, bilateral technology agreements are forged as an alternative to a multilateral solution.

Summary of the effects of mitigation policies via the transmission mechanisms

Table 9 below summarises the transmission mechanisms of each mitigation policy.

Table 9: Effects of mitigation policies (in annex 1 countries) on developing countries: '+' indicates positive effect, '-' indicates negative effect, '+/-' indicates indeterminate effect

	Trade	Capital Flows	Aid/Development Finance	Technology	Growth
Carbon taxes	+ Production and hence exports to countries with no carbon taxes (leakage) - slower global growth reducing global trade opportunities overall - Higher price of carbon imports + / - shifts in comparative advantage and knock on impacts on other economic sectors transmitted through changes in real effective exchange rate	+ Carbon leakage increases FDI to countries with no carbon taxes esp. those with a good investment climate - Less investment in carbon intensive industries in mitigating countries	+ If countries with taxes will allocate revenues from a carbon tax to developing countries	+ / - Depends on overall impact on FDI and incentives for low carbon investment	+ / - Depends on impact on FDI, technology transfer & trade patterns
Emission trading schemes Similar impacts as carbon tax plus:	+ Reduced cost of mitigation minimises growth sacrificed and trade opportunities lost ? increases in trade in CERs amongst participating countries, but affect on other trade not clear	+ More investment in abatement in countries with low cost abatement opportunities	+ ETS could be implemented so that a share of proceeds are used as aid flows to poor countries	+ More cross border investment in energy efficiency leads to more technology transfer and productivity growth	+ Faster growth through increased trade, FDI and possibly also aid if revenues are used for that purpose.

Border tax adjustment	- Exporters of products to sectors affected by emission targets in developed countries face loss of export revenues - Lower global growth and welfare due to increased protectionist tendencies. + Reduced import prices for affected products in non-mitigating countries	- Less carbon leakage		- Less technology flows	- Reduced trade, capital flows and technology flows leads to lower growth
Carbon labelling	+ / - Depends on impact on competitiveness which in turn depends on methodology used for labelling, carbon intensity of production, and ability to obtain certification.	+ / - A well designed carbon labelling scheme could create incentives for production of different parts of the supply chain to move to lower emission locations, which may be in developing countries. High carbon exporters lose investment.	+ Aid may help cover certification costs with knock-on benefits in other areas	+ Carbon labelling could increase transfer of green technologies	+ / - Depends on impacts on export opportunities and technology transfer.
Liberalisation of environmental goods and services	+ Lower tariffs generate welfare gains for importers, and export opportunities for exporters. Will lead to more trade in EGS benefitting developing countries trading in EGS			+ EGS liberalisation would lead to technology transfer to developing countries through increased trade and developed country exports	+ EGS liberalisation leads to faster growth through new export opportunities and spillovers from imports.

REDD+	+ If fungible with carbon markets, then countries implementing CERs can sell credits to countries with emission targets, perhaps through intermediaries - If high aid inflows results in Dutch disease may damage competitiveness of some economic sectors	+ Financial inflows (FDI) used for mitigation, in those countries able to deliver forest-sector emissions reductions	+ Development finance, in those countries able to deliver forest-sector emissions reductions - Through possible Dutch Disease effects unless appropriately managed	+ Technology transfer through FDI	+ Spillovers from FDI and financial inflows if used wisely may stimulate growth for recipient countries. - if generates significant Dutch Disease
CDM	+ Countries implementing CERs can sell credits to countries with emission targets, perhaps through intermediaries	+ Financial inflows (FDI) to countries with mitigation opportunities and good investment climate.		+ Technology transfer through FDI	+ Spillovers from FDI increase growth
Technology transfer	+ Increased technological capacities may increase capacity to export	+ Increased technological capacities may increase capacity to export and hence attract investment. - mandatory technology transfer might hamper FDI	+ If aid supports transfer of energy efficiency technologies	+ Whether FDI or aid induced, there will be more technology flows	+ More technology flows raise productivity and growth