Title:	Policies, Instruments and Cooperative Arrangements		
Chapter:	Chapter 13		
(Sub)Section:	All		
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	CAs:		
Remarks:	First Order Draft		
Version:	Ch13- FOD Text 24-11_Th.doc		
File name:	Chapter 3.doc		
Date:	24/11/2005 14:06	Time-zone: Paris	CET

Policies, Instruments and Cooperative Arrangements

Content

Executive Summary

This chapter synthesizes information from the relevant literature on policies, instruments and cooperative arrangements, focusing mainly on new information that has emerged since the TAR. The literature continues to reflect that a wide variety of national policies and measures are available to governments if they wish to limit or reduce GHG emissions. These instruments include: regulations

and standards, emission taxes and charges, tradable permits, voluntary agreements, information instruments, subsidies and other financial incentives, research and development and insurance. Other policies, such as those affecting trade, foreign direct investments, and social development goals also can also affect GHG emissions. In general, climate change policies, if integrated with other government polices, can contribute to sustainable development goals in both developed and developing countries.
While the literature identifies advantages and disadvantages for any given instrument, three main criteria are widely used by policy makers to select and evaluate policies: environmental effectiveness, economic efficiency and political feasibility. Other more specific criteria, such as, effects on competitiveness, administrative feasibility, and trade effects, are sometimes used to expand upon these three.

The literature provides a good deal of information to assess how well different instruments meet these criteria, most notably, it suggests that:

- Voluntary measures and information campaigns are not generally environmentally effective, yet they are widely used because they are politically attractive and provide a means of educating stakeholders prior to the introduction of other measures.
- Taxes and charges are given high marks for economic efficiency, but they cannot guarantee a particular level of emissions and may be politically difficult to implement and, if necessary, adjust.
- Regulatory measures are generally viewed as inferior to price-based instruments in inducing innovation and technological change. Regulatory measures and standards generally provide environmental certainty, but offer little flexibility to stakeholders. However, regulatory measures may be preferable in some circumstances, for example, when information or other barriers prevent firms from responding solely to price signals.
- Tradable permits have become a popular instrument to control conventional pollutants or greenhouse gases at the sector, national and international level. The volume of allowed emissions determines the environmental effectiveness of this instrument, while the distribution of allowances has implications for both economic efficiency and equity. Experience has shown that banking provisions can provide significant temporal flexibility and that care must be taken in establishing an effective compliance mechanism for the instruments to be effective.
- Innovative financial incentives are frequently used by governments to stimulate the diffusion of new less GHG emitting technologies, but the economic cost and environmental merits of such programmes have not been determined in most cases. Incentives must be carefully designed to avoid perverse market effects. Subsidies for fossil use remain a common practice in many countries, although those for coal have declined in recent years.
- One subset of incentives are those related to government support for research and development, particularly for renewable energy. Funding for such efforts has been flat for nearly two decades, and there is little evidence to indicate that governments are capable of providing significant sustained support over 30-50 year time periods for social purposes. Nevertheless, international cooperation relating to research and development can be a useful long-term measure, if supplemented with policies to promote deployment and diffusion.

In practice, climate related policies are seldom applied in complete isolation, as they overlap with other national polices relating to the environment, forestry, agriculture, waste management, and energy, and in many cases require more than one instrument. Applying an environmentally efficient and economically effective instrument mix requires a good understanding of the environmental issue to be addressed, of the links with other policy areas and of the interactions between the different instruments in the mix. For example, a tax (or a tradable permit system) can affect the total use of a given product and the choice between different products, but may be less suited to address how a given product is used, when it is used, where it is used. Hence, other instruments may be needed.

The Kyoto Protocol has set a significant precedent as a means to solve a long-term international environmental problem. It's most notable achievements are the stimulation of an array of national policies, the creation of an international carbon market and the establishment of new institutional mechanisms, but its environmental effectiveness and economic impacts have not yet been demonstrated. The CDM, in particular, has created a large project pipe-line and mobilized substantial financial resources, but it has faced methodological challenges regarding the determination of baselines and additionality. The protocol has also stimulated the development of emissions trading systems, which are an important implementation mechanism for addressing climate change in nations around the world, but a fully global system has yet to be implemented.

Numerous options are identified in the literature for improving the Kyoto Protocol, for example, by expanding the scope of market mechanisms through sectoral and sub-national crediting agreements and by enhanced international R&D technology programmes. Sectorally focused market mechanisms are attractive for a number of reasons, for example, because they can contribute to sustainable development and attract additional investments and participants; but they are generally less efficient since they include only a portion of an economy. International R&D programmes can induce cost savings, build national capacity and create goodwill. However, there is no evidence that investments in R&D activities will achieve the same level of emission reductions as global targets and common markets (such as those under the Kyoto Protocol) in either the near or long-term unless supplemented with other policies to promote diffusion. Integrating and comparing activities with fundamentally different structures and designs, such as developing technology and quantitative emission objectives, is very complex and resource consuming.

A great deal of new literature is available on potential structures for and substance of future international agreements. As has been noted in previous IPCC reports, because climate change is a global commons problem, any approach that does not include a large portion of the world, and at a minimum the world's major emitters, will be more costly and less environmentally effective – in other words, a second best approach. There is a broad consensus in the literature that a successful agreement will have to be fair/equitable, flexible (accommodate changes while providing adequate investment certainty), scientifically sound, economically efficient and lead ultimately toward universal participation and a more sustainable development path. While sustainability is defined differently by various authors, most agree that the political acceptability of an outcome is in part determined by this often subjective criterion. Most agreements contain common elements, including: goals, actions, timetables, participation, institutional arrangements, reporting and compliance provisions. With the emphasis on environmental effectiveness, and hence broad participation, considerable attention may be appropriately given to incentives, non-participation/non-compliance penalties, and political leadership.

The specification of clear goals is an important element of any climate agreement. Several authors have attempted to assess different goals and the pathways to reach them. For example, to limit global temperatures to a goal of 2°C above pre-industrial levels, developed countries would need to reduce emissions in 2020 by approximately -5% to -30% below 1990 levels and in 2050 by approximately 60% to -90%. Developing country emissions would need to deviate from their current path as soon as possible. Reaching lower levels of greenhouse gas concentrations requires earlier reductions and greater participation compared to higher levels of greenhouse gases.

While the preponderance of the literature reviews nationally based governmental regimes, corporations, sub-national governments, NGOs and civil groups play a key role, and are adopting a wide variety of actions to reduce emissions of greenhouse gases. Corporate actions range from voluntary initiatives to specific emissions or intensity targets and, in a few cases, internal trading systems. The literature suggests a number of reasons that lead corporations to act unilaterally, the most prominent of these are the desire to influence or pre-empt government action, to create financial value and to differentiate a company and its products. Actions by regional, state, provincial and local governments have limited geographical scope, but often mirror efforts taken at the national level, and include renewable portfolio standards, energy efficiency programs, emission registries and emission trading mechanisms. These actions are undertaken for a number of reasons, such as a desire to influence national policies, address stakeholder concerns, create incentives for new industries or to create environmental co-benefits. Many of the above actions may limit GHG emissions, stimulate innovative policies, encourage the deployment of new technologies and spur experimentation with new institutions, but they are by their nature limited in scope (and often in duration) and are thus less than optimal in terms of economic efficiency and environmental effectiveness. There is no evidence in the literature indicating that actions by corporations, sub-national governments, NGOs or other civil groups can, by themselves, lead to significant national emission reductions, unless supplemented by government policies.

The complex nature of the policies and measures taken at the national and sub-national level and by the private sector and members of civil society, suggests considerable interaction between climate change mitigation and adaptation policies and policies in other areas. Given that some of the most significant emissions reductions in both developed and developing countries have occurred at this intersection (e.g., the UK switch to gas, the Chinese energy efficiency programs for energy security, the Brazilian development of a bio-fuel driven transport fleet, or the trend in the 1970s and 1980s toward nuclear power), both new research, and potential future agreements might further examine such endeavours might serve as a model to encourage politically feasible actions.

13.1 Introduction

Article 4 of the United Nations Framework Convention on climate change commits all Parties, taking into account their common but differentiated responsibilities and their specific national and regional priorities, objectives and circumstances to formulate, implement, publish and regularly update national and where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions of greenhouse gases by sources and removals by sinks. The main purpose this chapter is to discuss national policy instruments and their implementation; international agreements and other arrangements; and initiatives of the private sector, local governments and non-governmental organizations. The chapter expands on the literature that has emerged since the TAR, particularly aspects previously covered in Chapter 6 and l0. There is a relatively heavier focus given to new literature on approaches to possible future international agreements, on alternative options for international cooperation and on initiatives of local governments and the private sector. Wherever feasible these agreements and arrangements are discussed in the context of criteria such as the administrative complexity, effectiveness, efficiency, equity, political feasibility and other factors. This chapter does not discuss details of sectoral policies as these can be found in other chapters of this report and adaptation policies as those may be found in the report of Working Group II.

13.1.1 Types of policies, measures, instruments and cooperative arrangements

There are a variety of policies, measures, instruments and approaches that are available to national governments to limit greenhouse gases. These include: regulations and standards, emission taxes and charges, tradable permits, voluntary agreements, informational instruments, subsidies and incentives, research and development and product bans. Box 13.1 Depending on the legal frameworks available to countries; these may be implemented nationally, at the sub-national level or through bilateral or multilateral arrangements. They may be legally binding or voluntary and they may be fixed or changeable (dynamic).

13.1.2 Criteria for Policy Choice

There are three principle criteria by which environmental policy instruments can be evaluated:

- Environmental effectiveness – the extent to which a policy meets its intended environmental objective at least cost. Least cost methods are deemed to be cost effective.
- Economic efficiency – the extent to which the policy can achieve its objective at minimum cost to society. Thus for a given level of emissions a policy instrument is economically efficient if it results in minimal compliance costs across all affected parties.
- Political feasibility – the extent to which a policy instrument is likely to be viewed as legitimate, gain acceptance, and be adopted and implemented.

However, there are a number of additional criteria which could be explicitly considered as well, such as administrative costs and dynamic effects. Criteria may be applied by governments in making *ex-ante* choices among instruments and in *ex-post* evaluation of the performance of instruments.

Box 13.1. *Definitions of Selected Greenhouse Gas Abatement Policy Instruments*

- An emissions tax is a levy imposed by a government on each unit of emissions by a source subject to the tax.
- A tradable permit (cap-and-trade) system establishes a limit on aggregate emissions by specified sources, requires each source to hold permits equal to its actual emissions, and allows permits to be traded among sources.
- A non-tradable permit system establishes a limit on the GHG emissions of each regulated source. Each source must keep its actual emissions below its own limit; trading among sources is not permitted
- A credit system generates credits when a source reduces its emissions below a business as usual baseline. A source subject to an emissions-limitation commitment can use credits to meet its obligation.
- A subsidy is a direct payment or tax reduction from a government to an entity for implementing a practice. Subsidies may encourage or discourage GHG gas emissions A voluntary agreement (VA) is an agreement between a government authority and one or more private parties to achieve environmental objectives or to improve environmental performance.
- A technology or performance standard establishes minimum requirements for products or processes to reduce GHG emissions associated with the manufacture or use of the products or processes.
- A product ban prohibits the use of a specified product in a particular application that gives rise to GHG emissions.
- Direct government spending and investment on mitigation, adaptation or physical and social infrastructure.[1]

[1] See the TAR for a discussion of insurance and information products which are also forms of policy instruments.

13.2 National policy instruments, their implementation and interactions

The policy making process by almost all governments involves complex choices involving many stake holders. These include the potential regulated industry, suppliers, producers of complementary products, labour organizations, consumer groups and environmental organizations. The choice and design of virtually any instrument has the potential to benefit some and to harm others. Stricter standards are likely to favour those that have invested in new technologies and to create barriers to new firms wishing to enter the market. Permits allocated free to existing firms represent a transfer of rents from government to industry while auctioned permits and emission taxes generally impose heavier burdens on polluters. Voluntary measures are often favoured by industry because of their flexibility, but opposed by environment groups because of their lack of accountability and enforcement. In practice policies may be complementary or opposing, moreover the political calculus used differs for each government.

Figure 13.1 illustrates the types of instruments used to address greenhouse gas reduction in the industry sector of 23 Annex I Parties, as outlined in their 3rd National Communications to the UNFCCC, and indicates the relative proportions (in terms of numbers of policies) in which these are applied. This illustrates the importance of voluntary agreements, regulation and economic instruments (taxes and trading) relative to other instruments used such as information, research and fiscal mechanisms.

[INSERT ***Figure 13.1*** here]

13.2.1 Climate Change and other related policies

13.2.1.1 Regulations and Standards

Regulatory standards are the most common form of environmental regulation, and what comes to mind when most people think of environmental regulations. In general, there are two different types of standards: technology standards and performance standards. Technology standards mandate specific pollution abatement technologies or production methods and, in their purest form, leave little room for firm or individual modification. Performance standards mandate certain environmental outcomes, but give flexibility in how those outcomes are met (Sterner, 2003). Prohibiting the use of coal in generating electricity is a technology standard; while limiting emissions to a certain number of grams of CO_2 emissions per kWh of electricity generated would be a type of performance standard.

Technology standards may cause inefficiencies by requiring firms to undertake more costly emission control steps than necessary to achieve the same level of environmental performance. There are a variety of reasons for this. An underlying reason is that the regulators who develop these standards will inevitably have less information about the abatement options and costs of firms and thus may be forced to impose uniform requirements on all firms Treating all firms the same inevitably raises costs, some find it easier than others to reduce emissions.

Performance standards can reduce these inefficiencies compared to technology standards by providing more flexibility (IPCC, 2001). Costs can generally be lower whenever a firm is given some discretion in how it meets an environmental target. Performance standards expand compliance options beyond one mandated technology and may include process changes, reductions in output, changes in fuels or other inputs, and selection of alternate technologies. Despite this increased flexibility, performance standards do not generally give full flexibility and thus fall short of the ideal least-cost way of attaining an environmental goal over an economy or even over a single industry.

The economics literature generally views regulatory standards as inferior to price-based instruments in inducing innovation and technological change (Jaffe et. al., 2003, Sterner, 2003), because they have a limited ability to induce innovation in pollution control. If a certain technology is mandated, there is no economic incentive for firms to develop more effective technologies. Moreover, there may be a "regulatory ratchet" whereby firms would be discouraged from finding more effective technologies out of fear that standards will be tightened. (Harrington, et al., 2004). Finally, although it may be possible to force some technological change through technology mandates, it is difficult for regulators to determine the amount of change that is possible at a reasonable economic cost. This raises the possibility of either costly, overly stringent requirements or weak, unambitious requirements (Jaffe et. al, 2003). Nevertheless, there are examples in the literature of technology innovations spurred by regulatory standards. For example, Wätzold (2004) found innovative responses from pollution control vendors in Germany in response to standards for SO2 control.

Despite a preference for market-based regulations in the economics literature, there are examples of cases in which standards may still be desirable in a practical sense (see Freeman and Kolstad, 2006; Sterner, 2003). Sterner (2003) gives several examples of these types of situations, including where pollution control information is complex and available only at the government level; where firms are not responsive to price signals (e.g., in non-competitive, transitional settings) but investment have long-run, irreversible effects; and where monitoring emissions is difficult but tracking the installation of technology is easier. Montero (2004, 2006) found that in situations where there is imperfect monitoring and homogeneous abatement costs between firms, standards may lead to lower emissions and may be more economically efficient than tradable permits. In an analysis of the German SO2 abatement program, Wätzold (2004) concluded that a technology standard may be acceptable when only one technology exists to achieve an environmental result and therefore firms do not face differential abatement costs. Finally, standards may be desirable where there is information or other barriers that prevent firms or individuals from responding solely to price signals. This may be particularly relevant for energy efficiency standards for household appliances and other similar applications (OECD, 2003).

Although few regulatory standards have been adopted solely to reduce greenhouse gases, standards have been adopted that reduce these gases as a co-benefit. For example, there has been extensive use of standards to increase energy efficiency in over 50 nations (IPCC, 2001). Energy efficiency applications include fuel economy standards for automobiles, appliance standards, and building codes. These types of policies are discussed in more detail in Chapters 5-6. Standards to reduce methane and other emissions from solid waste landfills have been adopted in Europe, the United States, and other countries (see Chapter 10). These standards are often driven by multiple factors, including the reduction of volatile organic compound emissions, improved safety by reducing the potential for explosions, and reduced odours for local communities (Hershkowitz, 1998).

There is a growing literature focused on whether regulatory standards or economic incentives are preferable for developing countries. One common view is that technology standards may be more appropriate for building the initial capacity for emission reduction because economic incentive programs require more specific and greater institutional capacity, have more stringent monitoring requirements, and may require fully developed market economies to be effective (IPCC, 2001, Bell and Russell, 2002). Willems and Baumert (2003) present this case, but also note that technology approaches and policies and measures may have greater applicability to the general capacity needs of developing countries interested in pursuing sustainable development strategies and broader policy processes. Vaughn and Russell (2003) suggest that a transitional strategy is appropriate for developing countries, whereby technology standards are introduced first, followed by performance standards and then experimentation with market based instruments. An alternative view is that in some cases, a performance-based approach based on measurement of mass emissions quantities at a facility level and an overall emissions cap could provide a more a more effective structure (Ellerman, 2002, Kruger et al., 2003). This type of approach could also facilitate a transition to a tradable permits program as institutions and economies develop over time.

13.2.1.2 Emission Taxes and Charges

An emission tax on GHG emissions requires individual emitters to pay a fee, or tax, for every tonne of CO_{2eq} of GHG released into the atmosphere. This unit tax or fee is paid per unit of emissions regardless of how much emission reduction is being undertaken. Such a fee would encourage emitters to see their costs reduced by reducing GHG emissions. In particular, measures to reduce emissions that are less expensive than paying the tax would be undertaken.

Since every emitter faces a uniform tax on emissions per tonne of CO_{2eq} (if energy, equipment, and product markets are perfectly competitive) this would result in the least expensive reductions throughout the economy being undertaken. Each emitter compares the cost of emissions control with the alternative of emitting and paying the tax; in the end, polluters undertake emission reductions that are cheaper than paying the tax but do not undertake those that are more expensive, at the margin (IPCC, 1996, Section 11.5.1; IPCC, 2001, Section 6.2.2.2; Kolstad, 2000). In the real world, markets, especially energy markets, deviate from this ideal (e.g., some firms may have economic power in the market place, some firms may be state enterprises less sensitive to price signals), so a uniform emissions tax may not be as economically desirable as one that varies from over the economy. In evaluating the desirability of an emissions tax, it is important to compare the tax to alternative policy measures. Furthermore, criteria other than efficiency, such as distributional impacts, are likely to influence the design of the emissions tax where this is the chosen policy. Although equity considerations could be, in theory, better addressed through other redistribution mechanisms, in practice most energy and emissions taxes apply differential tax rates to different sources.

An emissions tax, unlike emissions trading, provides some assurance regarding the marginal cost of pollution control, i.e., the marginal costs will be equal to the tax rate, but does not guarantee a particular level of emissions. (Conversely, emissions trading, unlike an emissions tax, does not guarantee a level of incremental costs of control.) Therefore, it may be necessary to adjust the tax level to meet an internationally agreed emissions commitment (depending on the structure of the international agreement). In a study prepared for OECD, Maestad assessed the impacts of participation, e.g., OECD wide or unilateral taxes in selected countries and regions, on the steel industry, if a carbon tax of 25 USD per tone of CO_2 was placed on the industry. An OECD tax would reduce emissions of CO_2 from the steel industry by 19 percent. Despite relatively high emission intensities in non-OECD countries, global emissions from the sector would decline 4.6 percent, because of the substitution toward cleaner inputs and processes in the OECD area. It would also reduce steel production by 9 percent.

Over time, an emissions tax needs to be adjusted for changes in external circumstances, like inflation, technological progress, and increases in emissions (Tietenberg, 2000). Inflation increases abatement costs, so to achieve a target emission reduction the tax rate needs to be adjusted for inflation. Fixed emissions charges in the transition economies of Eastern Europe, for example, have been significantly eroded by the high inflation of the past decade (Bluffstone and Larson, 1997).

Innovation and invention generally has the opposite effect, reducing the cost of making emissions reductions. Thus, innovation generally increases the emissions reductions achieved by a fixed (real) tax rate. Of course, new sources add to emissions. Thus if the tax is intended to achieve a given overall emissions limit, the tax rate will need to be increased to offset the impact of new sources (Tietenberg, 2000).

Implementation of a domestic emissions tax requires governments to consider a number of issues. At the most basic level, there is the issue of the level at which it should be set, particularly in the case of pre-existing taxes, e.g., taxes which already exist on energy) or other distortions, e.g., subsidies to certain industries or fuels). For example, in many countries petrol is heavily taxed. Should a GHG emission tax result in further taxes on petrol or should some of the existing taxes be considered GHG taxes? Furthermore, the question of what happens to the tax revenue is an important question that can influence the political acceptability and environmental effectiveness. Should the tax revenue go into government treasury, be used to offset other taxes, or be transferred across national boundaries to an international body? Should revenues be earmarked for specific projects? Should revenues be refunded to those most adversely impacted by either the costs of emission reduction or damage from climate change? Additionally, the question of where in the tax should be levied is pertinent. Should emitters always pay the tax directly (such as individual automobile owners) or should the tax be levied at more convenient points (such as the petrol refinery)? These questions are not easy to answer; the answer is as much political or practical as it is economic.

The largest number of environmentally related *taxes* with implications for GHG emissions in OECD countries is levied on energy products (150 taxes) and on motor vehicles (125 taxes), rather than on CO_2 emission directly[2]. There is also a significant number of waste-related *taxes* in OECD (about 50 taxes in all), levied either on particular products that can cause particular problems for waste management (about 35 taxes), or on various forms of final waste disposal, i.e. on incineration and/or land-filling (15 taxes in all). A very significant share of all the revenues from environmentally related taxes arises from taxes on motor fuels. Such taxes were introduced in all member countries many decades ago, primarily as a means to raise revenue. Regardless of that, they do impact on the prices (potential) car users are facing, and thus they do have important environmental impacts. Figure 13.2 presents a comparison of the 'normal' tax rates that applied to petrol and diesel in OECD member countries as of 1.1.2000 and 1.1.2005.[3] [4] (OECD, 2006)

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[2] A few examples of CO_2 taxes are the following: According to Nordic Council of Ministers (2002), CO_2 emissions in Denmark decreased 6% during the period 1988-1997 while the economy grew by 20%. They also decreased 5% just between 1996 and 1997, when the tax rate was raised. Bruvoll and Larsen (2004) analyzed the specific effect of carbon taxes in Norway. Although total emissions did increase, they found a significant reduction in emissions per unit of GDP over the period due to reduced energy intensity, changes in the energy mix and reduced process emissions. The overall effect of the carbon tax was, however, modest and may be explained by extensive tax exemptions and relatively inelastic demand in the sectors in which the tax is actually implemented. Cambridge Econometrics (2005) did an analysis of the impacts of the Climate Change Levy in the United Kingdom, comparing actual emission developments to a counterfactual reference case with no levy in place and estimating developments up to 2010 under various assumptions. The study inter alia found that total CO_2 emissions were reduced by 3.1mt C (million tonnes carbon) – or 2.0% – in 2002 and by 3.6mtC in 2003 compared to the reference case. The reduction is estimated to grow to 3.7mtC – or 2.3% – in 2010. Most of the reduction (1.8mtC in 2010) was found to take place among 'other final users', i.e. in commerce and the public sector, but 'other industry' – i.e. industry other than basic metals, mineral products and chemicals – was also found to reduce emissions around 0.8mtC in 2010. Emissions from power generation were also found to decrease, due to lower demand for electricity.

[3] In many OECD countries, certain sectors pay significantly lower effective tax rates, in particular as regards diesel. This applies e.g. to the goods transport sector, public transport and to off-highway uses of vehicles, for instance in the agriculture sector.

[4] Source: OECD/EEA database on instruments for environmental policy. Tax rates expressed in euro over time for countries outside the euro area can both be due to changes in tax rates in national currencies and to changes in the

[INSERT **Figure 13.2** here]

The tax rates on motor fuels vary considerably between countries. For example, even when taking into account the taxes levied at a state or provincial level in Canada and USA, the taxes on petrol and diesel in these countries are only a small fraction of the taxes levied in several European countries. There have also been significant changes in the tax rates between 1.1.2000 and 1.1.2005 in a number of countries – in both directions. The tax rate for diesel is much lower than the tax rate for petrol in most countries – with notable exceptions for Australia, Switzerland, the United Kingdom and United States. From an environmental point of view, this is regrettable, as diesel-driven vehicles cause more local air pollution and are noisier than petrol-driven vehicles, but from a climate perspective diesels tend to be more efficient and climate change friendly.

The magnitude of the behavioural responses to environment related taxes can be measured in terms of the relevant price elasticities. If, after the introduction of an environmentally related tax, the price of the taxed good increases by 10% and, as a result of the higher price, its consumption falls by 2%, the own-price elasticity in this particular case is -0.2. Demand for *energy in total* is rather inelastic in the short term; (OECD, 2000) with short run elasticity ranging between -0.13 to -0.26. However, long run elasticities are considerably higher (-0.37 to -0.46). Nevertheless, an elasticity significantly different from zero indicates that price increases can substantially reduce the demand for energy, especially in the long run. (OECD, 2005)

Tradable permits

Tradable permits have become an increasingly popular instrument for the control of both conventional pollutants and greenhouse gases. There is a growing body of research on tradable permits, including efficiency and equity issues associated with the distribution of permits, implications of economy wide vs. sectoral programs, mechanisms for handling price uncertainties, different forms of targets, and compliance and enforcement issues. Some of this work grows out of past experience with emissions trading programs in the U.S. and elsewhere. With the recent development and launch of the EU Emission Trading System (ETS), the body of work has expanded to include analysis of additional design and competitiveness issues and to explore the linkages between domestic greenhouse gas trading programs and the international climate regime. It has led to an intensive discussion about efficient and politically feasible design options (Svendsen, Vesterdal (2003) and to a very limited extent about the applicability of cap and trade approach to the GHG emissions Berstein (2003). Finally, there is a small, but growing body of literature on the applicability of the tradable permits mechanism for developing countries and economies in transition. Potential benefits and criteria for evaluation as taken from OECD (2004) are shown in Table 13.1.

exchange rates. There is no taxation of diesel fuel in Iceland and New Zealand. Separate taxes are instead levied on the use of diesel-driven vehicles. Information on tax rates as of 1.1.2005 is missing for Korea. No information is available regarding the diesel tax rates in Turkey, and as regards petrol tax rates, information is missing concerning 1.1.2000. No tax rate information is available for Mexico. For Canada and United States, two sets of bars are shown; one that only includes the federal tax rates and one that also includes un-weighted averages of the taxes levied at a provincial or state level, based on information from The International Fuel Tax Association, cf. www.iftach.org/index50.htm. The red dotted horizontal lines shown for the United Kingdom and United States are estimates of second-best optimal petrol tax rates made by Parry & Small (2002), made on the assumption that revenues from petrol taxes replaces revenues on distorting taxes on labour income. If instead revenues from petrol taxes financed additional public spending, the optimal tax rates would be higher than that calculated here (to the extent that the social value of additional public spending were greater than the social value of using extra revenue to cut distortionary income taxes). The blue lines shown for the United Kingdom indicate ‘optimal’ tax rates for petrol and diesel respectively as estimated by Newbery (2005).

[INSERT Table 13.1. here]

Tradable permits systems can be designed to cover emissions from only some sectors of the economy or virtually the entire economy.5 A number of analyses have found that economy-wide approaches are superior to sectoral approaches because they minimize marginal costs across the entire economy. Pizer et. al. (2003) find significant cost savings to an economy-wide program when compared to a sectoral program coupled with non-market-based policies in the U.S.6 Cost savings for an economy-wide approach have been found for the European Union by Babiker et al. (2003). Similarly, Klepper and Peterson (2004) use a simulation model and find that for the EU ETS, cost savings can only be realized, if the cap on emissions is distributed between the covered sector and the rest of the economy in such a way that marginal abatement costs are equalized. This would imply a relatively tighter cap in the sectors covered in the EU ETS. Finally, Proost and van Regemorter (2004) find larger effects of an emissions trading system on industrial activity and welfare when sectors are exempted than when no industrial sectors are exempted.

In addition to coverage of sectors, the point of obligation may also vary in a tradable permits program. Responsibility for holding permits may be assigned directly to emitters, such as energy-using industrial facilities (downstream) or to producers or processors of fuels (upstream), or to some combination of the two (a "hybrid system").7 The upstream system would require allowances to be held at the level of fossil fuel wholesalers and importers (Cramton and Kerr 2002). 8

Part of any tradable permit system is a method for initially distributing emission permits/allowances. There are two basic options available: free distribution of permits to existing polluters or auctions. Of course, a combination of these approaches may also be undertaken. The literature on the distribution of tradable permits describes the benefits of auctioning permits rather than distributing them at no cost. For example, Cramton and Kerr (2002) describe a number of equity benefits, including providing a source of revenue that could potentially address inequities brought about by a carbon policy, creating equal opportunity for new entrants, and avoiding the potential for "windfall profits" that might accrue to emissions sources if allowances are allocated at no charge.9 Recently, windfall profits to electricity utilities have been an important issue in the political discussion about the allocation for the second phase of the EU ETS. Goulder et al. (1999) and Dinan and Rogers (2002) find that recycling revenues from auctioned allowances can have economy-wide efficiency benefits if they are used to reduce certain types of taxes. Free initial distribution of permits is obviously more popular with industrial emitters. However, Dinan and Rogers (2002) and Parry (2004) argue that free allocation of tradable permits may be regressive because this type of allowance distribution leads to income transfers towards higher income groups (i.e., shareholders) at the expense of households. In contrast, these authors find that government reve-

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5 Thus far, emissions trading program such as those for SO2 and NOx in the U.S. and the EU Emissions Trading System (EU ETS) for carbon dioxide have only covered certain sectors. In the case of the EU ETS, Christiansen and Wettestad (2003) write that the EU restricted the sectors involved to ease implementation during the first phase of the program.

6 However, they also find that the exclusion of certain sectors such as residential and commercial direct use of fossil fuels, does not noticeably affect the cost of an otherwise economy-wide tradable permit system covering electricity production, industry, and transportation.

7 See (IPCC, 2001, Baron and Bygrave 2002, and UNEP/UNCTAD, 2002 , and Baron and Philibert (2005 forthcoming) for a discussion of the advantages and disadvantages of these different approaches.).

8 As the discussion below notes, the point of obligation is not necessarily the point where all permits need be allocated.

9 Bovenberg and Goulder (2002) and Burtraw et. al. (2002) find that allocating only a small portion of allowances at no cost can compensate industry for losses due to a carbon policy.

nues from auctions may be used to address equity issues through reductions in taxes or other distributions to low income households.

Despite these potential benefits, auctions have been little used in both U.S. trading programs for conventional pollution and the emerging EU ETS.10 This is largely because of the political difficulty in convincing industry groups to support auctions. The literature on the U.S. experience with the free allocation of emission allowances to firms describes the deeply political nature of these processes for both the U.S. SO2 program and the Regional Clear Air Incentives Market (RECLAIM) program in Southern California (Ellerman et.al. 2000, Raymond, 2003, Ellerman et. al., 2003). Christiansen and Wettestad 2003) and Markussen and Svendsen (2005) discuss how interest group pressures led to a largely free allocation of allowances in the EU ETS.

As the most common form of allowance distribution, the free distribution of allowances has received greater attention. Harrison and Radov (2002) and U.S. EPA (2003) outline some of the design variables for allocation, including whether allocations should be fixed based on historic measures or updated over time; whether they should be based on emissions, production, or fuel use; and whether they should take into account special issues such as early reductions and other policies. A growing literature is exploring the efficiency and equity implications of these different approaches. For example Burtraw (2001) and Fisher (2001) found that updating output based allocation methodologies serve as an economically inefficient subsidy for production. In an analysis of a potential emissions trading program in Alberta, Canada, Haites (2003) found that an out-put based allocation may reduce the decline in production for some sectors that might arise from an emissions cap, but that it also may reduce profits and raise overall costs.

The type of target in an emissions trading system has received increasing attention as parties to the Kyoto Protocol consider domestic trading programs and non-Kyoto parties adopt voluntary targets. Discussion of target type has been applied to both the national and the sectoral level. Several authors have compared the advantages and disadvantages of absolute targets (i.e., mass emissions limits on a sector or economy), to those of an intensity targets (i.e., limits on emission per unit of GDP or other economic output).11 Ellerman and Wing (2003) and Kolstad (2005) find that intensity targets can reduce uncertainties associated with the cost of emission reduction under uncertain economic growth levels.12 Additionally, Pizer (2004) finds that intensity targets may be more appropriate if the short-term objective is to slow, rather than halt, emissions growth. An alternative view comes from Dudek and Golub (2003), who argue that absolute targets have more certain environmental results and lower transaction costs for emissions trading, thereby creating stronger incentives for technological change. Kuik and Mulder (2004) argue that for the EU, an intensity or relative target would avoid negative effects on competitiveness, but would not reduce emissions at the lowest costs. In contrast, an absolute target trade leads to efficient emissions reduction, but its overall macroeconomic costs may be significant.

Some researchers have looked at the implications of linking different types of targets. Fischer (2003) finds that emissions would normally increase where a system with a rate-based target was linked to a system with an absolute target, although she notes that exchange rates and other adjust-

[10] The SO_2 trading program contains a small reserve auction, which was valuable for price discovery during the early years of the program (Ellerman, et. al, 2000). A few EU member States have chosen to experiment with small auctions. For example, Denmark will auction 5% of its allowances during the first phase of the EU program.

[11] Intensity targets are also known as "rate-based" or "relative" targets.

[12] Price uncertainty may also be addressed by a "safety valve" mechanism, which guarantees that the government will sell additional permits if the market price of allowances hits a certain price (Pizer, 2002 and Jacoby and Ellerman 2004).

ments can be used to maintain aggregate emissions levels. However, these types of mechanisms may forfeit some of the gains from trade (Fischer, 2003 and Zapfel and Vainio, 2002), may be difficult to administer (Fischer, 2003), and may cause uncertainty for industry participants if they believe that total emissions will be adjusted downward in the future to meet an environmental goal (Zapfel and Vainio, 2002). Philibert and Criqui (2005) considered the compatibility of different quantitative options with emission trading and found that dynamic targets, binding targets with price caps, non-binding targets, sector-wide targets, action targets and long-term permits are all compatible with international emission trading, and could also allow domestic entities to trade directly on international markets. They also found that in general dynamic targets, non-binding targets, binding targets and price caps are compatible with each other and with fixed, binding targets. 13 Morthorst (2001) assesses interaction between greenhouse gas allowances and green certificates under a renewables portfolio standard. Only if the allowances are auctioned, trade in green certificates will be equivalent to the domestic development of renewables. Boots (2003) discusses such impacts on the Dutch green certificate system. Morthorst (2003) recommends that greenhouse gas allowance allocation should be reduced when green power production is increased.

Experience with trading programs in the U.S. has shown significant benefits from the temporal flexibility provided by banking provisions (Stavins, 2003, Ellerman et. al., 2000).14 Allowance banking can create a cushion that will prevent price spikes and can hedge uncertainty in allowance prices (Jacoby and Ellerman 2004). A banking provision allows the arbitrage between actual marginal abatement costs in one phase of a program and the expected abatement cost in a future phase of a program. Banking can also mitigate the consequences of "overinvestment" by providing extra allowances that may then be used for future compliance (Ellerman et al. 2000). The temporal flexibility of banking is particularly useful for companies facing large capital expenditures because it provides some flexibility in the timing of those expenditures (Tietenberg 2003). Kruger and Pizer (2004) note that the lack of a mandatory banking provision between the first two phases of the EU ETS could complicate investment and compliance planning for European companies. On the basis of a simulation carried out in Germany with companies and with a student control group. Schleich et al. (2006) argue that an EU-wide ban on banking would lead to efficiency losses in addition to those losses which arise from the lack of inter-temporal flexibility.

Several critical elements of an effective enforcement regime for emissions trading are described in the literature. The first question is whether the goal is strict adherence to the limits implied by the issued permits or whether there is a desire for a safety valve for firms to be able to emit more that permitted, should control costs end up being exceptionally high (Pizer, 2002, Jacoby and Ellerman, 2004, Baron and Philibert, 2005 forthcoming)). If the goal is absolute adherence to the emission limits implied by the number of permits, then excess emissions penalties should be set at levels substantially higher than the prevailing permit price to create the appropriate incentives for compliance (Stranland et al., 2002; Swift, 2001). On the other hand, if excess emissions penalties for tradable permit programs are too high, regulatory authorities may be reluctant to impose them (Tietenberg, 2003). Second, the certainty that a penalty will be imposed is a critical element in providing the correct incentives in an emissions trading program. Ellerman (2003) contrasts the certainty of an automatic excess emissions penalty with an approach where violators can negotiate with regulators

[13] Note that the compatibility of different types of targets is one of many issues raised by linking different domestic systems. Baron and Philibert (2005 forthcoming) discuss the implications of a variety of linking issues, including different allowance prices and levels of emissions cap stringency, different banking or borrowing policies, and different monitoring and verification schemes.

[14] In contrast, the lack of an adequate banking provision in the RECLAIM trading program in Southern California may have been at least partially responsible for extreme price volatility following high electricity demand in 2000. See Ellerman et al. (2003).

for exemptions and notes that if these negotiation costs are less than the cost of compliance, then participants in a trading program have little incentive to comply. A third component of an enforcement regime is reasonably accurate emissions monitoring (Stranland et al., 2002, Stavins, 2003). San Martin (2003) and Montero (2003) found that incomplete monitoring can undermine the efficiency of trading programs. Finally, Tietenberg (2003) and Kruger et. al. (2000) emphasize that public access to emissions and trading data provides an additional incentive for compliance and that the use of information technology to implement tradable permits programs has facilitated public involvement in these programs.

There have been several experiments with tradable permits for conventional pollution control in developing countries and economies in transition, including Chile, China and Slovakia (Bygrave, 2002, USEPA, 2004). For example, Montero et. al. (2002) evaluates an experiment with tradable permits for total suspended particulates (TSP) in Santiago, Chile. They find that despite a lack of permit market development, there was improved documentation of historic emissions inventories and increased flexibility to address changing market conditions. Evaluation of practical experimentation with tradable permits in developing countries has been complemented by a small but growing literature on both the potential benefits of and obstacles to the use of these mechanisms. Panday and Bhardwaj (2004) found that a system of intra-plant trading in a steel plant in India would result in significant cost savings and better environmental performance than under conventional regulation. Gupta (2003) offers a number of suggestions for strengthening the monitoring and enforcement capacity that would be required to implement these types of programs. Wang et. al. (2004) find cost savings from the potential use of tradable permits for SO2 in China and they note several areas of capacity building that would support national implementation. These include a more explicit legal basis for cap and trade, standards and guidelines for measurement and verification of emissions, systems for data management, allowance allocations methodologies that provide appropriate incentives, and general education and outreach on emissions trading. Finally, several authors have analyzed the suitability of tradable permits programs for developing countries, including whether these programs require more developed environmental and market institutions than conventional regulatory programs. (Blackman and Harrington, 2000, Bell and Russell, 2002, Kruger et. al., 2004.)

13.2.1.3 Voluntary agreements

Voluntary agreements (VA) as used in this report are agreements between governments and one or more private parties to achieve environmental objectives or to improve environmental performance.[15] Voluntary agreements of all types play an increasingly important role in many countries as instruments to achieve environmental and social objectives. In recent years, over 300 negotiated agreements have been identified in the European Union, over 30, 000 local pollution control agreements in Japan, and over 40 voluntary programmes (more than 20 of direct relevance to climate change) managed by the federal government in the US (OECD, 1999d). Since 1990, over 13,000 organizations have participated in voluntary programs on all types of environmental issues sponsored by the US Environmental Protection Agency. Mazurek, (2002) Thousands more have participated in voluntary programs sponsored by many other governments, industry and independent third parties. In contrast to regulatory and even market-based approaches, voluntary approaches tend to be popular with those directly affected by these instruments, and thus can be used to address con-

[15] It should be pointed out that voluntary agreements are a subset of a larger set of "Voluntary Approaches." See Box 13.2 In addition to voluntary agreements as we have defined them, this larger set may include unilateral commitments by industry; private agreements between industry and stakeholders. Industry may negotiate standards of behaviour with public authorities, other firms in the same line of business, or private groups, and then allow third parties to monitor compliance.

cerns in areas where other instruments face strong political opposition. Thalmann and Baranzini (2005) provide a broad overview of the economics of voluntary agreements.

Under such agreements, firms commit to a level of environmental performance or social responsibility beyond legal requirements. The benefits of voluntary agreements for individual companies and for society may be significant. Firms may enjoy lower legal costs, can enhance their reputation, and may smooth their relationships with society and shareholders (OECD, 2001n). Societies gain to the extent that firms translate goals into concrete business practices and persuade other firms to follow their example. Often negotiations to develop VAs raise awareness of climate change issues and potential mitigative actions within industry (e.g. Kågeström et. al. 2000), establish a dialog between industry and government and help to move industries towards best practice. They can also play an important role in the development and evolution of national policies and institutions.

The structure of the VA can influence how effective it is at reducing emissions beyond business-as-usual levels16. Thus, more detailed and targeted voluntary approaches are likely to be more environmentally effective (Braathen 2002) and more cost-effective (Phylipsen and Blok 2002), although they also require a greater up-front government involvement. Indeed, although VAs are “cheaper” to implement than subsidies, the Dutch voluntary agreements have been estimated to cost 10-15 €/t CO_2 (Phylipsen 2002).

It is difficult to compare the “stringency” of different targets in the same sector, as different VAs are measured using different units, timeframes and/or boundaries. For example, the German VA on the steel industry is to reduce emissions of CO_2 per ton of rolled steel by 16-17% by 2005 compared to 1990. The Japanese target for the same sector is to reduce total energy consumption by 10% in 2010 compared to 1990 levels. Consequently, there are widely differing views as to the environmental effectiveness of VAs. Some governments, as well as industry, are of the opinion that VAs are effective in reducing GHG emissions (e.g. Sullivan and Rand 2001, CEC 2001, IAI 2002). The Australian Greenhouse Office has initiated several efforts to independently verify the Greenhouse gas Challenge Program (2003), most recently to foster the credibility through improved reporting measure. In general, studies of the design and efficacy of voluntary agreements have involved assessments of a single program (e.g. Arora & Cason 1996; King & Lenox 2000; Welch, Mazur & Bretschneider 2000; Rivera 2002, Khanna & Damon 1999)

Others are much more sceptical about the effect of VAs in reducing emissions over what would have happened anyway. Independent assessments of voluntary approaches - while acknowledging that there have been absolute emission improvements brought about by investments in cleaner technologies - have indicated that there is little improvement over BAU scenarios as these investments would have probably happened anyway (e.g. Rietbergen and Blok 2000, Kågeström et. al. 2000, OECD 2002b). In other cases, the fact that some targets set by VAs are met well ahead of schedule has led to questions about the validity of such targets (Buttermann and Hillebrand 2000). Thus, Braathen (2002) notes that if VAs are not sufficient to stimulate lower GHG emissions than would have happened in a business as usual scenario, their environmental effectiveness is questionable. Other analysis has indicated that VAs work best as part of a policy package, rather than as a stand-alone instrument (Torvanger 2002, Krarup and Ramesohl, 2002). Braathen (2002) indicates that the performance of many VAs would be improved if there were a real threat of other instruments being used if targets are not met. Design characteristics that would help to improve the environmental effectiveness of voluntary approaches include: setting clearly defined targets, developing a business-as-usual (baseline) scenario, having incentives in the case of non-compliance (e.g. sanc-

[16] The economic efficiency of VAs can be low, as they seldom incorporate mechanisms to equalise marginal abatement costs between different emitters (Braathen 2002).

tions or regulatory threats), putting in place an effective monitoring mechanism (including through an independent agency); and including third-party participation in the design of the VA.

There are relatively few comprehensive reviews of the effectiveness of voluntary programs. Lyon and Maxwell (2000), Darnall and Carmin (2003) In the survey conducted by Darnall, sixty one governmental, industry and third-party agreements were reviewed, mainly in the United States. Every voluntary agreement had at least some form of performance requirement, with two thirds requiring some form of written agreement. Overall, the results demonstrate that the voluntary programs had low program rigor in that they required limited levels of administrative, environmental performance and conformance requirements. For example, two thirds did not require participants to create environmental targets and to demonstrate that the targets were met. Similarly, almost half of the programs had no monitoring requirements. Compared to government programs, industry programs had stronger administrative requirements and third party programs slightly stronger requirements. Also, the government environmental performance requirements were weaker than those of the other two sponsors.

Box 13.2. *Examples of National Voluntary Agreements*

- In the Netherlands, and companies that account for almost all (96%) of Dutch industrial energy use have subscribed to an energy efficiency “benchmarking covenant” (ENDS 2002). The “long-term agreements” between the Dutch government and different industry sectors are legally binding once entered into.
- In Australia 100% of aluminium and cement producers, 98% of electricity generation and distribution and 98% of oil and gas extraction have signed up to the Australian “Greenhouse Challenge” (AGO 2002, Shevlin 2002).
- European automobile agreement: the EU Commission has negotiated an agreement with European, Korean and Japanese car manufacturing associations to reduce average emissions from new cars to 140 gCO_2/km by 2008-2009
- Canadian automobile agreement: the Canadian government and representatives of the domestic automobile industry agreed to a reduce emissions from cars and light duty trucks by 5.3 $MtCO_2e$ by 2010. The agreement also contains provisions relating to research and development and interim reduction goals.
- Climate Leaders: Under this U.S. program, companies develop comprehensive greenhouse gas inventories, set corporate emission reduction targets, and report annually their emissions and progress towards reaching their targets to the U.S. Environmental Protection Agency. See: http://www.epa.gov/climateleaders/
- Climate Vision: The U.S. Climate Vision program encourages industry efforts industry to reduce, capture or sequestering greenhouse gases. Climate VISION links these objectives with technology development, commercialization, and commercial utilization activities supported by the private sector and the government. See http://www.climatevision.gov/

13.2.1.4 Subsidies and other incentives

In liberalized markets, investors, operators and consumers should in theory face the full costs of their decisions. This applies to access to resources and capital, and the social and environmental impacts of consumption. Liberalized markets give suppliers, producers, distributors and consumers greater choices and flexibility. However, current prices in most countries fall short of the ideal because of market failures. In many cases, impacts of market failures may be hard to quantify and when they are, decisions on which they should be internalized involve political judgments.

One of the most important influences on markets is direct and indirect subsidies. Subsidies tend to expand the industry which is being subsidized, relative to the non-subsidy case. If the subsidized industry is a source of greenhouse gas emissions, then subsidies result in higher emissions. Subsidies to the fossil fuel sector result in over-use of these fuels with resulting higher emissions; subsidies to agriculture result in expansion of agriculture into marginal lands or expansion of certain subsidized crops. In either case, higher greenhouse gas emissions can result.

The IEA estimates that in 2001 energy subsidies in OECD countries alone were approximately $20-30 billion USD. (IEA, 2001) The level of subsidies in developing and transition economy countries is generally considered to be much higher. One example is low domestic energy prices that are intended to benefit the poor, but which often benefit high users of energy. The result is increased consumption and delayed investments in energy efficient technologies. OECD countries are slowly reducing their subsidies to energy production or fuel (such as coal), or changing the structure of their support to reduce the negative effects on trade, the economy, and the environment. One third of energy subsidies support coal production, however coal subsidies in OECD countries fell by 55% between 1991 and 2000 (IEA, 2001).[17] Subsidised production is expected to decline further over the next few years, as several OECD countries plan to reduce their remaining subsidies. See Figure 13.3. and Chapter 7 for additional information

[INSERT Figure 13.3. here]

Subsidies for agriculture remain high. In 2001, total support estimates to agriculture amounted to US$ 318 billion (OECD, 2002c), or 1.2 % of GDP in OECD countries. While during the 1990s many OECD countries began to take steps to reduce and restructure the subsidies so as to discourage overproduction, reduce trade distortions, and encourage more environmentally sound use of land, soil, and water, subsidies remain high in many OECD countries and for some commodities, with harmful environmental consequences. In 2001, total support estimate to agricultural producers was 31% of the value of farm receipts, compared with 38% in the 1986-1988 period. Several organizations (FAO, 2001 and OECD, 2001) have examined the GHG emissions from agricultural lands. One study has accessed the effects of the common agricultural policy on emissions in the European Union and found that in general during the last 30 years emissions have declined, but that there were variations among member states, with a few states showing increases. (Soares and Ronco, 2005)

Another form of a subsidy is export credit guarantees by OECD governments. In the late 1990s export credit guarantees facilitated 17 USD billion of annual investments in fossil energy and only 0.8 US billion in renewables.

13.2.1.5 R&D[18]

Many countries pursue research and development of technologies individually or jointly with others as a national policy because it is in their self interest, for example, because it may foster the development of innovative technologies that help domestic industries be competitive. When they chose to cooperate with others, the reasons vary, but often include: a desire to share costs, spread risks, avoid duplication, access facilities, enhance domestic capabilities, support specific economic and political objectives, harmonizing standards, accelerate market learning and create goodwill. Researchers join in collaborative efforts in order to access funding, link with foreign experts, access facilities, share data and enhance creative thinking. However, cooperation may have higher transac-

[17] Calculated using producer subsidy equivalents.
[18] As used in this section, the term R&D generally refers to research, development, demonstration and diffusion

tion costs, require extensive coordination, raise concerns over intellectual property rights and may prematurely foreclose other technology pathways. (Justice and Philibert, 2005)

Innovation is frequently pictured as a linear process, taking a new technology from research, development, demonstration and strategic deployment, until a technology can finally compete in mass markets. (Foxon, 2004) However, practical experience suggests that these processes often proceed in parallel, for example, market experience often refines the research results and at the same time helps to identify new research needs. For a variety of reasons, industry can only appropriate a fraction of the benefits of research and development investment at each of these stages19. In the energy sector in particular, technology 'spill over' is large20, investors face difficulties in evaluating intangible research and development outputs21, and regulatory interventions can cap profits in the case of path-breaking research success22.

The benefits of R&D may not arrive for two to three decades, which is beyond the planning horizons of even the most forward-looking companies (Anderson and Bird, 1992). Therefore, it is generally accepted that public support is required to achieve the optimal investment level, particularly areas such as untried renewable technologies, energy system integration, superconductivity, carbon capture and storage and hydrogen technologies. Popp, (2004) notes that when considering the potential for technology to help solve the climate problem, two market failures exist which lead to underinvestment in climate-friendly R&D: environmental externalities and the public goods nature of new knowledge. As a result, government subsidies to climate-friendly R&D projects are often proposed as part of a policy solution. Using the ENTICE model, the effectiveness of such subsidies, both with and without other climate policies, such as a carbon tax was analyzed. He notes that while R&D subsidies do lead to significant increases in climate-friendly R&D, this R&D has little impact on the climate itself. Subsidies address the problem of knowledge as a public good, but they do not address the environmental externality, and thus offer no additional incentive to adopt new technologies. Moreover, high opportunity costs to R&D limit the potential role that subsidies can play. While R&D subsidies can improve efficiency, policies that directly affect the environmental externality have a much larger impact on both atmospheric temperature and economic welfare.

Sathaye (2005) observed that when governments fund such research at government owned facilities, private companies and universities, such pursuits may result in the identification of patentable technologies and processes. They reviewed the process of allocating patent right to research organiza-

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[19] Margolis and Kammen (1999b) estimated the social rate of return on R&D investment to be around 50% and the private rates around 20-30% across various sectors, indicating that only a fraction of social returns are appropriated by private investors.

[20] Research results 'spill over' to competitors and therefore provide more benefit to society than to the investing company. As the investing company only captures a fraction of the benefit, it tends to invest less than what is socially optimal. According to Azar and Dowlatabadi (1999), overwhelming empirical evidence exists for the consistent (since Mansfield, 1968) of under-investment of private firms in R&D.

[21] Alic et al. (2003) assess private public research partnership under the Advanced Technology Program in the U.S. "Time lags, along with the difficulty inherent in retrospective evaluation of factors affecting the timing and character of innovations, make it difficult if not impossible to attribute specific commercial advantages to funding awarded much earlier." As a result, research and development intensive companies are systematically under-priced by the market as noted by Lev (2004) who studied more than 750 firms in sectors with substantial R&D in the period 1983-2000). In general, companies shifting funds away from basic research towards product modifications and extensions. The allocation of R&D funds to directed basic research declined every year from 1993 to 2003 in favour of modifications and extensions of current products.

[22] Renewable energy technologies compete in electricity wholesale markets that are frequently exposed to regulations, e.g., price caps. Since government regulators are also expected to intervene if a company with a path-breaking energy innovation extracts monopoly rents, this reduces incentives for private investment in long-term research and development.

tions in the United Kingdom, United States, Republic of Korea and Canada and found that such processes vary considerably and that IPR regimes have changed considerably since the ratification of the UNFCCC. While all share the goal of ensuring that technology is transferred and implemented as rapidly as possible, diffusion typically takes place along a pathway of licensing or royalty payments rather than use without restriction in the public domain. Popp (2002) also examined patent citations and found that the level of energy-saving R&D depends not only on energy prices, but also on the quality of the accumulated knowledge available to inventors. He finds evidence for diminishing returns to research inputs, both across time and within a given year and notes that government patents filed in or after 1981 are more likely to be cited. More importantly, descendants of these government patents are 30 percent more likely to be cited by subsequent patents. Earlier government research was more applied in nature and is not cited more frequently.

Improvements in patent laws are frequently proposed to increase incentives for innovation because there is a correlation between research and development input and patent output (Jaffe, 2000). However, Mansfield (1986) surveyed 100 firms in 12 industries. Patenting was considered instrumental to the development of innovations in less than 20% of the innovations, with only the petroleum industry (25%), chemical industry (38%) and pharmaceuticals (60%) showing high impacts of patenting. Rather than incentivising research and development, Cohen et al. (2000) suggest that firms patent in order to prevent competitors from patenting related innovations and to improve their negotiation position in patent infringement lawsuits. According to Jaffe (2000), patenting could be a "zero- or negative-sum game for society".

[INSERT Figure 13.4. here]

There is some debate over the impact of government funded R&D on society. For example, Goulder and Schneider (1999) argue that increasing R&D expenditures in carbon-free technologies could crowd out R&D in the rest of the economy and therefore reduce overall growth rates. However, Azar and Dowlatabadi (1999) refer to Mansfield's (1968) convincing counter argument: radical technological change will trigger more research overall and therefore increase economy-wide productivity rates. Irregardless of this academic discussion, support by governments for the development of renewable energy technologies has not improved since the TAR. Figure 13.4a shows that in the last decades only a small fraction of public energy R&D funds of IEA countries have been allocated to renewable energy technologies, less than 8% in the period 1987-2002, a low level relative to nuclear and fossil energy R&D. IEA (2004) Figure 13.4b shows the allocation of public R&D funds to different renewable technologies over time. IEA (2005) Funding has dropped after the initial interest created through the oil shock in the 1970s and has stayed constant, even since the UNFCCC was ratified. However, the aggregate picture hides the large uncertainty to which individual research streams are exposed. Funding levels for individual technologies in individual countries have changed by more than 30% in about half the observation years. This 'roller-coaster' of research funding limits the ability of laboratories to attract, develop and maintain human capital for successful research and development.[23]

[23] The total public funding for energy technologies in IEA countries in the period 1987-2002 was US$ 291 billion, 50% allocated to fission and fusion, 12.3% to fossil fuels and 7.7% to renewable energy technologies (in year-2000 US$ and exchange rates, International Energy Agency, 2004). Margolis and Kammen (1999) show that total investment in R&D in the US increased from US$100 billion in 1976 to US$200 billion in 1996, while US energy R&D decreased from US$7.6 billion to US$4.3 billion. Renewable fuels make up 4% of the United States' energy supply, yet receive only 1% of federal tax expenditures and direct fiscal spending, excluding revenue outlays for the Alcohol Fuels Excise Tax (Herzog et al., 2001). Kamman (2004), based R&D data provided by IEA,

There is little evidence to indicate that governments are capable of providing significant sustained support for R&D programmes over a 30-50 year time period for social purposes, exceptions may include nuclear power, defence, and some areas of public health.[24] As noted above, since the UNFCCC was ratified in 1992 there has been no increase in support for renewable research. This will limit the options available to governments and industry to respond to climate change in the future. Nevertheless, international cooperation relating to research and development can be a useful long-term measure, if supplemented with policies to promote deployment and diffusion.

13.2.1.6 Trade, foreign direct investment and ODA

Among the most important factors sustaining economic growth in OECD countries is openness to trade and foreign direct investment (FDI). Trade and investment generally promote economic growth, employment, and development by improving resource allocation, exposing producers to competition, and diffusing technology and knowledge. During the past few decades, OECD countries have reduced their tariffs and non-tariff barriers to trade and investment, although to a varying extent across different sectors. This process was particularly pronounced during the 1990s, when new regional trading arrangements were forged (especially in the Asia-Pacific, Europe, and North America) and the World Trade Organisation (WTO) Agreements were concluded. (Galeotti and Kemfert, 2004) See section 13.4.2.6 for additional information.

13.2.1.7 Non-Climate Policies

There are a number of non-climate national policies that can have an important influence on GHG emissions. These include: structural reform policies, liberalization and restructuring of energy and other markets, trade and foreign direct investment policies and population policies. During the last decade, countries with economies in transition and many developing countries, have implemented drastic market reforms that have had important effects on agriculture, industry, and energy use and production, and therefore GHG emissions. These have included financial deregulation, tax reforms, privatization of state owned enterprises and opening of capital accounts. These reforms while aimed at encouraging economic development have had both positive and negative impacts on GHG emissions. The TAR (WG III Chapter 6) discusses these policies extensively. The global population affects the consumption of natural resources, such as energy, and hence can also affect greenhouse gas emissions. Consumption of natural; resources varies significantly between developed and developing countries. New information on Governments' views and policies concerning population and development for member and non-member States of the United Nations, in the areas of population size and growth, population age structure, fertility and family planning, health and mortality, spatial distribution and international migration may be found in (United Nation, 2003), while the most recent data and estimates of the global population in 2050 may be found in United Nations (2002). This chapter focuses on new information relating to foreign direct investment and ODA.

13.2.2 Criteria for evaluating instruments

(Note to the readers of the FOD: In the final version of this chapter some of the following material may be moved to section 13.4 or vice versa)

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concluded that national research and development programs have frequently have exhibited "roller-coaster funding cycles."

[24] Exceptions are military programmes and cancer research (US)

13.2.2.1 Introduction

As note in Section 13.2.3 there are three main criteria for evaluating policy instruments *namely environmental effectiveness, economic efficiency and political feasibility. However, other criteria such transaction costs, administrative costs, and robustness against corruption may also be important in pursuing both ex post and ex ante evaluations*.

13.2.2.2 Environmental effectiveness

The main target of an environmental policy instrument is to achieve a reduction in the negative impact of human action on the environment. Harrington et. al. (2004) reviewed the literature and evaluated a number of case studies of national level pollution abatement policies in Europe and the United States using various criteria. Their main purpose was to test various hypotheses (preconceived notions) about economic and regulatory instruments. All the cases documented significant environmental results. One of the important findings is that the administrative burdens associated with both regulatory and incentive–based instruments are significant, i.e., the accomplishments do not come easily. Also interesting is the fact that the authors were able to find or re-create *ex ante* estimates of expected emissions reductions in all the U.S. cases and four of the European cases. Comparison of the *ex ante* with *ex post* observations suggests a reasonable degree of accuracy in the estimates. The cases in which emissions reductions were greater than expected involved incentive-based instruments. The cases in which reductions fell short of expectations involved regulatory approaches. This finding, consistent with other literature, suggests that regulators may be unduly pessimistic about the performance of incentive-based instruments or unduly optimistic about the performance of regulatory approaches, or perhaps both. Table 13.2 summarizes their hypotheses and findings, sorted first by those favouring economic incentives and secondly by regulatory instruments. Some of the hypothesis such as efficiency, effectiveness and regulatory burden may be more important than others.

[INSERT Table 13.2. here]

13.2.2.3 Economic Efficiency

The economic efficiency of a policy instrument is a key decision parameter in a world with scarce resources. Efficiency depends on the costs incurred during implementation of the instrument; the key cost categories will be discussed below. Besides through costs, inefficiencies may arise from behavioral parameters. The TAR of Work Group III provides an overview of the efficiency of different instruments in this section, we focus in particular on recent literature relating to emission trading.

Burniaux et. al. (2000) summarized the results of applied general equilibrium models; the leakage rates are from 6% to 20% depending on the specification of models. This analysis assumed that USA and Australia participate in the Kyoto Protocol. Since they are not going to participate in the Protocol, the leakage rates would be increased. Assuming that they do not participate in it, Tamechika (2005), also assuming non-participation by the US and Australia, estimates the leakage rates to be 53% when emissions trading is not utilized and 27% when it is fully utilized.

Generally emissions trading will have lower transaction costs than the Clean Development Mechanism (CDM) and Joint Implementation (JI) because the latter have costs associated with project identification and development, negotiation, baseline determination, monitoring, verification, review, certification, and enforcement. Michaelowa et. al. (2003) used survey data from the Activities

Implemented Jointly (AIJ) pilot phase and the Prototype Carbon Fund (PCF) programme and concluded that projects with annual emission reductions of less than 50,000 t CO_2 equivalent are unlikely to be viable. They argue that small scale CDM projects should get special treatment.

There have been a number of experiments using human subjects conducted on GHG emissions trading. Bohm (1997) and Hizen and Saijo (2001) found that the market efficiency in experiments is quite high (91.9-99.9%). Furthermore, Bohm and Carlén (1999) showed that the market power problem is not as serious as other researchers suggested, since participants in an emissions-trading market can buy and sell the permits. However, the experimental design did not include several important features in GHG emissions trading such as the effects of investment irreversibility and investment time lag. Investment irreversibility means that once a country invests a certain amount in the abatement of emissions, it is hard to return to the original position. For example, once a country started to build a nuclear power plant, it is difficult to reverse the investment decision.

Including these two features of abatement investment, Kusakawa (2005) identified a 'success case' and a 'bubble case'. In the success case, relatively low contract prices in the early stage caused insufficient emissions reduction by suppliers, and in many cases demanders made excessive reductions to avoid a non-compliance penalty just before a deadline for emissions reductions. Although this caused efficiency losses, these were minor. In the bubble case high contract prices in the early stage or an expectation of high prices in the future caused some subjects to make excessive reductions. Nevertheless, contract prices did not drop immediately due to price inertia, so that some subjects continued to reduce their emissions. The efficiencies of these sessions were relatively low. Baron (2001) also found the bubble case in his experiment using government officials of various courtiers.

13.2.2.4 Political feasibility

Economists have often set out theoretically desirable features of market-based instruments for environmental policy; however those theoretical prescriptions are rarely met in practice. The main reason for this disparity is that governments cannot design and implement policies without taking into account political realities. Policy choices must be acceptable to a wide range of stakeholders, and must be supported by institutions, notably the legal system, the human capital and infrastructure, and take into consideration the dominant culture and traditions. The decision making style of each nation is therefore a function of its unique political heritage. The political economy literature looks at the factors that influence the design of policies, including the influence of different pressure groups, political sensitivity of governments for the poor, and the past history of policies. Sayer (2000) provides an overview of political economy, while Kirchgässner and Schneider (2003) and Pearce (2002a) consider political economy and the environment, focusing on the political difficulties of introducing market-based instruments.

An example for one country is shown in Box 13.3 is taken synthesized many from (Pierce 2004). A broader discussion of the importance may be found in the TAR Working Group III Chapter6

***Box 13.3**. The United kingdom Climate change Levy: A Study in Political Economy*

Background:
The United Kingdom has had a strong tradition of action on climate change, dating mainly from the early acceptance of the problem by Prime Minister Thatcher in 1988. The Labour government in 1997 reaffirmed the commitment to act on climate change and to use market-based instruments where possible. However, the new government had concerns that made the design of such measures complex. First, the government did not wish to introduce measures that might have a disproportionate effect on the

poor. Second, Labour owed an allegiance to the coalmining communities, in stark contrast to the previous government which had successfully made overt attempts to curtail the power of the mineworkers. Third, Labour had to escape a past image of 'high tax and high public spending', so that whatever measures were introduced had to be as friendly to industry as possible and had to avoid the impression that any new tax was simply for revenue-raising.

What are the UK greenhouse gas targets?

The EU-wide burden sharing agreement linked to the Kyoto Protocol sets a 12.5 per cent reduction in all gases relative to 1990 by 2008-12. The UK has a domestic 20 per cent reduction goal in carbon emissions by 2010 and an 'aspirational' goal of 60 per cent reduction of 1990 emissions by 2050. The two domestic targets, which are not linked to international agreements, indicate the strength of government commitment to climate change control.

What is the levy?
The levy itself has features that are readily explained by the need, as government saw it, to avoid taxing households, keep industrial cost burdens to a minimum, and bring industry on board with the UK climate change programme. The levy is 'downstream', i.e. is paid by energy users not extractors or generators, is levied on industry only, with households and transport being exempt, and is structured so as to encourage renewable energy, but not nuclear power (users of nuclear electricity pay the tax). An 80 per cent discount could be secured if the industry in question negotiated a 'climate change agreement', i.e. an industry package of measures to reduce emissions relative to some baseline. Anyone over-complying with their agreement could, in principle, trade the resulting credits into the UK emissions trading scheme, along with permits allocated under that scheme and renewable energy certificates under a separate renewable energy constraint on generators. In this way the levy is linked to the other measures in the climate change programme.

Is the climate change levy effective?
The design of the levy reflects the political economy considerations of government. The issue reduces to asking how effective it is relative to what the alternative measure might have been. Coverage is limited because of the exemption of households, who must nonetheless bear some incidence of the tax, and transport which is subject to other tax measures. The electricity generators have no incentive to switch between fuels by carbon content because the tax is levied downstream rather than upstream. What is clear is that a pure tax would have come into conflict with government goals concerning household vulnerability, competitiveness concerns and the sensitivity of some sectoral interests.

Is it a good tax?
It has made a contribution to the UK climate change targets, but this measure of effectiveness assumes that the alternative was doing nothing. It may well have fared better than some outright regulation measures, but whether it has done better than a pure carbon tax is very much open to debate. The political economy literature argues that there is little point in comparing actual measures against ideal measures if the ideal measures could never be implemented.

Michaelowa (2003) notes that industry was offered a rebate of 80% of the tax if they negotiated agreements on greenhouse gas reduction with government. Industrial emitters wanted to get an instrument to reduce cost implications of the climate change levy beyond the discount. With lobbying, they managed to set up a voluntary emission trading scheme. Under the so-called "auction" companies with annual emissions above 10,000 t CO_2 equivalent could bid for allocation of subsidies. The "auction" offered subsidies of 360 million € and yielded a de-facto subsidy of 27 €. Thus the trading scheme has design elements that strongly reflect the interest groups involved.

Special interest groups of all types often attempt to influence the outcome of political decisions. Bulkeley (2001) describes the different interests in the Australian climate policy debate and shows how industrial emitters managed to steer the country from a position supporting ambitious reduction targets to the request of an emissions increase at the third Conference of the Parties in Kyoto. Due to lobbying, Australian climate policy was framed as looking for no-regrets measures. While emitters argued that no-regrets should be interpreted on an aggregated level, emitters argued that each measure on its own should not have a cost. Steurer (2003) describes the lobbying in the US which led to President Bush's withdrawal from the Kyoto Protocol. Blanke (2002) shows the influence of lobbying on the design of Germany's ecological tax reform, while Schrader (2002) compares it with the UK climate change levy. Both conclude that industrial emitters managed to get large exemptions. Storchmann (2006) shows how German coal subsidies were hidden in a complex system of 58 different measures; however since 2002 they have been streamlined to 6 and are thus easier to attack.

There are often differences between the formulation of national emission targets and actual measures implemented to reach these targets, as described for the EU by Gupta and Ringius (2001), Germany by Michaelowa (2003), the Netherlands by Anderson and Mol (2002) and Norway by Andresen and Butenschon (2001). This literature notes that ambitious targets were negotiated with high public awareness about climate change. Subsequently pressure from industrial emitters led governments to introduce instruments that would have less of or not burden emitters. In the case of Germany, for example, the resulting combination of instruments is very cumbersome and leads to hugely varying marginal abatement costs (Michaelowa 2003). Woerdman (2004) argues that sunk costs, switching costs and learning explain why European politicians were initially tempted to add credit trading to existing, sub-optimal policies and only external shocks caused the introduction of a capped trading system. In contrast to public choice-type analyses, Foljanty-Jost and Jacob (2004) argue that the German climate policy community forms a network that is divided into environmental and economic interests, but it is not fragmented. Levels of conflict are seen as low and co-operation and information exchange is not divided along conflict lines.

13.2.2.5 Mitigation/adaptation policies

Climate policy options can include both mitigation and adaptation (see chapter 17 of WG II report for a discussion on adaptation policies and chapter 18 for a detailed analysis of interaction between mitigation and adaptation). Many adaptation options are pathways towards effective and long-term mitigation and, in turn, several mitigation options can facilitate planned adaptation. Examples of areas where there are potential synergies include: water management strategies, farm practices, forest management strategies and residential building standards. Mitigation and adaptation instruments that maximise the potential synergies between them could become socially and economically efficient and may offer opportunities for countries to achieve sustainable development targets, even in the face of uncertainties. This is especially important given the limited financial and human resources in developing countries (Dang et al. 2003).

Some governments are assessing and developing both adaptation and mitigation policies; the former to cope with the additional warming and other effects that cannot be avoided and the later to minimize future impacts. Examples of countries that are actively developing adaptation programmes include: Australia, Finland, France, New Zealand and the United Kingdom. (New Zealand, 2004) However, the literature provides few examples of countries that have developed optimum mitigation and adaptation policies.

13.2.2.6 National policy interactions/linkages and packages

Climate change considerations provide both developing and developed countries with an opportunity to look at their respective development strategies from a new perspective. Fulfilling development goals through policy reforms in such areas as energy efficiency, renewable energy, sustainable land use or agriculture, will often also generate benefits related to climate change objectives. Additional local benefits related to technology and other resource transfers aimed at climate policy objectives may also be generated. Poverty reduction strategies provide unique opportunities to integrate climate initiatives and other issues related to environmental sustainability into poverty reduction efforts.

Climate related policies are seldom applied in complete isolation – in a large number of cases one or more instruments will be applied. The mere existence of instrument mixes is, however, obviously not a 'proof' of their environmental effectiveness and economic efficiency. A rather obvious first requirement for applying an environmentally efficient and economically effective instrument mix is to have a good understanding of the environmental issue to be addressed. In practice, many environmental issues can be more complex than perhaps first thought, as they often have a number of relevant, and often correlated, 'aspects' or characteristics' – and many of the instruments that are applied contain a large number of separate 'rules' or 'mechanisms'. A tax (or a tradable permit system) can affect the total amount used of a given type of product and the choice between different product varieties, but could – inter-alia for monitoring and enforcement reasons – be less suited to address, for example, how a given product is used, *when* it is used, where it is used, etc. Hence, other instruments could in any case be needed. A second requirement for designing efficient and effective policies is to have a good understanding of the links with other policy areas. In addition to coordinating different environmental policies, co-ordination with other related policies is needed. A third requirement is to have a good understanding of the interactions between the different instruments in the mix. Various instruments can interact in a number of ways. For example:

- R&D expenditures are more important in a carbon tax instrument than in emissions trading scheme and can spill over from one party to another. (Golombek and Hoel, 2003)
- A labelling system can help increase the effectiveness of a tax by providing better information to the users on relevant characteristics of different product the tax applies to. The price elasticities of concern can hence increase.
- Combining a tax on energy use with targeted subsidies for better isolation of buildings can be a good way to address split incentives.
- The combination of a tax and a voluntary approach can increase the 'political acceptability' of the former – by limiting any negative impacts on sectoral competitiveness – at the cost of reduced environmental effectiveness or increased economic burdens placed on other economic actors.
- Setting a price cap and a tradable permits system can help limit compliance cost uncertainty – compared to the application of a trading system in isolation, but may increase the uncertainty related to the environmental effectiveness.

Several countries have under taken a more integrated and strategic approach to promote technologies and emission reductions. One example of an integrated and strategic approach is the promotion of wind energy in Denmark. The successful deployment of wind turbines in Denmark is the result of local community involvement, subsidies to energy companies, public and private R&D support and government support. Over time, Denmark has developed domestic industries to design, finance, insure, manufacture, install and maintain renewable systems using local labour. It suggests that successful deployment requires an integrated approach and a learning process not just by different industrial sectors, but by communities as well.

Note to readers of the FOD: The literature relating to international emission trading, the Clean Development Mechanism and Joint Implementation is lagging the dynamic process of implementing these mechanism and therefore it is likely that these sections, in particular, will need to be updated.

13.3 International climate change agreements and other arrangements

International climate change agreements have multiple characteristics that are affect their relevance and effectiveness. In addition, most agreements are built on multiple agendas, including not only those related to climate change, but also to sustainable development, as well as sectoral and to environmental policies. These complex and interlinked features can only be evaluated using comprehensive and often equally complex criteria. Additional discussions on some of these links can also be found in Chapters 2, 3 and 12.

13.3.1 The context for climate change and related agreements

Action to mitigate climate change and other global environmental problems are driven by a variety of concerns. One key interest is to reduce emissions of greenhouse gases and future damages associated with climate change, other drivers are often at least as important. These include national (as well as local) development, efforts to increase international, national or local competitiveness, efforts to promote equity (between countries or between regions or groups within a country), corporate citizenship, public relations, and moral or religious beliefs. Each are addressed below.

13.3.1.1 Emissions/environmental goals

Environmental and emissions goals are one of the primary drivers of climate agreements. The language of the UN Climate Convention and Kyoto Protocol attests to the importance of these goals in reaching consensus and taking action. Legislation in national and regional legislatures as well as corporate policies further highlights the importance ascribed to the environmental goals.

A fairly recent development in the climate change literature and the international debate on future agreements has been driven by new work on the effects of GHG emissions and associated temperature and climate change impacts. For example, Toth (2003), Toth et al. (2003a, b) developed the integrated assessment model ICLIPS to underpin the Tolerable Windows Approach. This approach outlines corridors for future carbon emissions that would keep the climate system within specific ranges at specified costs. Meinshausen (2004) has examined the probability of exceeding certain temperatures (and hence environmental damages) if temperatures rise above specific levels. While the damages themselves are the purview of Working Group II of the IPCC, the effect such models have had has been to refocus political attention on agreements that reduce the environmental effects of climate below set levels. Notable in the range of political statements to this effect is the European Unions call for a new, post-Kyoto regime that assures the world will not exceed a 2º C limit on global average temperatures (see European Council, Presidency Conclusions, 2005).

Efforts to promote development are often taken piecemeal, without regard to the links between the pillars. For example, in the energy sector (which, according the UNFCCC statistics, is responsible for about 80% of global GHG emissions), policy efforts are often designed to focus on energy security, reliability or access. However, if properly designed, these can also facilitate more sustainable development. For example, reduced oil demand leads to a lower balance of payments, additional individual income that can be spent on other societal needs, and reduced environmental pollution. In most case, the non-environmental components of sustainable development take priority over the environmental ones: immediate demand for access to electricity, clean water and health care, along with limited financial resources, have historically led to increased emissions, with little account taken of the associated local or global environmental damages In addition, the case studies and analysis in Bradley and Baumert (2005) suggest the priorities within the development agenda is usually driven by national, rather than international agendas – although sources of funds, particularly for least developed countries, may often come from development assistance, World Bank lending or other aid programs.

Both the UN Climate Change Convention and its Kyoto Protocol explicitly acknowledge the need for development. Literature related to the development of post-Kyoto agreements continues to include this concept (see, Heller and Shukla, 2003, Baumert et al, 2002, Bodansky, 2003), suggesting both its widespread acceptability in the community, as well as its centrality to any future agreement.

Another aspect of development that is a locus of attention in the economic community is the relative value of actions taken today versus benefits that accrue in the future. For example, Newell and Pizer (2004) look at the impact of discount rate uncertainty in the future on valuation of benefits, and find that future valuations rise by a factor of many thousands at horizons of 300 years or more. As this would almost double the expected present value of climate mitigation benefits relative to constant 4% discounting, it has clear implications for development policies. A more extensive treatment of this issue is provided in Chapter 2 and 3 of this report, as well as in the IPCC Third Assessment Report

Another area of focus in the climate/development debate has been that of impacts. In examining the consequences to built infrastructure, managed and unmanaged ecosystems, water and health, a variety of scientists have concluded that significant damages can begin to occur at temperature increases ranging for a few tenths of a degree and higher. (For a more complete treatment of damages and impacts, see the contribution to the fourth assessment report from IPCC Working Group I and II; treatment of impacts is also incorporated in the IPCC Special report on Emissions Scenarios, 2001.) When these are correlated to concentrations, and from there to emissions, they create a framework for driving significant emissions reductions – and the concomitant global agreements under which such reductions might be taken (see Pershing and Tudela, 2003, Corfee-Morlot and Höhne, 2003, and others.)

13.3.1.2 Competitiveness

GHG constraints – and hence the lack of such constraints, could increasingly affect the competitiveness of specific companies, industry sectors and nations. At the local and company-specific level, adding a price to carbon or other GHG emissions could affect profitability and shareholder value (see, for example, Austin et al, 2003, on the impact of possible future carbon constraints on the transportation industry – and specific companies within it, and Austin and Sauer, 2002, which examines similar impacts in the oil and gas sector). Agreements are sometimes designed to reduce such impacts. Noteworthy among those at the sectoral level is the agreement among the European, Japanese and Korean automobile manufacturers to reduce CO_2 emissions from passenger vehicles. In large part, this was designed so that a single country, acting alone, would not disadvantage its own auto manufacturers in the context of designing new transport related emissions policies.

At the national level, it has been asserted (see, for example, European Commission, 2001) that early movers toward climate constraints reap the benefits in terms of increased competitiveness and commercial advantages. Such advantages may be abetted through subsidies to affected industries, as well as special incentives to develop new technologies of commercial value in GHG constrained economies. In a more specific sense, the effects of competitive advantages play out in the context of the evolving emissions trading and project-based offsets regimes. For example, Szabo et al. (2006) analyze the impacts of emissions trading on the global cement sector, using a simulation model where business-as-usual emissions increase by over 50% between 2000 and 2030. Under an

EU15-wide emission trading scheme the costs of fulfilling the Kyoto Protocol targets in the cement sector would be reduced by 50 million €. At the equilibrium price of 28 €/t CO_2, the cement industries of most of the EU-15 countries would be permit buyers. If the trading scheme is enlarged to the EU-27, the permit price would fall to 18 €/t CO_2) and benefits would increase to 67 million €. Accession countries would mainly benefit from a surplus in their assigned amounts, but their projected growing cement consumption reduces their trading potential by 2010. An Annex B-wide emission trading would reduce the price to 15 € and benefits increase to 99 million €.

13.3.1.3 Equity

Equity has consistently been, and continues to be a driver for international agreements. The desire to reduce distributional effects between countries and among industries, as well as to properly allocate intergenerational costs and benefits, has driven the negotiation and adoption of many agreements. The importance of equity issues to the climate change debate is clear: language focused on equity issues features in both the UN FCCC and its Kyoto Protocol. A central issue in climate policy is thus to find some combination of equity, participation, and efficiency that maximizes results

Two important strands in the equity problem relate to within and inter-generational equity (see, for example, Ashton and Wang, 2003). Generation equity issues include numerous sub-elements (see Dwarkin, 1981a,b), including: responsibility and compensation; entitlements; capacity; and basic needs. Intergenerational equity issues arise particularly because of the long time lags associated with climate change mitigation and impacts. Ashton and Wang (2003) argued that future generations will have no responsibility for the problem that is handed down to them. They are also entitled to a fair share of carbon emissions. Their capacity to cope with climate change is uncertain and their basic needs will be no less important than ours. Furthermore, it is impossible to negotiate with them since they are not at the table.

A key element in the equity debate is related to national participation in global agreements: partial participation of all parties inevitably implies some violation of equity. Saijo and Yamato (1999) found that it is impossible to design a system (whether voluntary or binding) in which every party has an economic incentive to participate, *and* a system that assures efficient allocations. Thus, there are parties that benefit from *not* joining the system. For this reason, Carraro and Siniscalco (1993) considered coalition formation among parties – although they conclude that it is difficult to achieve global participation. This conclusion is supported by Bosello et.al. (2001), who find, using simplified assumptions and model results from RICE, that most Annex I countries in the Kyoto Protocol "lose" by ratifying the agreement (i.e., the equivalent net benefits possible through free-riding and letting other countries reduce emissions is larger than the net benefit of domestic reductions). Several formulas have been proposed to share the level of efforts in reducing emissions between the participating countries (see 13.4.2.2). These can either be based on one of the above equity principles (need could lead to equal per capita entitlements) or try to accommodate all of them, for example, the Triptych approach.

Moral and religious beliefs have also played a role in evaluations of equity – and hence in the development of environmental agreements and practices (see Brown, 2001). Conferences, such as those in Tehran in 2001co-sponsored by UNEP on Environment, Religion and Culture, as well as academic programs (such as the Harvard University Forum on Religion and Ecology, established in 1996), and speeches by religious leaders at international negotiations of the UNFCCC attest to the influence of this community.

13.3.1.4 Public relations/corporate citizenship

The issue of climate change has attracted increasing business attention in the past decade. Whereas companies initially aimed primarily at influencing the policy debate, corporate strategies increasingly include economic responses. Existing classifications for climate change strategies however still reflect the political; non-market components. Using empirical information from the largest multinational companies worldwide, Kolk and Pinske (2004) examine current market responses, focusing on the drivers (threats and opportunities) and the actions being taken by companies to address climate change. They develop a typology of climate strategies that addresses the market dimensions, covering both the aim (strategic intent) and the degree of cooperation (form of organisation). They conclude that most companies aim either for innovation or compensation, while the organisational arrangements to reach this objective can be oriented at the company level (internal), at companies' own supply chain (vertical) or at cooperation with other companies (competitors or companies in other sectors - horizontal).

Multinational corporations are increasingly facing global environmental issues demanding coordinated market and non-market strategic responses. The home country institutional context and individual company histories can create divergent pressures on strategy for MNCs based in different countries; however, the location of MNCs in global industries and their participation in 'global issues arenas' create issue-level fields within which strategic convergence might also be expected. Levy and Kolk (2002), analyzing the responses of oil MNCs to climate change, find that local contexts influences initial corporate reactions, including pressure for environmental performance. However, they also note that over time, companies seek to harmonize their efforts across the corporation and thus, across countries.

13.3.2 Elements of international agreements and related instruments

The main elements of climate change international agreements are listed in Box 13.4, and expanded upon in the sections below. International agreements on climate change have been evaluated by a number of authors (see, for example Tol and Verheyen (2004), Bodansky (2004), Hohne et al (2005). Perhaps unsurprisingly, the majority of these treatments seek to evaluate existing multilateral agreements (the UNFCCC and its Kyoto Protocol). However, other agreements, related to climate change but not specifically focused on GHG mitigation, are less extensively analyzed in the climate literature. These include energy policy and technology agreements (see for example, work by the International Energy Agency evaluating their "Implementing Agreements"), international efforts on electricity regulation (see CITE), evaluation of voluntary arrangements with the auto sector (see, for example, Sauer et al, 2005 on the ACEA agreement between the European, Japanese and Korean auto manufacturers).

Box 13.4. *Elements for climate change agreements*[25]

A number of elements are commonly included in existing – and proposals for new – international climate change agreements. These include

Goals: Most agreements establish objectives that implementation is supposed to achieve. In the climate context, a variety of goals have been proposed, including those related to emissions reductions, stabilization of GHG concentration, avoiding "dangerous" interference with climate, technology transfer, and sustainable development. Goals can be set with varying degrees of specificity.

Actions: All agreements call for some form of action. These also range widely, from obligations to set national cap on emissions, to establishment of standards for certain sectors of the economy, to financial payments and transfers, to technology development, to specific programs for adaptation, to reporting and monitoring. Actions include those to be taken immediately as well as ones that may take effect only over the longer term; actions may be taken internally (within contracting Parties) or with others (both with non-Parties as well as non-State actors).

Participation: All agreements are undertaken between specific groups of participants. Some have a global scope while others focus on a more limited set of Parties. Agreements may be global, regional in nature, or limited to arrangements between private sector partners. Obligations can be uniform across participants, or differentiated among them.

Compliance provisions and other mechanisms: Many agreements contain provisions for establishing and maintaining supporting institutions. These perform tasks as varied as serving as repositories for specific, agreement-related data, to facilitating or even adjudicating compliance, to serving as clearing houses for market transactions or information flows. In addition, most agreements have provisions in case of non-compliance. These include binding and non-binding consequences, and may be facilitative, or more coercive in nature.

Other elements: Many (although not all) agreements contain additional elements, including, for example, "principles" and other preambular language. These can serve to provide context and guidance for operational elements, although they may themselves be points of contention during negotiations.

13.3.2.1 Goals

As noted in Table 13.3, most agreements (including those on climate change such as the UNFCCC and the Kyoto Protocol), include specific goals and objectives.

Since the release of the IPC TAR, there have been both new policy announcements, as well as new analysis related to the UNFCCC's ultimate objective "to achieve […] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner." These include agreements within the European council (e.g., first agreed in 1996 and reconfirmed in 2005) that the global mean temperature increase should be limited to 2°C above pre-industrial levels (European

[25] While not an element, agreements often contain specific information as to the time for commencing actions, and often, a date by which efforts are to be completed. In addition, many agreements contain provisions for evaluating progress – with a timetable for reviewing the adequacy of efforts, and evaluating whether they need to be augmented or modified.

council 1996; 2005); a call for reducing emissions 60% by 2050 (Prime Minister Blair of the UK), a call for reducing emissions fourfold by 2080 (Prime Minister Chirac); see Pershing and Tudela 2003 for a review of these proposals.

In parallel analytical efforts, there has been new work on the effects of GHG emissions and associated temperature and climate change impacts. For example, Toth (2003), Toth et al. (2003a, b) developed the integrated assessment model ICLIPS to underpin the Tolerable Windows Approach. This approach outlines corridors for future carbon emissions that would keep the climate system within specific ranges at specified costs. Other analyses, e.g., by Hare and Meinshausen (2004) and Meinshausen (2005) have suggested that the probability distribution function of climate sensitivity (based on the most recent set of probability distribution functions) requires a more stringent and nearer term reduction in emissions if concentrations – and hence temperatures – are to be controlled. In his analysis, in order to limit temperature change to 2°C or less with a probability of 80% or more, concentrations cannot rise above 400 ppm CO_2-equivalent.

Several authors have examined emission pathways towards stabilization of the climate that include all greenhouse gases, not only CO_2 (Reilly et al., 1999; Eickhout et al., 2003; Meinshausen et al., 2004; Den Elzen and Meinshausen 2005; Wigley et al., submitted). Meinshausen et al. (2004) and Den Elzen and Meinshausen (2005a) conclude that lower concentration stabilization targets (ranging from 400to 550ppm CO_2-eq.) would be necessary to increase the certainty of reaching a 2°C target. For these lower concentration targets, these studies assume a certain overshooting (or peaking), i.e. concentrations may first increase to an 'overshooting' concentration level up to 480 or 525ppm before stabilizing at 400 or 500ppm CO_2-equivalet, respectively. Allowance are made for overshooting in part to attempt to avoid drastic, immediate reductions in the present emission pathways. The science of the climate system and related damages are the purview of Working Groups I and II of the IPCC; this section seeks more explicitly to address the effect such models have had on informing decision makers about how to formulate agreements that reduce the environmental effects of climate below set levels.

Options for the design of international regimes consider long-term stabilization of the climate system in several ways:

One option is a long-term CO_2 concentration or temperature stabilization level. A discussion on the level of greenhouse gas concentrations that are "dangerous" helps to clarify the magnitude and scope of the problem. While a large number of authors have commented on this issue, several have suggested that it may be difficult to gain an agreement on any set "dangerous" levels due to political and technical difficulties (Pershing & Tudela 2003, Corfee-Morlot and Höhne 2003).

An alternative to agreeing on specific CO_2 concentration or temperature levels is an agreement on specific long term actions such as for example "eliminating carbon emissions from the energy sector by 2060". An advantage of such a goal is that it might be linked to specific actions. A disadvantage would be that several different targets would have to be set to cover all climate relevant activities (Pershing & Tudela 2003).

Another option would be to adopt a "hedging strategy" (IPCC 2001b, chapter 10), defined as a shorter-term goal on global emissions, from which it is still possible to reach a range of desirable long-term goals. Once the short-term goal is reached, decisions on next steps can be made in light of new knowledge and decreased levels of uncertainty. To implement this option, the international community could agree on a maximum quantity of permissible greenhouse gases emissions in, e.g., 2020 (see also Corfee-Morlot and Höhne 2003, and Pershing & Tudela 2003).

Another proposal would aim to formulate reductions step by step, based on the willingness of countries to act, without explicitly considering a long-term perspective. While such an approach does meet political acceptability criteria, it poses the risk that the individual reductions may not add up to the level required for certain stabilization levels. Some stabilization options may be out of reach in the near future.

Several studies have analyzed the emission allocations or requirements on emission reductions and time of participation in the international climate change regime to be able to ensure different stabilization targets, including the EU goal of limiting temperature increase above pre-industrial level to 2°C[26] (Jacoby, 1999; Berk and Den Elzen, 2001; Blanchard, 2002; Winkler et al. 2002; Criqui et al., 2003; Den Elzen and Meinshausen, 2005a; Den Elzen and Meinshausen, 2005b; Den Elzen and Berk, 2003; Den Elzen et al., 2005a; Den Elzen and Lucas, 2005; Den Elzen et al., 2005b; Groenenberg et al., 2004; Höhne, 2005; Höhne et al., 2003; Höhne et al., 2005; Michaelowa et al., 2003; Nakicenovic and Riahi, 2003; Persson et al., 2005; WBGU, 2003). They analyzed a large variety of system designs for allocating emission allowances / permits (before emissions trading), including contraction and convergence, multistage, triptych and intensity targets.

Several parameters and assumptions influence these results: future emission, population, GDP development of individual countries or regions, global emission pathways that lead to climate stabilization (including the uncertainty about the climate sensitivity for different concentration stabilization targets), parameters about thresholds for participation or ways to share emission allowances.

The conclusions of these studies can be summarized as follows:

- Under the considered regime designs that aim at a maximum temperature increase of 2°C above pre-industrial levels, i.e. a range of associated levels of greenhouse gas concentrations, developed country greenhouse gas emissions would need to be reduced substantially during the next century. Developed countries as a group would need to reduce their emissions below 1990 levels in 2020 (in the order of -5% to -30% below 1990 levels) and to low levels by 2050 (-60% to -90% below 1990 levels). The reduction percentages for individual countries vary between different regime designs and parameter settings and may also be outside of this range. However, the general order of magnitude stays the same.
- Under the considered regime designs that aim at a maximum temperature increase of 2°C above pre-industrial levels, developing country emissions need to deviate from what we believe today would be their reference emissions as soon as possible. For the advanced developing countries this should occur even as of 2020 (mostly Latin America, Middle East, and East Asia). Actions from developed countries, such as technology transfer or financial contributions could assist Non-Annex I countries.
- Reaching lower levels of greenhouse gas concentrations requires earlier reductions and faster participation compared to higher levels of greenhouse gases.
- For many countries, the difference in reductions needed to reach certain greenhouse gas stabilization targets (e.g. 400, 450, 550, 650 ppmv CO_2eq.) is larger than the difference between the various approaches aiming for one stabilization target. Hence, for those countries the choice of the long-term ambition level may be more significant than the choice of the approach.

13.3.2.2 Participation

[26] Most of the studies use stabilization of CO_2 concentration at 450 ppmv as a proxy for the 2°C target, but several studies also look at a range of concentration targets.

As noted in the Table 13.3, participation in international agreements can vary, with diverse groups of countries as well as differentiation within a single agreement as to obligations of Parties. Participation in the UNFCCC and the Kyoto Protocol can be divided into several groups (Figure 13.5). Options for future agreements have been widely discussed by Höhne et al. 2005, Torvanger et al. 2005, Bodansky 2004, Baumert et al. 2002:

1. Splitting participants in two groups. Usually the literature refers to a group of more developed countries (akin to Annex I in the UNFCCC), and a group of "other" countries (e.g., in UNFCCC jargon, Non-Annex I countries). Participation in the first group is usually assumed to be gradually extended, either by amendment of existing provisions in international treaties, or though the establishment of new agreements. In the Convention, Annex I countries were assigned based on 1992 membership in the Organization for Economic Co-operation and Development (OECD), along with countries with "economies in transition" (EITs – the Russian Federation and several other Central and Eastern European countries). While the Kyoto Protocol updated Annex I by adding those countries that applied to be included and changing the names of those whose geographical borders changed (new states formed out of Yugoslavia and Czechoslovakia), there has been considerable opposition to further modification to the Annex B list (e.g., petitions to move into Annex I by Kazakhstan, or out of Annex I by Turkey have been strongly opposed), which has led to a rigid divide between the two groups.

2.Developing a system of multiple stages, where countries graduate from one stage to another, and where different of commitments are applied at different stages (see Gupta 1998, 2003, Berk and Den Elzen 2001, Gupta and Bhandari 1999, 2003 Höhne et al. 2003, 2005, Michaelowa et al. 2003, Criqui et al. 2003, Ott et al. 2004, Torvanger et al 2005). In one example of such a structure (the Multistage approach by RIVM, described in Berk and Den Elzen 2001, Den Elzen et al., 2004a) the first stage is an intensity target, the second stage calls for constant emission levels and the third stage requires absolute emission reductions. There are many variations on this theme (e.g., Gupta and Bhandari 1999, 2003, suggest a combination of intensity and per capita targets; Höhne et al. (2003) proposed a first "soft" stage of sustainable development policies and measures, followed by moderate emission limits and, finally, emission reductions; and Ott et al, 2004, proposed a system with 6 country groups and assigned different types of targets and financial responsibilities to these groups). A definition of when a country moves between stages is crucial to all multi stage proposals. It is clear that such staged proposals must also, separately, address the issue of stringency if a long term goal of stabilization is desired.

3.Developing a menu of commitments. In this system, each participating country chooses the type of commitment that best suits its conditions (see Kameyama 2003, Reinstein, 2004, Bradley and Pershing, 2005). Such activities may be focused on local or national development priorities as well as (or instead of) on climate change. If specific global emissions goals are to be reached, incentives may be needed to drive additional action. The literature also makes it clear that it will be difficult to compare such efforts across countries (see Bradley and Pershing, 2005 and Philibert, 2005). Information and mutual trust will thus likely be critical components of any international regime that seeks to adopt such an approach.

4. Applying a single type of commitment to all countries. One such approach, outlined by Meyer (2000), is that of contraction and convergence. This approach applies absolute binding emission targets to all countries so that per-capita emission allowances converge to the same level for all countries. However, while such a system may be simple, analysts have suggested that it does not fully take into account structural differences between countries, potentially limiting its acceptability (e.g., see Philibert and Pershing, 2001). Variants on the simple per capita emissions have been

proposed. For example, Bode (2004), suggests that both per capita equality should be defined as a fully constrained paths over time. Tonn (2003) proposes to determine an equal per-capita allocation on the basis of a risk estimate of climate change damages using thresholds of damage probabilities of 1:1,000,000 to $1:10^{10}$).

Even if a specific approach for grouping Parties could be agreed, it does not automatically prescribe how countries should be assigned to groups. Two options are outlined below:

Assign thresholds using agreed indicators: For a system with several stages or with a menu of different types of targets, indicator thresholds for the participation could be set to define participation. Indicators (or combinations of indicators) such as emissions, cumulative emissions, GDP per capita, relative contribution to temperature increase or other measures of development, such as the human development index may be used (see Höhne et al.,2005 for a review of per-capita emissions thresholds; Criqui et al., 2003 for a view on a composite index using the sum of per-capita emissions and per-capita GDP; Torvanger, 2005, for further composite indices; or Müller, 2001 who proposes using a preference score approach according to population weight to determine emissions allocations). All literature makes clear that the choice of indicators will be controversial; with any single indicator (or even a specific combination of indicators) being generally acceptable.

Country self-selection. In such a system, incentives have to be provided to motivate countries to move into certain groups. “Pull incentives” (or “carrots”) promote participation; for example, economic benefits to Russian from sales of excess emissions or to developing countries through CDM. “Push incentives” (or “sticks”) may also be applied; for example, publicly available and comparable data on indicators could create political pressure for compliance. In the absence of a supra-national authority (such as that of the European Commission in reviewing member States’ allocation plans within the European Emissions Trading System), countries must develop and implement bilateral or multilateral incentives. Issue linkage provides a possible incentive. For example, while trade sanctions may too strict (see Charnovitz, 2004), the application of border tax adjustments has been explored (e.g. Biermann and Brohm 2003).

In either of the cases described above, it may be possible to explicitly link the participation of new participants to successful efforts by current participating States. One proposal (see Höhne et al. 2005) suggests that developing countries only start to take on further commitments once global or Annex I average per capita emissions are reduced. In their “common but differentiated convergence” approach, Höhne et al. (2005) propose that individual developing countries only start to take on further commitments once they reach a certain percentage of the time dependent global average per capita emissions. Den Elzen (2002) has also analyzed thresholds based on the Annex I average. Rajamani (2002) argues that differential treatment in international law tends to favor developing countries in some cases and favors industrialized countries in other cases. Having analyzed the doctrinal basis of differentiation, she concludes that differential treatment is necessary to secure developing country participation in the climate change regime; but that if this is to be effectively applied, then the categories of developing and developed countries need to be revisited and closely examined to ensure that like countries are treated alike.

Box 13.5. *Explanation of terms used to describe future architectures of international climate agreements*

Multistage approach / increasing participation: Countries participate in system with different stages and stage-specific targets; countries transition between stages as a function of development

Contraction and convergence: Countries participate with quantified emission targets based on a path that leads to an agreed long-term stabilization level for greenhouse gas concentrations ('Contraction'), with targets for individual countries set so that per-capita emissions converge from the current levels to a level equal for all countries within a convergence period ('Convergence').

Triptych approach: National emission targets are allocated based on sectoral considerations. The emissions of different sectors are treated differently: For example, 'electricity production' and 'industrial production', are assumed to grow along with production efficiency, taking into account economic development, while 'domestic' sectors, are assumed to converge to a specific per-capita level, taking into account the converging living standard of the countries. National sectoral aggregate emissions are then adopted; while the sum is determined based on sectoral analysis, countries are allowed flexibility to pursue any emission reduction strategy that meets the targets.

Historical Responsibility (The Brazilian Proposal): Obligations between countries are differentiated in proportion to countries' relative share of responsibility for climate change, i.e. their contribution to the increase of global-average surface temperature over a certain period of time. Research on the historical contributions is ongoing (see e.g. www.match-info.net)

While bilateral agreements between countries of almost equal bargaining power on subjects of reciprocal interest have a high chance of being effective (cf. Henkin 1972), universal agreements with their tendency to design solutions at a highly aggregated nature, may be less effective, especially because they do not always address an issue that embodies reciprocity and instead tend to address rival, non-excludable common pool resources. In theory, see for example, Sindico and Gupta (2004), bilateralism may serve to circumvent, substitute or act as an impediment to multilateralism or to reinforce, implement/operationalize, and / or complement Multilateralism.

Other authors have compared climate change agreements to other multilateral instruments, including disarmament treaties, and the Antarctic Treaty (see Murase, 2002). In this analysis, the authors assert that success can only be achieved if the major stake-holders act. Thus, for example, a nuclear disarmament treaty would be meaningless if it was not ratified by the nuclear weapon States, even if it was ratified by, say, 180 non-nuclear States. By analogy, a climate change treaty is meaningful only if commitments are adopted and implemented by major emitters. Murase suggests that a future regime after 2012 might thus need to include key countries or groups such as the US, EU, Japan, China, India, Korea, Mexico, Brazil, Indonesia, South Africa and Nigeria.

13.3.2.3 Commitments and actions

As noted in Table 13.3, multiple forms of commitments or actions may be undertaken by Parties to agreements. While the climate change literature provides a review of many of these, the most frequently evaluated type of commitment is the binding absolute emission reduction target as included in the Kyoto Protocol for Annex I countries. The broad conclusion from the literature is that such targets provide certainty about future emission levels of the participating countries (assuming targets will be met). These targets also can be reached in a flexible manner across greenhouse gases and sectors as well as across borders through emission trading and/or project based mechanisms (in the Kyoto Protocol case, referred to as Joint Implementation, and the Clean Development Mechanism). While a variety of authors propose that such targets be applied to all countries in the future, many have raised concerns that the absolute targets may be too rigid and cap economic growth. (Hohne et al, 2003, and Bodansky, 2003)

To address this problem, a number of more flexible emission targets have been proposed:
- "Positively binding" or "no lose" emission targets, in which excess emission rights can be sold if the target is reached, but no additional emission rights have to be bought if target is not met (see Philibert and Pershing, 2001).
- "Dual" emission targets, in which two targets are defined, a "selling target", below which emission rights can be sold, and a "buying target", above which emission rights have to be bought (Philibert and Pershing, 2001, Kim and Baumert, 2002).
- "Price cap", in which an unlimited number of additional emission rights is provided at a given maximum price (Pizer 1997, Pizer 2002; McKibben and Wilcoxen., 2004)
- Dynamic emission targets, where targets are expressed as dynamic variables as a function of the GDP ("intensity targets") or variables of physical production (e.g. emissions per tone of steel produced); (Kolstad, 2005, Ellerman and Wing, 2003).
- Flexible binding targets, where a framework for reaching targets could be modelled after a WTO/GATT scheme for tariff and non-tariff barriers through rounds of bilateral and multilateral negotiations (Murase, 2003a).
-

All of these options aim at maintaining the advantages of international emissions trading while providing more flexibility to countries to avoid extremely high costs if economic development (and therefore emissions trajectories) are different than expected at the time of target setting. However, this flexibility reduces the certainty that a given emission level will be reached. Thus, there is a trade-off between costs and certainty in achieving an emissions level. One crucial element is defining and agreeing on the emission targets. Examples of options to agree on a target are outlined below (Höhne et al., 2005).

- Participating countries make proposals for individual reductions on a bottom-up basis. This approach has the risk that reductions may not be adequate to lead to the desired stabilization levels.
- A common formula could be agreed according to which the emission targets are determined. This rule could lead to reduction percentages for each individual country, which can then be modified by negotiations.
- An overall target can be given to a group of countries, with the group deciding internally on how to share the target amongst the participants. This could, for example, be applied to the EU, the current group of Annex I countries, the total of the G77 or any other group of countries.

13.3.2.3.1 Sectoral Approaches

A number of researchers have proposed that sectoral approaches may provide an appropriate framework for post Kyoto agreements (Bodansky, 2003, Samaniego and Figueres 2002). Under such a system, specified targets could be set, starting with particular sectors or industries that are particularly important, politically easier to address, or comparatively insulated from international competition.

Sectoral commitments have the advantage of being able to be specified on a narrower basis than total national emissions. Thus, sectoral approaches might be a pragmatic first step towards more comprehensive action to achieve sustainable development. Sectoral approaches could also be the natural progression in the evolution of the Clean Development Mechanism (CDM) (Samaniego and

Figueres 2002). Under such a scheme, countries might choose to expand from a specific "project" under the CDM to a broad policy covering an entire sector, setting a no-lose, sectoral emission target. Sectoral targets might be fixed or indexed, "no-lose", binding or non-binding (Philibert et al. 2003; Bodansky 2003)...

While sectoral approaches provide an additional degree of policy flexibility, they also create economic inefficiency. Trading across all sectors will inherently be at a lower cost than trading only within a single sector; the loss of supply to the market will in turn increase prices.

A sectoral approach need not be taken as an exclusive approach: it might be part of a wider agreement. For example Phylipsen, et al, in proposing the triptych approach, ultimately adopted by the EU as a method for determining their burden sharing arrangements under Kyoto, used a sectoral analysis to calculate one element of the appropriate effort for each country.

Baumert et al (2005) reviewed sector-based statistics in detail, and conclude:

- The sectors responsible for the largest shares of global GHG emissions are electricity and heat (22 percent), land use change and forestry (18 percent), agriculture (14 percent), transportation (13 percent), and manufacturing and construction (10 percent).
- *Electricity and Heat* represents the largest source of emissions for 15 of the world's top 25 emitting countries. .
- *Transportation* emissions range from 4 percent of the national total (Ukraine) to a quarter of total emissions (France, Spain, and USA). In general, the share in developing countries ranges from 2 to 10 percent, and in industrialized countries, from 15 to 25 percent. Transportation is the fastest growing share of emissions in most countries. In fact, corporate responsibility for emissions is as focused as national responsibility: in the oil sector, the largest 20 companies produce approximately 60% of the world's oil. Meanwhile, the ten largest countries with respect to transport emissions are responsible for 80% of the world total – and the top 20 car companies build 92% of the world's cars.
- *Agriculture and Waste* constitute the largest share of emissions from less developed countries, although within the group of the top 25 emitters, it represents the largest share of emissions from Argentina, Pakistan, and India.
- *Manufacturing and Industry* emissions range from a very small share of the national total in Argentina and Brazil to 27 percent in China, with developing, transition, and industrialized economies spread across that range. For instance, the share of national emissions is small for the United States and Pakistan (12 and 10 percent, respectively) and large for Japan and China (26 and 27 percent).

Bodansky (2005) describes several forms of sectoral targets. His description of the Growth Baselines and the Converging Markets proposals, for example, envision the possibility of sector-based targets. Conversely, the Technology Backstop Protocol would, in effect, define long-term zero emission targets for particular sectors: fossil fuel electric power generation, synthetic fuels, and fossil fuel refining. Bosi and Ellis (2005) have explored different design options for sectoral crediting, including policy, rate-based and fixed limit approaches and Ellis and Baron (2005) have assessed how these options could be applied to the aluminium and electricity sectors.

13.3.2.3.2 Flexibility / Market Mechanisms

Many environment agreements seek to address complex issues by maximizing flexibility as a means to achieve their goals... Climate change is no exception. Policy makers have sought to provide flexibility as to "when," "where," and "what" emissions are to be reduced. In the climate change context, emission reductions under an international agreement can conceptually be achieved any "where" on the globe. It is also possible to a shift the timing ("when") of emission reductions (depending on the emission pathway), and "what" policy instrument is used and the specific emission source or sink that is the target of the policy. This Section focuses on the issue of "where", which, with the adoption of the Kyoto Protocol, has been extensively examined in the literature. Issues of timing have been addressed in section 13.4.2.1, while questions of "what" flexibility are examined elsewhere in the WG 3 Fourth Assessment Report.

The Kyoto Protocol incorporates three articles that provide flexibility as to 'where' emission reductions occur, namely through is provisions regarding emission trading, joint implementation and the clean development mechanism. The latter two are project based mechanisms. Under an emissions trading system, emission allowances may be traded between governments, if a surplus occurs in one country and a deficit occurs in another (for an overview of activities see Philibert and Reinaud 2004). In the Kyoto Protocol, project based emission reductions between Annex I countries are called Joint Implementation (JI) and emission reduction projects located in developing countries are called Clean Development Mechanism (CDM) projects. Strict rules have been designed for the development of the baseline and the monitoring of the emissions to ensure that the created allowances actually represent the emissions reduced.

The mechanism within the Kyoto Protocol allowing reallocation of emission targets under a "bubble" in the case of the EU is often not listed as one of the "Kyoto flexibility mechanisms", although it does provide additional "where" flexibility (Dessai and Michaelowa 2001). Initial EU negotiations over its bubble and the question how EU enlargement could be reflected in a future bubble were analyzed in Blok et. al. (1997) and Michaelowa and Betz (2001).

13.3.2.3.3 International Emissions Trading

Note to readers of the FOD: This draft includes the EU ETS as an international system. We will reconsider whether it is more appropriately placed in section 13.3 after we receive comments on this section.

Emissions trading has become an important implementation mechanism for addressing climate change in nations around the world over the past five years, but a fully global system has yet to be implemented. So far, international trading is mainly done in emission credits generated by the project-based mechanisms (see Section 13.4.2.2.3)[27].

Full international trading would provide market players and policy makers with information thus far absent from decision-making: the actual, unfettered cost of GHG mitigation in a range of economic activities. With cost-effectiveness delivered by the market, emissions trading allows policy making to focus on the acceptability of efforts required from various players through the allocation process, both at domestic and international level. As such, international emissions trading would provide the necessary transparency to assess the burden involved in mitigating greenhouse gas emissions. However, emissions trading does not necessarily provide a practical limit of GHG from all sources; additional measures are needed to shift energy systems away from carbon consumption because a number of market imperfections impede rational energy choices leading to lower, more efficient energy use. A broad review of emission trading is provided in Baron and Philibert (2005).

[27] The EU ETS has also an international component as it will involve cross-border trades and transaction between national allowance registries

Lecocq and Capoor (2005) note that while the international greenhouse gas emissions market remains fragmented, trading activity has increased substantially over the last five years. According to their analysis, in the absence of a ratified international agreement, regional, national and sub-national trading programs are operating under different rules, which could inhibit "market convergence" and increase the costs of trading. However, Baron and Pershing (2000), indicated that linkages between fragmented regimes are possible – borne out by the existence of trades between multiple regimes. More recently, Baron and Philibert (2005) indicated that a global market can technically incorporate domestic and regional systems, despite divergences in design and that the current design of emissions trading systems does not yet provide an incentive sufficient to reduce emissions at least-cost. There is room for improvement. A full assessment of the elements required to link multiple regimes is provided by Haites and Mullins, 2001.

Under the Kyoto Protocol, the European Union committed to reducing its common emissions of greenhouse gases by 8% from 1990 levels during the 2008-2012 period. Under Article 4 of the Kyoto Protocol, the EU-15 negotiated a burden-sharing agreement that split this common target into 15 of varying stringencies. As such, EU-15 nations emerged from the Kyoto agreement with domestic targets that accounted for current emissions, relative economic development and their domestic idiosyncrasies. In October 2003, the European Parliament and the Council of the European Union adopted Directive 2003/87/EC, establishing a scheme for greenhouse gas emission allowance trading within the Community.[28] This date marks the birth of the EU ETS title, though the design was amended in October 2004, primarily to enable use of the Kyoto project-based mechanisms.[29] Starting January 2005, approximately 11,500 plants across the EU-25 have been authorised to buy and sell emissions allowances representing their CO_2 emissions over 2005-2007, subject to transaction registries' function. The system covers about 45% of the EU's total CO_2 emissions. The emerging price provides all sources with a clear market incentive to control emissions, buying EU allowances (EUAs) when reduction costs exceed the market price, or selling them if at a profit.

The percentage of total greenhouse gas emissions covered within each nation by ETS ranges from approximately 20% in France to 69% in Estonia. Differences stem mainly from the contribution of the power sector to the country's total emissions. The number of installations participating in ETS ranges from 2 in Malta to 1849 in Germany[30]. There exist of course great differences in the size of installations, as 55% of installations covered by the trading scheme emit only 3% of its total emissions.[31] Large differences arise in volumes allocated to identical sectors. As illustrated in Figure 13.6, allocated emissions for the electricity sector range from 30.9% above the baseline (Finland) to 21.5% below the baseline (UK). (Baron and Philibert, 2005)

[INSERT Figure 13.6. here]

One extensively analyzed issue related to international emissions trading under the Kyoto Protocol is the size of the allowance surplus of the countries in transition. Victor et al. (2001) estimated the joint Russian and Ukrainian surplus at 3.7 billion t CO_2 for the entire commitment period 2008-2012. Golub and Strukova (2004) see Russian surplus at up to 3 billion t CO_2. They argue that due to barriers in the Russian capital market, the forward trading with OECD countries is only the pos-

[28] See Lefevere (2005) for a detailed history of the EU ETS.

[29] Directive 2004/101/EC of the European Parliament and of the Council, generally known as the Linking Directive since it establishes links with other mechanisms under Kyoto.

[30] European Commission, press release, 20 June 2005. *Emissions trading: Commission approves last allocation plan ending NAP marathon.*

[31] Seb Walhain, presentation at Chatham House conference – *Emerging carbon markets, can they deliver?* 16 June 2005.

sibility to raise initial investments to mobilize no-regret and low-cost GHG reduction. Kuik (2003) sees a trade-off between economic efficiency, energy security and carbon dependency concerning the EU acquisition of Russian and Ukrainian assigned amount units. Berkhout and Smith (2003) estimate the surplus level of the former Soviet Union until 2030 and state that it could only cover half of an assumed 30% reduction target for a 28-member state EU.

The first six months of 2005 recorded EUAs transactions totalling more than 70 $MtCO_2$, against 107 $MtCO_2$ traded globally in 2004. Prices rose initially as the European trading infrastructure became operational. At this early stage, several factors influenced the unit price of carbon under the EU ETS:

- The stringency of emissions caps. This is a function of the initial allocation – it is assumed that allocations are lower than business-as-usual emission projections – and of the economic environment of the underlying activities. For instance, a sustained demand for steel would obviously increase emissions in the near term and drive demand for allowances. Similarly, demand for electricity-intensive products would also put pressure on the power sector to marginally reduce emissions per unit of output;
- The external supply of project-based mechanisms. An abundant supply of CERs (and ERUs in 2008-2012) could dampen the price of EUAs, as EU firms fill compliance shortfalls with inexpensive CERs and ERUs. It is not yet clear that CDM and JI can adequately supply the Annex I Kyoto Parties' demand for credits. However, relatively relaxed emissions constraints could limit demand for EUAs and increase the relative share of project-based units in firms' compliance;
- Relative fuel prices. For some industries, especially power generation, the price of gas relative to the price of coal drives operating choices. All other variables being equal, a relatively high gas price encourages the use of coal, driving demand for CO_2 allowances.[32]
- Weather: temperature, rainfall, cloudiness. A dry year in Scandinavia is likely to trigger more demand from fossil-based generators and increase emissions – a scenario that has frequently caused Denmark's emissions over the past two decades, as its coal-based generation supplanted power usually produced by defaulting hydro plants in Norway and Sweden.[33]
- Regulatory features. Several NAPs specify[34] the operator forfeits EUAs allocated to closing plants. As operators cannot sell any of these allowances, they are discouraged from closing inefficient plants to reduce emissions. This should, in a tight market, propel prices up.

Market liquidity and prices have been strongly impacts because not all registries in new member countries of the EU are operational and because the international transaction log is not functioning. In addition not all players understand their potential needs for credits and hence have been few sellers; speculation rather than compliance has likely been driving the price of carbon. Only when compliance requirements dominate allowance demand and only when the market is fully functional will the market's carbon price reflect the actual marginal cost of an avoided tonne of CO2.

13.3.2.3.4 Project-based mechanisms (Joint Implementation and the Clean Development Mechanism)

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[32] As of June 2005, the coal-to-gas spread in power generation was primarily responsible for EUA prices of EUR 25/tCO_2.[32] At this price, gas-based generation would theoretically surpass coal-based generation on the power market.[32] At this early stage, any increase in gas prices is immediately followed by an increase in EUA prices.[32]

[33] "A warm, wet and windy winter would lower actual emissions, power consumption, CO_2 prices and UK gas prices… improve the hydro situation and increase wind production. It would lower the utilities' income substantially but bring them closer to compliance." Carbon Market Europe, 1 July 2005.

[34] For instance: Austria, Denmark, Finland, France, Sweden, the United Kingdom. Others, like Germany, Hungary, Portugal, or Slovenia make it possible to transfer to firms that are opening plants.

The earliest project based mechanism of the UN Climate Convention process was the pilot phase of "Activities Implemented Jointly (AIJ)." Most of the 150 AIJ projects were small and many were only partially implemented due to the lack of finance resulting from the lack of emissions credits. Only half a dozen investor countries and even fewer host countries developed real, national AIJ programmes. Selection criteria for AIJ programmes often delayed the acceptance of projects – and most that were undertaken were commercially viable only if additional financing was provided by a separate investment subsidy (Michaelowa 2002).

The Clean Development Mechanism (CDM) allows crediting of project-based emission reductions in developing countries and is the first part of the Kyoto Protocol to have been implemented. A number of analysts have estimated CDM volume and price. For example, Grubb (2003) estimated a CDM size of 50 to 500 million t CO_2 during the first commitment period. Chen (2003) derived prices of 2.6-4.9 $/t CO_2 and annual volumes of 654 - 992 million certified emissions reductions (CERs). Jotzo and Michaelowa (2002) and Michaelowa and Jotzo (2005) model an annual CER demand of 360 million t CO_2 and a price of 3.6 €/t CO_2. Halsnaes' (2002) concludes that 10–15% of future baseline emissions reductions can be achieved for a cost below 25 $/ t CO_2 from the energy sector in developing countries. Springer and Varilek (2004) predict a likely CER price of less than 10 $/t CO_2 in 2010.

As of November 2005, the volume of CERs estimated from 626 proposed projects in 57 countries is 132 Mt CO_2-eq/y in 2008-2012 and 224 Mt pre-2008 (Ellis and Levina, 2005) (See Figure 13.7) They also indicate that almost half the proposed CDM projects are in the electricity sector, but that such projects account for about 25 percent of the credits. Many are small renewable projects, occurring in 40 countries. However, the majority of credits are expected to come from CDM projects reducing high GWP gases, i.e., N_2O, HFC23 and to a lesser extent CH_4. Publicly committed budgets for CER acquisition stood at approximately 2 billion USD (UNFCCC 2006, World Bank 2006, Ellis and Levina, 2005). At such a scale, the CDM begins to reach the same order of magnitude as GEF and Official Development Assistance (ODA) resources.

[INSERT Figure 13.7. here]

Zhang and Maruyama (2001) suggested that government funds should be used to buy CERs to generate CDM projects. Kim (2001) identified potential conflicts between the Kyoto mechanisms and WTO. He suggested that it will be impossible to tell what (if any) formal obstacles exist until outcomes emerge from dispute settlement procedures. Other project risks were identified as a potential deterrent to use the project-based mechanisms (Laurikka and Springer, 2003).

In contrast to these early concerns, a relatively large number of projects are being done unilaterally, indicating that developing country companies are procuring the financing to implement projects and sell the CERs to industrialised countries[35]. Other projects secure funding through bilateral transactions and many have attracted support of pooled funds. As of June 2005, pledges by carbon funds and government tenders for carbon reduction projects total approximately USD 3.7 billion. Established by nations, private firms, and organisations, credit procurement funds are summarised in **Error! Reference source not found.**13.4 and Table13.5 If efficiently managed, such funding could generate between 200 and 400 $MtCO_2e$ of credits, assuming a price between USD 5 and USD

[35] The CDM Executive Board at its 18th meeting decided that registration can take place without an Annex I Party being involved at the time of registration. An Annex I partner would need to issue a letter of approval after registration in order to get the CERs.

10/tCO_2e per project-based emission reductions. Not all the funds publish the quantity of credits that they intend to acquire for 2012. (Baron and Philibert, 2005)

[INSERT Table 13.4. here]
[INSERT Table 13.5. here]

A CDM project has to go through an elaborate project cycle with external validation (Yamada and Fujimori 2003) that has been defined by a decision of the 7th Conference of the Parties to the UNFCCC (UNFCCC 2001) and the CDM Executive Board which is overseeing the project cycle (UNFCCC 2003a-c). As CDM projects are implemented in countries without emissions targets, project "additionality" becomes important to avoid generating fictitious emission reduction credits through business as usual activities. Several tests of additionality have been discussed in the literature; these include investment additionality and environmental additionality (on the former see Greiner and Michaelowa 2003, on the latter Shrestha and Timilsina 2002). The CDM Executive Board has developed an additionality tool that project proponents can use to test and demonstrate the additionality of a CDM project (http://cdm.unfccc.int/methodologies/PAmethodologies/ Additionality_tool.pdf

If a project is additional, the next step is to determine a "baseline", i.e. the emissions that would have occurred if the project had not taken place. One potential risk is the overestimation of baseline emissions – a major problem as all participants profit from an overestimate, so there is no incentive to correct it. This requires stringent rules and modalities for determining baselines affecting the efficient processing of the CDM (Bailey et al. 2001). One way to improve efficiency is to develop standardized baselines that multiple projects can use. (A consolidated methodology has been developed for the electricity sector resulting in its use in over 30 projects.) Fischer (2006) argues that rules for benchmarking are likely to be systematically biased to over allocate, and also risk creating inefficient investment incentives. Broekhoff (2004) argues that availability of data and the level of data aggregation determine to a large extent the cost of deriving multi-project baselines. The initial higher costs of multi-project calculations in the development stage are easily offset once more projects will use such a baseline.

Illum and Meyer (2004) argue that as several energy projects are implemented, and other changes in the energy system take place over time, national energy systems databases and models have to be used for baseline derivation. Begg and van der Horst (2004) conclude that standardized baselines for the electricity sector depend on country specific characteristics, the project type, and whether it provides new or existing demand and to discount the derived benchmark to take into account the risk of non-additionality. Rosen et al. 2004, Fichtner et al. (2001) note that the use of energy models to derive systems emissions without the project is dependent on the model assumptions. Sathaye et al. (2004) define five dimensions that determine which plants a project is compared to: geographic scope, generation type, vintage, breadth, and stringency. Kartha et al. (2004) discuss how the operation of existing power plants (the operating margin) or the construction of new generation facilities (the build margin) are to be considered in the baseline. They argue both effects are important and recommend a combined margin approach for most projects, based on grid-specific data. Their approach has essentially been accepted by the CDM Executive Board as basis for power sector baselines. Zhang et al. (2001, 2005) argue that in the Chinese context, sectoral baselines based on government plans are better than project-specific ones as the former accounts for subsidies, other policies, institutional choices and macroeconomics factors. Spalding-Fecher et al. (2002) assess whether the current technology (kerosene stoves) is an appropriate baseline for a community-based solar water heating project in a low-income community in South Africa. The current technology does not reflect likely future trends and also penalizes the community for their poverty and lack of infrastructure.

Indirect effects of CDM projects (“leakage”) leading to overestimation of carbon credits have been discussed by Geres and Michaelowa (2002), Kartha et al. (2002) for the electricity sector and Working Group on Baseline for CDM/JI Project (2001)). The determination of project boundaries is critical to evaluation of leakage – a very narrow definition of system boundary can create inaccurate assessments of additionality.

National institutions necessary for project-based mechanism operation have been slow to develop. The institutional problem is often exacerbated in countries with unstable economy and institutions; project developers often have very short time horizons for returns on investment, and are unwilling to wait for the revenues – or to provide regular and ongoing monitoring and verification of reductions (see Michaelowa (2003) for CDM host countries and Korppoo (2005) for the Russian Federation).

The coverage of forestry and forest related projects has long been a contentious issue under CDM rules. Problems primarily related to the impermanence of the forest and to leakage to other regions. Dutschke (2002) suggested leasing CDM credits to address the non-permanence of forestry sinks. Herzog et al. (2003) argue the value of temporary carbon sequestration can be nearly equivalent to permanent sequestration if marginal damages remain constant or if there is a backstop technology that caps the abatement cost. A forestry project in Chiapas, Mexico shifted from a development emphasis to a focus on carbon sales by individual farmers. The farmers’ selection changed from a variety of species and systems to a concentration on two tree species and two systems in some regions (Nelson and de Jong 2003). Vöhringer (2004) assessed the Costa Rican Protected Areas Project AIJ project which was meant to avoid deforestation, promote the growth of secondary forests and regenerate pastures. The baseline of historical deforestation rates was seen as a major problem in this case. Asquith et al. (2002) analysis of the AIJ forest protection project Noel Kempff in Bolivia, suggests that to improve local rural livelihoods requires full community participation. Van Vliet et al. (2003) analyze six proposed plantation forestry projects in Brazil for uncertainty. Fluctuations in product prices cause variations up to 200% in CERs and net present value, leading to difficulties in determining the additionality of such projects and making five of the six projects ineligible for CDM.

Several options have been proposed to expand the CDM beyond the limits imposed under the Kyoto Protocol in the future. A reform of the CDM scheme has been urged with a view to securing incentives for developing countries to take action and accelerated diffusion of energy-saving and renewable energy technologies (METI, 2004). The impact on the supply of CERs of a post-2012 emission target on host countries is analyzed by Olsen and Painuly (2002). They suggest that developing countries will always be better-off participating in the CDM if their future emissions budget is not linked to their baseline emissions. If their quota is related to their baseline emissions, a CDM participation strategy may only be a preferred alternative if the CDM price is high enough to offset losses in the post-Kyoto period due to participation.

Joint Implementation has been much less extensively researched than the CDM, due to its later start date (2008) and the institutional problems in countries in transition. Laroui et al. (2004) give a general overview of Russian JI potential, determining it to be very substantial – a finding based on industrial and energy sector inefficiency. Fernandez and Michaelowa (2003) discuss the impact of defining the “acquis communautaire” as baseline for JI projects in the new member states and stress the need to establish a predictable legal framework in the host countries, while Van der Gaast

(2002) sees a reduced scope for JI in Eastern Europe due to the "acquis". As transactions under Joint Implementation are seen as both cumbersome and beset with institutional obstacles (Korppoo 2005), countries in Eastern Europe have started to grant surplus "Assigned Amount Units" to projects that reduce greenhouse gas emissions either before or during the commitment period of the Kyoto Protocol (Taylor 2004) or to projects that reduce emissions but cannot be verified properly ("Green Investment Scheme").

13.3.2.4 Technology

The literature explores a number of issues related to technology research, development and deployment (including transfers and investment).

13.3.2.4.1 Technology Agreements

One variant on a technology agreement is described by Barrett (2001, 2003). This proposal emphasizes common incentives for climate friendly technology research and development (R&D), rather than targets and timetables. Barrett's approach includes a research and development protocol that would support collaborative research, and protocols that would require common standards for technologies identified through collaborative research efforts. Barrett maintains that the departure from emissions commitments and market-based instruments is the necessary cost of designing a participation- and compliance-compatible regime. His proposal also includes a protocol aimed at making some short-term progress, but without reliance on international enforcement. He argues that his proposal could potentially support a high degree of environmental effectiveness, depending on the payoffs to the cooperative R&D efforts, but notes that the system would neither be efficient nor cost-effective, not least because the technology standards would not apply to every sector of the global economy, and may entail some technological lock-in.

13.3.2.4.2 Technology transfer

While many researchers have focused specifically on transfers between developed and developing countries, other literature also evaluates investment regimes between more advanced countries, and within the developing world.

One mechanism for technology transfer is through the establishment of and contribution to special funds, which disburse money to finance emissions reduction projects or adaptation activities. The UNFCCC and the Kyoto Protocol already include funds and project activities, although contributions to and participation in those are mostly voluntary. It also includes provisions for technology transfer, but volumes of financial flows are not defined.

The literature on technology transfer under the UNFCCC suggests that transfer mechanisms provided have yielded only limited success to date. The Expert Group on Technology Transfer (EGTT) has met several times since 2002, adopting a work program and providing input and advice to the SBSTA on technology transfer. To date, the EGTT has considered a variety of issues, focusing on information dissemination, enabling environments for the transfer of environmentally sound technologies, technology needs assessments and, more recently, options for financing technology transfer, and the adequacy of the UNFCCC technology information clearing house (TT:CLEAR). Other international efforts have also been undertaken to examine technology transfer in the climate change context, including a joint effort by the UN Industrial Development Organization (UNIDO) and the Climate Technology Initiative (CTI) of the International Energy Agency, and the OECD. However, as noted by the US National Research Council additional work is particularly needed to assist poor countries, which lack scientific resources and economic infrastructure, as well as appropriate technologies to reduce their vulnerabilities to potential climate changes (NRC, 2003).

Gwage (2002) has argued that the private sector, particularly in developing countries, should directly assist government in negotiations on technology transfer needs. Such participation would both establish links between those most directly involved in technology development and diffusion (the private companies), as well as assure that necessary institutional arrangement that would best promote the aggressive deployment of technologies would be adopted in international agreements.

A number of bilateral and multilateral R&D programs are moving forward, and may offer a model for future cooperative arrangements in this area; several are highlighted in Box 13.5 below.

Box 13.6. *Examples of Coordinated International R&D*

- International Partnership for a Hydrogen Economy: Announced April 2003, the partnership' includes 15 countries and the European Union (EU), working together to advance the global transition to the hydrogen economy, with the goal of making fuel cell vehicles commercially available by 2020. The Partnership will work to advance research, development, and deployment of hydrogen and fuel cell technologies; and develop common codes and standards for hydrogen use. See: http://www.eere.energy.gov/hydrogenandfuelcells/international_activities.html.
- Carbon Sequestration Leadership Forum: This international partnership initiated in 2003 works to advance technologies for pollution-free and greenhouse gas-free coal-fired power plants that can also produce hydrogen for transportation and electricity generation.
- See: http://www.fe.doe.gov/programs/sequestration/cslf/.
- Generation IV International Forum: A multilateral partnership fostering international cooperation in research and development for the next generation of safer, more affordable, and more proliferation-resistant nuclear energy systems. This new generation of nuclear power plants could produce electricity and hydrogen with substantially less waste and without emitting any air pollutants or greenhouse gas emissions. See: http://gen-iv.ne.doe.gov/intl.html-
- Renewable Energy and Energy Efficiency Partnership: Formed at the World Summit on Sustainable Development in Johannesburg, South Africa, in August 2002, the partnership seeks to accelerate and expand the global market for renewable energy and energy-efficiency technologies.

13.3.2.5 Financing

Financial flows of all types can have either a positive or negative affect on GHG emissions and on sustainable development in all countries. Funding sources for GHG mitigation in developing countries has been one of the crucial issues in the international debate about tackling climate change. So far, assistance for developing country climate change mitigation has come mainly from public financing, while most technology investment has come from the private sector. However, limited progress has been made in large scale investments in climate-friendly projects that entail higher risks and higher initial costs than conventional projects. See also Section 13.4.2.2.3

13.3.2.5.1 Foreign Direct Investments

OECD trade and FDI grew strongly in relation to GDP during the past decade: OECD trade (measured as the sum of imports and exports) in proportion to GDP grew from 18% of GDP in 1990 to 22% in 2000, while OECD FDI grew from 1% of GDP in 1991 to 3.3% of GDP in 1999. However, while the total sums grew, 40% of this was invested in just four countries in 1999: Argentina, Brazil, China, and Chile (OECD, 2000b). The statistics on the concentration of flows are telling:

FDI flows to the top ten non-OECD countries increased from 19% in 1985 to 53% in 1999 of total OECD flows to non-OECD countries.

One common assertion in international environmental negotiations is that FDI promotes sustainable development as multinational corporations (MNCs) transfer both cleaner technology and better environmental management practices. However, most FDI in developing countries is targeted to activities, such as extraction of oil and gas, manufacturing, and electricity, gas and water, which aim to improve economic development but also increase greenhouse gas emissions. (Figure 13.8). Maurer and Bhandari (2002) report that during the mid- to late-1990s major developed countries through their export credit agencies (ECAs) co-financed energy-intensive projects and exports valued at over US$103 billion. These projects and exports included oil and gas development, fossil fuel power generation, energy-intensive manufacturing, transportation infrastructure, and civilian aircraft sales. These countries accounted for 90 percent, of the co-financing provided by ECAs to these energy-intensive exports and projects Crescencia Maurer. By comparison industrialized countries have directed just a fraction of their ECA financing to renewable energy projects. Between 1994 and 1999 ECAs supported a total of US$2 billion in renewable energy projects.

The World Bank (2004) reviewed its investments in extractive industries determined that in the future it would be more selective, with greater focus on the needs of poor people, and a stronger emphasis on good governance and on promoting environmentally and socially sustainable development. It decided to increase support, for economically viable renewable energy and other clean fuels with the goal of helping developing countries provide their people with access to clean, affordable, and sustainable sources of energy and to ensure that extractive industries contribute to economic growth, sustainable development and poverty reduction.

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[INSERT Figure 13.8. here]

Empirical studies have also failed to find evidence that MNCs transfer both cleaner technology and better practices. In statistical studies of Mexico (manufacturing) and Asia (pulp and paper), foreign firms and plant performed no better than domestic companies. (Zarsky and Gallagher, 2003). According to Jordaan (2004) the externalities from the presence of foreign-owned firms do not occur automatically, but are dependant on certain underlying characteristics of industries and manufacturing firms. Mabey and McNally (1999) suggest that business and industry must take greater responsibility for their operations abroad in order to maximize long-run host country capacity to regulate or comply with international minimum standards.

13.3.2.5.2 Direct international transfers

Official development assistance (ODA) remains an important source of financing for those parts of the world and sectors where private sector flows are comparatively low. Revenues are particularly important in sectors such as agriculture, forestry, human health and coastal zone management. ODA also tends to provide basic social or environmental services, to support the creation of enabling conditions, which may leverage larger flows of private finance into environmentally sound technology (EST) in the context of overall sustainable development goals in the recipient countries. It provides an important share of total resources available for social and environmental improvements in recipient countries and is likely to remain so in the future.

Recent studies show that the effectiveness of aid depends on various factors (World Bank, 2002), the most important of which are good governance; policy and institutional frameworks that encourage private investment (macroeconomic and political stability, respect for human rights and the rule of law); minimum levels of investment in human capital (education, good health, nutrition, social safety nets); and policies and institutions for sound environmental management. While the importance of the private sector has increased substantially, there continues to be a role for governments both in providing an enabling environment for the technology transfer process as well as participating directly in it. NGOs also support investment and direct transfers through targeted capacity building, information access, and training for public and private stakeholders and support for project preparation and through strengthening scientific and technical educational institutions in the context of technology needs.

13.3.2.5.3 GEF and the Multilateral Development Banks (MDBs)

The Global Environment Facility (GEF), established in 1991, is intended to help developing countries fund projects and programs that protect the global environment. Jointly implemented by the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank, GEF grants support projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants.

Compared to the magnitude of the environmental challenges facing recipient countries, GEF efforts are of modest scale, even when added to the contributions from bilateral development assistance. Hall (2002), analyzing the GEF portfolio, notes the focus on incremental, one-time investments in mitigation projects that test and demonstrate a variety of financing and institutional models for promoting technology diffusion and suggests this should help contribute to a host country's ability to understand, absorb and diffuse technologies. Sohn et. al (2005) note that in spite of proposals to fund renewable energy and incorporate climate change into their financing, the World Bank has both continued to support CO_2 intensive fossil fuels efforts, and has provided relatively limited resources to renewable and low CO_2 emitting energy alternatives.

Continued effectiveness of GEF project funding for technology transfer will depend on factors such as duplication of successful technology transfer models; enhanced links with multilateral-bank, and coordination with other activities that support national systems of innovation and international technology partnerships. Meanwhile, Sohn et al suggest that Governments may use their leverage to direct the activities of multilateral development banks (MDBs) through their respective Boards and Councils in order to strengthen MDB programs to account for the environmental consequences of their lending; develop programmatic approaches to lending that remove institutional barriers and create enabling environments for private technology transfers

13.3.2.6 Capacity building

Capacity has not been extensively addressed in the literature despite the fact that it is of critical relevance to the climate change issue. Part of the solution to the climate change problem has been cast in terms of helping developing countries with technology transfer and assistance. Both the Climate Convention and Kyoto Protocol refer to capacity building, while the Marrakesh Accords set up a framework for capacity building.

The capacity building framework within the climate change regime focuses on developing capacity in developing countries to implement decisions. Historically (e.g., as in the IPCC 1990 Special report), the literature has defined capacity as the formal training of employees, technological gatekeeping and learning-by-doing, but has noted that it is a slow and complex process. According to Yamin and Depledge (2004), the Marrakesh Accords have been partially successful in bringing some additional coherence, coordination and prioritization in the process of capacity building.

These authors argue that the effort to promote country-driven and contextually tailored efforts that are both iterative and involve learning-by-doing are appropriate.

However, Sagar (2000), argues that it may be more relevant to strengthen the domestic capacity for undertaking policy research and innovation, as well as for managing technological and institutional change rather than merely creating capacity for implementing policies developed elsewhere. This is based on the idea that only context relevant policy instruments are likely to work within the domestic context of countries. Gupta (1997 and 2003) argues that capacity building might also be needed to collectively *unlearn* elements of the development model.

Research has also questioned whether capacity building can be initiated from outside a country. Anders (2005) argues that developing capacity to institutionalize good governance in a developing country might lead to unforeseen results (i.e. an increase in corruption as opposed to a decrease). However, since capacity issues are embedded in local contexts, the OECD (1995) has argued that assuming that capacity building can be easily done from outside may be a mistake.

13.3.2.7 Coordination/harmonization of policies

As an alternative to (or complementary to) internationally agreed caps on emissions, it has been proposed that countries agree to coordinated policies and measures (e.g., technology standards or taxes) that reduced emission of greenhouse gases. A number of policies are discussed here, including trade coordination/liberalization, R&D; Taxes (including carbon taxes); and policies that modify foreign direct investment, including GATT, WTO; EU; and OECD agreements on taxes.

As discussed in section 13.3 above, a tax is often considered an appropriate instrument to address climate change because it can reduce demand for energy, promote more efficient technologies, and lead to the adoption of cleaner energy technologies. A tax conveys the same incentive to all emitters, leading to the internalizing of the costs. Those with low reduction costs are likely to undertake them; those with high costs may either change businesses, or pass the price through – leading to additional emissions-related decisions downstream.

However, not all taxes are acceptable in the international context. For example, WTO rules constrain governments’ tax policies. To date WTO case law has not provided specific rulings on climate related taxes (Fischer, Hoffman, and Yoshino 2002). However, such taxes and border adjustments would need careful design, taking into account WTO law and using any space created by legal ambiguities (Biermann and Brohm 2003). Thus, if a government refrained from rebating any tax on exports and refrained from applying any tax to imports, no WTO legal problems would be encountered. But such tax restraint is unlikely (Charnovitz, 2003).

A number of examples demonstrate some of the possible pitfalls. A tax on gasoline at the retail level must be imposed identically on gasoline produced from domestic and imported sources; otherwise it is in contravention of GATT Article III. A tax on automobiles based on the fuel economy of each model type must be applied an origin-neutral manner to be in accord with GATT Article III. Complications can still arise if the brunt of the tax is borne by imported vehicles; under such a case the exporting country can argue that the tax amounts to de facto discrimination because the tax provides protection to domestic production. Such a case has been taken to the GATT (in the 1994 Automobile Taxes case, a GATT panel ruled that high-fuel efficient cars are not “like” gas-guzzling cars); whether the contemporary WTO jurisprudence would lead to the same result is unclear. Another hypothetical is the cased where a tax is based on the carbon content of fuel. In a recent submission to the WTO Committee on Trade and Environment, Saudi Arabia advocated basing fossil fuel taxes on carbon content in order to reduce energy market distortions (Saudi Arabia 2002, paras. 17). A key legal judgment would be whether differential taxes on fuel (e.g., natural gas versus coal) lead to higher taxes being imposed on imports, in violation of GATT Article III. If so, then the government applying the tax would seek to offer a defense under GATT Article XX. Some analysts doubt that such a defense would be successful (e.g., Zarrilli 2003). Still greater legal complexity could ensue under a case where a tax on electricity was based on the amount of GHG emissions released during power generation (e.g., electricity produced from hydropower would be taxed at a lower rate than electricity produced from oil). A 1998 case arising under European Union law (similar to WTO law) is instructive: Finland taxed electricity using different rates depending on generation. Because of the practical difficulty in determining how imported energy was produced, imports were taxed at a flat rate set to approximate an average of the domestic rates. (see Krämer 2002).

Instead of a tax at the consumer level, a government might impose a tax at the producer level based on the amount of energy used in production. However, in addition to its GHG benefits, such a tax may also reduce the international competitiveness of energy-intensive industries. In response, some governments grant tax exemptions to the most energy-intensive industries. Other governments seek to apply a border tax adjustment on imports and exports. However, both responses present trade law concerns. If a government generally imposes a high energy tax but then exempts particular industries, such an exemption might be viewed as a specific subsidy that would be actionable under the WTO Agreement on Subsidies and Countervailing Measures (SCM). Furthermore, if an exemption is targeted to industries that export, it might be viewed as an export subsidy illegal under the SCM.

A border tax adjustment is a more murky area of trade law. According to the GATT, nothing prevents a government from imposing a charge equivalent to an internal tax on a like article from which the imported product has been manufactured According to Charnovitz (2003), the GATT panel has held that whether a tax is enacted for revenue or to encourage rational use of environmental resources is irrelevant to the legality of the border adjustment. In 1970, a GATT Working Party was constituted to examine “Border Tax Adjustments,” and this report has often been cited authoritatively in subsequent jurisprudence. The Working Party agreed that taxes directly levied on products (e.g., a sales tax) are eligible for a tax adjustment, and taxes not levied on products (e.g., a payroll tax) are not eligible for adjustment. Yet the Working Party was unable to agree on the status of adjustments for “taxes occultes,” which are taxes on capital equipment, advertising, energy, machinery, transport, and other services. The category of taxes occultes includes many excise taxes that are of interest in the current climate debate, such as taxes on energy, refrigerants, cleansers, and transport used in the production process. Whether or not such a tax adjustment on imports would meet the WTO’s border adjustment rules would seem determinative of its legality. While one can easily see a competitiveness rationale to use a border tax adjustment, it is difficult to visualize a valid environmental reason under GATT Article XX in support of a border adjustment.

Another aspect of potential conflict that may arise concerns the application of the Kyoto Protocol’s flexibility mechanisms, in particular, CDM and JI. Murase (2002b). These project based offsets represent foreign direct investment (FDI) which involve trade in goods as well as the provision of services. According to Brewer (2002), issues could arise in relation to the GATS and perhaps also the Subsidies and Countervailing Measures Agreement and the application of the TRIMs and Agriculture agreements. These and other questions could emerge in the context of cases processed under the WTO Dispute Settlement Understanding. (Murase 1995, 1997)

13.3.2.8 Compliance

Using game theory, Hovi and Areklett (2004) argue that a compliance system has to fulfill several criteria: (1) consequences of non-compliance have to be more than proportionate; (2) punishment needs to take place on the Pareto frontier rather than by reversion to some suboptimal state; (3) an effective enforcement system must be able to curb collective as well as individual incentives to cheat. The compliance system agreed under Kyoto (as outlined in the Marrakech Accords) is seen as only partially fulfilling these criteria. For example, Nentjes and Klaassen (2004) argue that the obligation to fully restore any excess emissions in subsequent periods does not exclude the option of postponing restoration forever. If such an outcome occurs, the trading mechanisms under the Protocol may be substantially weakened.

Two schools of thought exist as to the appropriate response to non-compliance that is contemplated under the Kyoto Protocol (see Murase, 2002). One view advocates "soft" compliance-management, which favours primarily facilitative and promotional approaches by rendering assistance to non-compliant States; those holding this view often compare desirable procedures to those used under the Montreal Protocol. The other view takes a "hard" enforcement approach in order to coerce compliance by imposing penalties or sanctions on non-complying parties. Financial penalties and economic or trade sanctions have been proposed along these lines. However, it has been suggested that such measures could be in conflict with WTO/GATT rules on trade liberalization. The uncertainties involved in the process will likely make it a very challenging to actually assess whether countries have implemented what they promised (Mitchell 2005; Bernstein 2005; Gupta et al 2004). Some argue that the Facilitation Branch under the Marrakesh Accords could help developing countries deal with these uncertainties through cooperation with the development of methodologies and technology transfer (Hovi et al 2005).

A more nuanced view is provided by Wettestad (2005), who concludes that there are 8 lessons to be learnt from other regimes. These include the need for an institutional warm-up period, wise institutional engineering, moderate expectations from the verifications process, increased transparency, efforts to maintain close cooperation between the Facilitative and Enforcement Branch of the Compliance Committee, seeking opportunities to engage civil society in the process, and focusing on assistance and compliance facilitation using the enforcement mechanism as an important but 'hidden' stick.

Barrett (2003; 2003) argues that if countries fail to comply over two compliance periods, they can essentially indefinitely postpone taking action: A country that is found in non-compliance in the first period has to make up the difference plus 30% in the next period. If it fails to achieve that target as well, it will have to make up the difference in the period thereafter – a process that can continue indefinitely. Perhaps most importantly, if countries feel that they cannot easily meet their commitments, they will negotiate for higher allowances in the period thereafter – or even withdraw from the agreement entirely. Furthermore, the Protocol does not have any procedures to deal with countries that decide not to cooperate with the rules. There is a literature that evaluates how rules related to non compliant countries affects other Parties. Hovi (2005) and Stokke (2005) argue that measures taken against non-compliant countries might also impact the compliant countries.

A significant body of research exists comparing various dispute settlement procedures. A number of these examine environmental agreements (see e.g., Werksman, 2002), while others more specifically focus on possible conflicts between climate agreements and trade agreements (see, e.g., Murase, 2002) With respect to this second issue, criteria need to be established for coordination between a multilateral environmental agreement (MEA) and the WTO. Given that MEAs and the WTO are independent treaties on equal footing; neither can automatically be held to be supreme in case of conflict. Theoretically, in such a case, coordination in the form of dispute settlement should take place at a forum other than the MEA or the WTO in order to maintain impartiality, or, alternatively, there should be at least an equal chance of selection between the two for dispute settlement. However, on the environmental side, there is no counterpart to the WTO's compulsory dispute settlement procedure, and therefore a dispute on "trade and the environment" is more likely to be submitted to the WTO rather than that under an MEA, which is possible only on the consensual basis. In part due to the disparity between these agreements, a number of authors (e.g., Murase, 2002, Esty, 2001) have called for the establishment of a new institution such as a World Environment Organization (WEO), embodying its own dispute settlement mechanism, as a counterpart of WTO with a view to attaining an equal footing between the two regimes.

13.3.3 Criteria for evaluating agreements- Does the heading need to change? It does not look proper for this sub-section?

13.3.3.1 Introduction

A number of authors have developed proposals for evaluation criteria, including Torvanger and Godal (1999), Torvanger and Ringius (2000), Philibert & Pershing (2001), Berk et al. (2002), Den Elzen (2002b), Torvanger and Ringius (2002), Höhne et al. (2003, 2005), Zarsky and Gallagher (2003), Den Elzen et al. (2003), Aldy et al. (2003), Bodansky (2004), Torvanger et al. (2004). Authors have also used different approaches to represent the application of different criteria. See Tables 13.5 and 13.6.

[INSERT Tables 13.6. and 13.7. here]

Depending on the selection of approaches and assessment criteria, the studies draw different conclusions from their assessment. Thus, for example, Torvanger and Ringius (2002) seem to highlight the advantages of the multi-sector convergence regime. Höhne et al. (2003, 2005) and Den Elzen et al. (2003) found that in particular the Multi-Stage and Triptych approach may provide good prospects for designing a regime architecture that is both environmental effective and in generally acceptable for all both developed and developing countries.

In broad terms, authors seem to agree that climate change agreements should: 1) Improve environmental performance, both directly and by increasing capacities for regulation; 2) be in line with economic development objectives; 3) Strengthen social resilience, including by reducing inequality. While the weighting given to different elements and sub-elements varies from author to author, most agree that a successful agreement will develop projects and policies which produce positive results for all three goals (or at least not retard one at the expense of another).

The procedures and processes to be followed in developing, testing and evaluating agreements will vary from country to country, depending on country specific conditions, national priorities and objectives, available infrastructure, expertise and the availability of data and other information for decision-making. Because the process requires the allocation of human and financial resources, a pragmatic, cost-effective approach is essential. The following procedural issues must be addressed: organization; implementation; assessment and evaluation; institutional support and capacity building; and reporting.

A number of criteria have been posited for evaluating agreements. This section reviews the literature on several, including

- Environmental effectiveness
- Economic efficiency / cost effectiveness

- Political feasibility
- Technical implementation

13.3.3.2 Environmental effectiveness

Successful international agreements provide incentives or deterrents to State and human behavior in order to achieve a specific outcome.

It has been argued that an instrument is more effective if it is legally binding, if the targets are clear and quantitative, if there are clear definitions and the use of unambiguous language, if the principles underlying the agreement are enunciated adequately, if there is a clear elaboration of rights and responsibilities for countries, if there are financial resources to support the operation of the regime, if there are mechanisms that promote implementation, if there are bodies that promote collaboration with the scientific community and promote implementation, when there is a regular call for reporting requirements, non-compliance mechanisms, options for dispute resolution, access to courts, and options for coordinating with other relevant regimes (Oberthur and Ott, 1999; Miles et al 2002; IPCC 1990; Jacobson and Weiss 1997; etc.).

A further critical element of effectiveness is that of implementation context: The literature shows that agreements tend to be more successful in countries with a high level of domestic awareness and resources, with a strong institutional and legal framework, and where there is clear political will. Where global agreements are designed with blue-print approaches to instruments, these instruments may ignore the specific cultural and institutional contexts and may not work as well (see conclusions of the Millennium Ecosystem Assessment, 2005).

Finally, a climate agreement has to ensure that global greenhouse gas emissions from all sectors are reduced to achieve an environmental goal, such as the ultimate objective of the UNFCCC. It could also promote ancillary objectives, such as, reductions in ordinary air pollution levels, should avoid leakage (the transfer of emissions to other countries instead of the reduction (See Box 13.7) and should provide certainty of the emission levels on the global level as well as for participating Parties.

13.3.3.3 Economic efficiency / cost-effectiveness

From the economic point of view, a successful implementation will be one that is most efficient for the global economy. This would thus minimize global costs, and give participating sovereign nations sufficient flexibility to reach their commitments in a fashion tailored to their national needs and priorities. Such a scenario would avoid being prescriptive in its actions, but leave room for the implementation of the target, (e.g. while reducing emissions in different sectors or reducing emissions of different gases, it would not lead to large distortions in competitiveness between countries). Furthermore, it would ensure that participating countries have certainty on the inferred costs of taking on commitments.

A further element of economic efficiency would be low transaction costs to comply with the agreement. If the institutions and procedures required to implement the agreement are very costly, a more efficient way may be found to reach the same environmental goal.

Many studies argue that a system that enables emission trading with the broadest possible participation of countries would be most efficient. Such a system would allow the emission reductions to occur in those countries, sectors and gases, where they can be achieved at the lowest cost. An approach based on specific policies and measures would have to be designed carefully to be as efficient as an emission trading system.

Studies are divided about the economic efficiency of the timing of reductions. While some studies argue that reductions should be postponed until low cost technologies are available, other studies argue that necessary decisions have to be made today to avoid a "lock-in" effect into an emission intensive pathway that would be expensive to leave at a later point in time. (See also chapter 11)

Box 13.7. *Emissions Leakage*

Emissions leakage occurs when a portion of the emission reduction that occurs when countries impose policies to abate emissions is offset by emission increases in countries without emissions abatement policies. In the context of the international climate regime, leakage is measured as the increase in non-Annex I emissions divided by the reduction in Annex I emissions (TAR, 2001). In general terms, leakage occurs because economic activity shifts to regions that do not face the costs of emissions abatement. Some portion of emissions leakage may be counteracted by "positive spillovers", where the introduction of an emission policy in a region with an emissions constraint leads to technological innovation in countries without a constraint.

While a comprehensive discussion of the literature on leakage and spillover effects appears in Chapter 11, there is a narrow question of the policy implications of leakage for the design of international regimes relevant to this discussion. According to Torvanger et al (2004), global participation is an important safeguard against 'leakage' and reduces the likelihood that the mitigation efforts of participants in a climate regime will be undermined (or even negated) by the activities of those outside it. Similarly, Kuik (2004) notes that the "first-best policy" to limit leakage is to increase the number of emission abating countries in the climate regime. He argues that a "second-best policy" would be to implement import and export taxes for trade of CO_2 intensive products with non-abating countries.[36] The author argues that a "third-best" policy would be to shelter economic sectors more vulnerable to leakage by imposing greater emission reduction responsibilities on sectors less vulnerable to leakage. This type of policy, however, could increase the overall costs of abatement. One example of such leakage is increased oil consumption and related carbon dioxide emissions by countries outside of the climate regime, caused by a lower oil price due to smaller demand from the countries participating in the regime.

Grubb et al. (2002) argue that under some scenarios, instead of leakage, one can expect technology development driven by the international climate regime in Annex I countries could offset some or all emissions leakage in non-Annex I countries. Sijm (2004) notes that a number of policies could promote this spillover effect in the longer-term. These types of policies include international cooperation on RD&D, promoting open trade, using the Clean Development Mechanism and other technology transfer strategies that build local technology capacity in developing countries, and promoting innovation and diffusion of carbon technologies through covenants between governments and industry.

13.3.3.4 Political feasibility

13.3.3.4.1 Equity

While cost effectiveness and efficiency are often taken as the criterion for measuring the appropriateness of an agreement, issues of equity have also been evaluated. Only an agreement that is perceived as equitable can be politically feasible. Equity as a concept emanates from the idea of justice and has been a key subject of international law since its inception. Principles of equity have developed considerably in the area of international water law and their inclusion was seen as inescapable for the effectiveness of these agreements (cf. Gupta 2004; Kaya 2003; Hildering 2004).

Although principles of equity are embodied in the climate change convention (e.g., in the principle of common but differentiated responsibility and capability and in a number of articles focusing on

[36] However, they also raise the question of whether this would be allowed under WTO rules.

vulnerable countries, technology transfer and financial assistance), the actual elaboration of this concept has been limited. However, equity can be defined in any number of ways in the climate context. Banuri et al. (2006?) argue that equity could be elaborated in terms of distributing the costs of adaptation, distributing future emission rights, distributing the costs of abatement and ensuring institutional and procedural fairness. They suggest that although some of these elements have been included in climate change agreements, much more needs to be done to improve their further elaboration.

While equity and fairness may be perceived differently, depending on the cultural background of the observer, Ringius et al. (2002) see *responsibility*, *capacity*, and *need* as basic principles of fairness that seem to be sufficiently widely recognized to serve as a normative basis for a climate policy regime. These three principles have been used in the evaluation of possible international climate agreements afterwards (e.g. Höhne et al. (2003, 2005), Den Elzen et al. (2003), Torvanger et al. (2004)). These studies conclude that a potentially successful system must satisfy each of the three equity principles *responsibility*, *capacity*, and *need.*

Kemfert and Tol (2002) describe four ways in which equity may be considered in the climate setting. They note that if development aid is a guide, international altruism is small and is likely to have little impact on optimal emission control. Conversely, if countries act as if they ‘feel’ (even if they do not ‘physically experience’) the climate impact of the most vulnerable countries, optimal emission reduction increases, albeit not substantially. An even stronger engagement emerges if countries actually have to pay for the damage done; under such a scenario, they prefer to reduce emissions substantially rather than incur damages. Finally, if countries are required to pay an equivalent amount in emission reductions as damages cost in countries adversely impacted by climate change, (that is, if climate policy restores the income distribution to what it would have been without climate change), emissions are rapidly cut to very low levels.

Several researchers evaluate individual elements of potential future agreements on an equity basis. For example, Leimbach (2003) uses the ICLIPS model to assess the equity implications of international emissions trading when developing countries are taking up commitments. She argues for short transition phases between status quo and equal per capita allocation of emission rights are more equitable. She also suggests that unrestricted trade is superior from an economic and equity point of view as trade restrictions may cause a considerable quantity of emission rights to remain unused. Imprudently combining equal per capita allocation and trade restrictions distorts fairness and efficiency by introducing an “equity dent”, i.e. a temporary decline of world emissions.

Pan (2003) differentiates between emissions rights covering basic needs that are not transferable. He argues that emission reduction targets should only address “luxury emissions”; the allowances for those should be fully tradable.

13.3.3.4.2 Negotiation forum / governance

At the global level there is consensus in the literature that we do not have a system of government, but rather, one of governance (Rosenau 2002; Krahmann 2003; Kahler and Lake 2003; Slaughter-Burley 1992). This implies that environmental issues are unlikely to be dealt with in a comprehensive manner and in their relationship with developmental and other issues.

There is a considerable divergence of views on governance structures in the research community. The realist, neo-realist and structuralist camp argue that power politics determines negotiation outcomes, and that there will be non-collaboration in the area of global public goods (Morse 1977, Ruggie 1992). For this community, although there may be rules at international level, these “do not exert an independent influence on state behavior” (Arend 1996: 289). The institutionalist group, however, argues that on specific issue areas it is possible to have issue-specific power that is in contrast to existing power structures and that there is often space for negotiation and designing good institutions (Junne 1992, List-Rittberger 1992, Krasner 1992, Young 1989a and 1989b). This is supported by the observation that environmental law making at the global level is piece-meal in nature.

There is consensus in the literature that managing international environmental issues has been undertaken primarily through legal agreements even if market instruments are embedded in these agreements (Harris 1991: 289; Henkin 1979: 47; Arend 1996: 306). This is in sharp contrast to the way decisions have been taken in relation to developmental issues, which have been primarily undertaken by policy decisions of countries (either individually or in groups such as through the OECD, or the IDBs or various UN agencies). Based on this, several authors have suggested that developmental law is a neglected dimension in international sustainable development law (Schrijver 2001; Fuentes 2002). While environmental issues have been predominantly on the agenda since the 1970s, it should not be forgotten that legal instruments have been used through the last few centuries to regulate resource based regime, primarily international river basins (e.g. Caponera 1990; Teclaff 1985; Gupta 2004).

13.3.3.4.3 Issue linkage / side payments

Several publications analyze how the links between the issue of climate and other issues can help to increase to political feasibility of a future agreement.

Reinstein (2004) sees the future of the international climate policy regime in negotiating a package of multi-component commitments by each country based on national circumstances and negotiated from the bottom up, as in a multilateral trade agreement. Philibert (2005) notes that there five reasons for integrating different approaches too increase the level of action, relating to the public good, competitiveness, fairness, static and dynamic-cost effectiveness and technology transfer. He examines ways to integrate different types of policy packages, e.g., a result oriented approach based on emission targets versus an effort oriented approach based on investments in developing new technologies. He concludes that, while not impossible, comparing such approaches is very complex and resource-consuming and that without a way to compare approaches it would be difficult to determine whether a proposal was fair to all countries. Den Elzen and Berk (2004c) also examine the merits of a ‘bottom-up’ approach such as technology and performance standards and R&D and compared to fixed national emission targets. They conclude that that such approaches may be offer the opportunity for early participation by developing countries and for enhancing the integration of climate policies and other policy areas, but do not provide a real alternative, since they provide little environmental certainty and substantial implementation problems. Kemfert (2004) uses game theory to show that incentives exist for non-cooperating countries like the USA to join a climate policy coalition if nations cooperate on technological innovations. Restrictions on trade such as sanction mechanisms against non-cooperating countries are not necessarily an incentive to join a coalition.

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Cesar and Zeeuw (1994) build a general framework linking environmental cooperation with cooperation in some other, non-specified area. They show that cooperation in both areas is sustainable provided that the two roughly offset each other. That is, agreements can be sustained if what a country gains from cooperating in one area is roughly equivalent to what the other one gains from cooperating in the other. Under this approach, the policy games are fully independent of each other, which is different from what would occur in a linked trade and environment policy negotiation.

Spagnolo (1996) analyzes strategic effects of linking international negotiations with different policies (which may include trade and environment) within a framework of repeated games. He finds that when issues are interdependent and are substitutes in governments' objective functions, linking agreements may help to sustain policy cooperation. Ludema and Wooton (1994) and Nordhaus and Yang (1996) use partial equilibrium models to examine a non-cooperative game between two countries in the presence of a cross-border externality. They show that countries would tend to use environmental policy as a substitute for trade policy and vice versa, and that there will generally be a tendency for the externality to be overcorrected. They do not explore the possibility of environmental policy co-operation, although they point out a linkage between trade and environment could be implicitly present in some free trade agreements involving countries of different size which contain some environmental provisions. This leads the larger country to give up its monopoly power to the smaller one as a form of side payment for agreeing to environmental cooperation. Strategic linkages between trade and environmental policies are not examined empirically.

Nordhaus and Yang use a multi-region dynamic general- equilibrium model to examine market, co-operative and non-cooperative environmental strategies. They compute non-cooperative Nash equilibria in environmental policies as well as cooperative equilibria where countries adopt globally efficient policies to reduce emissions. One of their findings is that the non-cooperative strategy is superior to the (do-nothing) market strategy but inferior to cooperative policies. They also find that some high-income countries (such as the USA) may lose from cooperation relative to non-cooperation, with the bulk of benefits from cooperation accruing to developing countries. In their model, bargaining solutions are not examined and no interaction between trade and environment is considered.

13.3.3.5 Technical implementation

Several technical issues are important to consider when an agreement is negotiated and implemented. Since the international negotiation process under the UNFCCC is based on decisions by consensus, an approach that is simple and requires a low number of separate decisions by international bodies could have a higher change of being agreed.

The literature also shows that ownership of an instrument and hence commitment to and effectiveness of it is linked to the way the agreement was negotiated. The literature shows that the leadership (directional, instrumental and unilateral) demonstrated in a regime may stimulate its effectiveness. The role and influence of non-state actors in the process of negotiation also increase the legitimacy and compliance-pull of a regime both because such participation both promotes broader acceptability of the agreement, and because it may increase knowledge about the regime. Agreements are also more likely to be effective when negotiated in accordance with established rules of procedure, when the negotiators of key countries have been able to adequately prepare themselves for the negotiation, when the subject matter of the negotiations is designed to address the problem (Gupta 1997), and has not been artificially limited to make the solutions more attractive to the more powerful countries (Greene 1996, Benedick 1993, Andresen and Wettestad 1992, Sebenius 1993, Sand 1990; Gupta and Grubb 2001; Gupta and Ringius 2002).

13.3.4 Interaction between national and international policies and agreements

13.3.4.1 Multilateral

Perhaps the interaction with the greatest potential for acrimony between countries surrounds conflicts between climate change and trade. While to date, disputes between climate and trade agreements have not been legally tested, the literature is full of references to possible conflicts – as well as possible synergies. Assuncao and Zhang (2002) suggest that an early process of pursuing consultations between WTO members and the Parties to the Climate Change Convention is necessary to further explore ways to enhance synergies between the trade and climate regimes. Whalley and Zissimos (2002) have suggested that governments could bargain simultaneously on climate and trade in order to achieve deals that would be unattainable in separate fora. Other authors suggest that the Kyoto Protocol ratification decision by Russia was tightly linked to the EU backing of its entry into the WTO (Kotov, 2004).

Although the trade and climate regimes have different aims and organization, they do in fact enjoy many common features. Both regimes aim to promote greater economic efficiency in order to enhance public welfare. Both regimes recognize linkages between the economy and the environment. Although the trading system often moves through joint cooperation, the reality is that trade liberalization is often in each country's own interest, and differential levels of market openness are tolerated – and with time, expected to converge. By contrast, in the climate regime, a high degree of inter-governmental cooperation is necessary if GHG emissions reductions are to be obtained. As a result, non-participation in the climate regime is ultimately a more serious matter than in the trade regime (WTO, 2001). There is a considerable history of international cooperation on environmental issues – including issues that are intimately linked to global trade[37]. Frankel and Rose (2003) provide a set of the potential conflicts and synergies between environment and development. (See Table 13.8)

[INSERT Table13.8. here]

In a global economy, the line between domestic and trade policies is not clear. The GATT and the WTO panels have repeatedly made reference to multilateral solutions to environmental problems, while the WTO Committee on trade and environment has reiterated over the years its endorsement of multilateral solutions based on international cooperation and consensus as the best and most effective way to solve environmental problems on trans-boundary or global nature. The GATT has two rules that curtail the use of outwardly directed trade measures. First, GATT Article XIII forbids

[37] These include: Montreal Protocol on Substances that Deplete the Ozone Layer (MP);Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR);Convention on Biological Diversity (CBD); UN Framework Convention on Climate Change (UNFCCC); International Tropical Timber Organization (ITTO); UNEP Chemicals on the Rotterdam Convention on Prior Informed Consent (PIC) and the Stockholm Convention on Persistent Organic Pollutants (POPs); International Commission for the Conservation of Atlantic Tunas (ICCAT); International Plant Protection Convention (IPPC); and UN Division of Ocean Affairs and the Law of the Sea on the UN Fish Stocks Agreement.

the imposition of quantitative restrictions on imports and exports that discriminate between countries. Second, GATT Article I requires most-favored-nation (MFN) treatment, meaning that a product from a WTO member country should be accorded treatment no less favorable than the like product from any other country. By forbidding trade discrimination, the GATT makes it hard to employ trade restrictions that treat two countries differently depending on an internal policy in one of the countries. The rules in GATT Articles I and XIII are subject to the General Exceptions in GATT Article XX (Charnovitz, 2003).

Should a complaint occur, the attitude of a WTO panel may depend on whether the disputed trade measure stems from a treaty obligation or a national policy. Neither the UNFCCC nor the Kyoto Protocol has language that can be reasonably interpreted to require or authorize a trade measure as a strategy to promote membership, make the climate regime more effective, or enforce the treaty. Thus, any use of a climate trade measure would be considered a national-level action. (See Box 13.6)

Rather than using trade bans or tariffs to induce other countries to join the Kyoto Protocol, concerned governments (e.g., in Europe) may seek to use border tax adjustments to offset the competitive advantage obtained by countries that are not undertaking emissions reductions (Charnovitz, 2003). The domestic measure could be as disadvantageous to a target foreign country as a trade measure. Important business groups from U.S. (U.S. Council for International Business 2002) and Mexico (CESPEDES, 2000) point to that scenario as problematic for the companies.

While there could well be pairs of governments willing to exchange action to liberalize trade for action to combat global warming, there has been no such cases. The most obvious deal would be a promise by developing countries to undertake climate commitments in return for a promise by developed countries to give more market access. But that swap seems impractical. Since low-income countries have been demanding greater market access for its own virtue, they would surely resist the notion of “paying” for it through a costly link to climate (Micheli, 2000).

While trade and the WTO are often at the center of debates over conflicts between national and international policies, other agreements and fora may also become a locus of climate related activity, for example, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, or CITES. Countries that are members of both CITES and the UNFCCC may find that common efforts both protect endangered species and the climate. Also, the Asia Pacific Economic Cooperation (APEC), provide a platform for regional economies to take steps to meaningfully address the adverse impact of climate change (Ivanova and Angeles, 2005). The APEC Virtual Center (APEC-VC) for region-wide Environmental Technology Exchange launched by the Asia-Pacific economies seeks to provide information through the Internet on environmental technology gathered in the APEC region by regional and local governmental authorities as well as companies and environment-related organizations in order to promote the exchange of environmental technology.

In the Northern Hemisphere, the Commission on Environmental Cooperation (the NACEC or CEC), created within NAFTA, is an innovative international environmental institution that was the first international organization created to address the environmental aspects of economic integration, and which has powerful tools and almost unlimited jurisdiction while providing opportunities for participation by civil society at the international level (Castañeda, 2004). Its effect has already been demonstrated: Gallagher (2004) presents data on changes in the Mexican environmental situation resulting from NAFTA, some of which, related to energy use, have a direct bearing on climate. Canada, Mexico and the United States signed an agreement to cooperate on reducing the threat of global change. The trilateral agreement is the basis for public-private partnerships to reduce greenhouse gas emissions in North America and to boost investment in green technology.

Box 13.8. Japan's "Top-runner" Approach: A Case Study

In 1998, Japan introduced the "top-runner" program in its revised Law concerning Rational Use of Energy (Energy Conservation Law) as part of its domestic efforts to implement the Kyoto Protocol. This legislation was intended to ensure that automobiles and other manufactured products would be more energy efficient; it required new appliance and manufactured goods be as efficient as the "top-runner" in the same category[38]. The legislation raised concern among other automobile exporting countries, most notably the United States and the European Union, which feared that the measures might have adverse effects on their exports; they suggested that the legislation was not compatible with WTO rules on free trade.

While the Japanese Government notified the WTO of its intention to revise its domestic law, no comments were submitted until less than one month before the Law was to enter into force, when written comments were received from both the United States and the European Commission (EC) expressing concern that the revision might adversely affect imported cars. Following the receipt of these complaints, intergovernmental discussions were held in accordance with the procedures prescribed in the WTO Agreement on Technical Barriers to Trade (TBT). The law ultimately took effect in 1999, and although discussions between Japan and the EC continued through 1999 to 2000, no formal appeal was ever submitted under the GATT or the TBT Agreement (see Murase, 2002).

According to Yamaguchi (2005) the Japanese Law provides for objective standards that would be applied equally to domestic and imported cars, and accordingly, he argues there is clearly no discriminatory treatment as a matter in law – or as a matter in fact: While the standards for cars are set at ambitious levels, US car sales in Japan that fall under these categories are relatively low. While 70% of European car sales are required to meet the new standard, only a relatively modest improvement would be required: 7.4%. In view of this, it is suggested that the standards do not discriminate against imported cars.

The arguably unique nature of the Japanese program along with the perception that it raised objectionable trade barriers, demonstrates the potential for conflict between climate and trade agreements. Similar concerns may ultimately arise in other sectors and between other countries. In fact, the problem is likely to become more severe as more aggressive efforts are made to mitigate climate change, and as larger number of countries, each acting in ways that reflect their own national circumstances, take policies that are not coordinated or harmonized.

13.3.4.2 Bilateral

As with multilateral agreements, there has been an increase too in bilateral arrangements. Historically, treaties between individual nations have formed the backbone of global networks – with the balance of power equations dating back to the Roman legates and European "Great Powers". It is therefore unsurprising that these bilateral relationships and arrangements play a critical role in the international environmental arena too. At the UNESCO EABRN workshop in 1997, the rationale for bilateral arrangements in the context of cross boundary conservation cooperation was considered – and it is clear a similar set of characteristics apply in the climate context, for example, when:

- The sites belonging to neighbouring countries are part of same ecosystems and home, same protected species and habitats. Sometimes the reserves are geographically adjacent or close to each other and the protected species migrating from one site to another.

[38] For example, fuel efficiency targets for passenger cars were set as a function of weight: for a car weighing 750 kg, the standard was 21.2 kilometres/per a liter of gasoline; for a 875 kg car, 18.8 km/l; for a 1000kg car, 17.9 kg/l. If these targets are met, the reduction of emissions from these cars, is estimated to be 22.8%.

- The people living in and around these protected areas share the same culture and have similar traditions as well as ways of using the resources.
- There are differences in management policies and practices, and
- There are differences in terms of demands of resource uses and level of human pressure.

A number of bilateral climate related efforts seek to address these problems. For example, agreements between the EU and China are looking to reduce duplication of effort in the development of carbon capture and storage technologies. Agreements between Japan and China are considering different practices related to local criteria pollutant emissions that cross the China Sea to Japan – and result from different practices in adjacent regions. As long as global, multilateral efforts are couched in terms of generality, national sharing common interests and borders are likely to continue to address local issues through bilateral programs.

13.4 Insights from and interactions with private, local and non-governmental initiatives

Increasingly, private companies, non-governmental organizations, and local or regional governments are developing initiatives to address greenhouse gas emissions. Some private initiatives are part of government sponsored voluntary programs. However, this section will discuss initiatives that are independent of, or complementary to, national or international policies.[39] For example, some private companies have developed corporate emission reduction programs that are intended to proceed, influence, or supplement national policies. Local, state, provincial, or regional governments have developed greenhouse gas policies and programs that are either synergistic with national policies or are independent of these policies. Non-governmental organizations, including environmental advocacy groups and industry associations, have started a variety of programs and initiatives to address greenhouse gases. Finally, both non-governmental organizations and sub-national governments have initiated court actions to influence national or international climate change policies. This section will explore the drivers of these actions, describe the types of initiatives underway, and examine the interactions between these activities and national and international programs.

13.4.1 Voluntary environmental actions (including sub-national governmental, corporate, NGO and civil actions)

13.4.1.1 Corporate actions

There is a growing literature exploring the factors that lead corporations to adopt voluntary environmental action (Lyon and Maxwell, 2004). Some companies have attributed these actions to sustainable development goals or environmental stewardship policies (Margolick and Russell, 2001). However, it is often difficult to separate these goals from economic motives (Kolk and Pinske, 2004). Less controversial is the notion that companies adopt voluntary initiatives to create financial value in one form or another (Lyon and Maxwell (2004).

There are both political and non-political drivers of corporate voluntary environmental action. Political drivers include a desire to pre-empt or influence future regulation. For example, trade associations have sponsored codes of management practices, which are partly intended to forestall the

[39] In the literature, these types of initiatives are sometimes referred to as "self-regulation" or "unilateral commitments." This type of action is differentiated from voluntary agreements where government has a role in negotiating or facilitating agreements. See Higley et. al., 2001, OECD, 2003 and Lyon and Maxwell, 2004 for typologies of different types of voluntary agreements and initiatives.

imposition of government mandates.[40] Imura (1999) finds that the Keidenren association of industrial companies in Japan took "unilateral action" to form a Voluntary Action Plan for greenhouse gas reduction to avoid mandatory regulation and government intervention.[41] (See Box 13.7) Alternatively, corporations may adopt voluntary initiatives to influence future regulation in ways that improve their strategic positions. Adopting environmental technologies or other strategies ahead of regulatory mandates can signal to regulators that these alternatives are practical or relatively cost effective (Reinhardt, 1999). Hoffman (2005) finds that some companies have adopted internal emissions trading schemes or greenhouse gas measurement programs to gain expertise that will help them influence future national or international policies. A related motivation for voluntary action is the desire to manage the risks of future regulations by taking action that would increase profitability or protect a company's competitive position in the event of future regulatory mandates. (Margolick and Russell, 2001)

Non-political drivers of voluntary corporate environmentalism include the desire to reduce costs through practices that also have environmental benefits (sometimes known as "eco-efficiency"). Esty and Porter, (1998) discuss how the desire to reduce energy or materials costs drives corporate voluntary action.[42] Hoffman (2005) and Margolick and Russell (2001) describe a variety of actions taken by U.S. and Canadian companies to reduce greenhouse gas emissions while also reducing energy and operational costs.

Companies may also adopt environmental initiatives to appeal to green consumers, environmentally conscious stakeholders, or even their own employees. Reinhardt (1998) discusses how this can take the form of companies differentiating their products by their environmental performance. Other companies have identified market opportunities for new products from potential greenhouse gas regimes (Reinhardt and Packard, 2001 and Kolk and Pinske, 2005.) Regarding stakeholders, Maxwell et. al. (2000) found that firms in U.S. states with higher per capita membership in environmental organizations had more rapid reductions of toxic emissions. Margolick and Russell (2001) found that corporate managers cited employee retention and recruitment as a reason for taking voluntary action. Employee morale and motivation has also been cited as one of the reasons for British Petroleum's corporate greenhouse gas reduction target and internal emissions trading program (Reinhardt, 2000b).[43]

For greenhouse gases, voluntary corporate-wide emissions targets have become particularly popular. For example, Hoffman (2005) finds that as many as 60 U.S. corporations have adopted corporate greenhouse gas emissions reduction targets. Some of these companies have participated in one of several partnership programs run by non-governmental organizations.[44] (See Box 13.9) Under many of these programs, companies develop a corporate greenhouse gas inventory and adopt an emission target. These targets take different forms, including absolute targets and intensity targets based on emissions or energy use per unit of production or sales. (King et. al., 2004, Margolick and Russell, 2001). Corporate targets have also been implemented with internal trading systems, such

[40] Nash and Ehrenfeld, 1996 find that such codes have been established in 30 nations.

[41] Although these plans have no participation of government, the Japanese government may ask industries to report on their implementation plans. (Imura, 1999). Because of this linkage, the Keidenren program might also be considered a more formal voluntary agreement instrument in some typologies of voluntary corporate actions.

[42] The extent to which these unrealized savings are available to industry are subject to some debate. See, for example, Porter and van der Linde (1995) and Palmer et. al. (1995).

[43] For a detailed description of this initiative, see Akhurst et. al., 2003.

[44] In some cases, companies participate in these programs in addition to government organized efforts such as U.S. EPA's Climate Leaders Program or the U.S Department of Energy's Climate Vision program (See section 3.3.x on Voluntary Agreements?).

as those operated by BP (Akhurst et. al., 2003), Shell (Margolick and Russell, 2001), and Petroleos Mexicana (PEMEX), (Bygrave, 2004).

13.4.1.2 Sub-national initiatives

In some countries, regional, state, provincial, or local governments have developed greenhouse gas reduction policies and programs. These initiatives may be independent of or complementary to national government policies. The global nature of the climate change problem may raise special issues for regional or local governments, whose actions have limited geographic scope. Nevertheless, there are a number of reasons cited in the literature for sub-national activity on climate change, including the desire to influence national policy or regulations, public or other stakeholder concerns about the impacts of climate change, and co-benefits from activities related to climate change.

There is an extensive literature on the appropriate level of government to address environmental problems. [45] For policies associated with greenhouse gases, there are additional issues because of the global nature of the problem. Regional or local entities that adopt programs or mandates that go beyond national requirements are addressing not just their local environments but also the global environment. This could be viewed as a "free rider" problem because non-participating regions benefit from the actions of the participating areas without paying the costs (Kousky and Schneider, 2003). It also raises the potential problem of "leakage" if mandatory requirements in one jurisdiction cause a shift in economic activity and emissions to another jurisdiction without mandatory requirements. (Kruger, 2005).

The literature discusses several reasons that sub-national entities might undertake independent policies on greenhouse gases or other environmental issues. Oates (2001) and Vogel et. al. (2005) highlight the influence that State governments in the U.S. have had on national policy by experimenting with innovative initiatives. Rabe (2004) argues that some U.S. states enacted greenhouse gas policies to create incentives for new emission reduction technologies or to facilitate recognition of emission reductions by companies in the event of future national regulations.

Sub-national governments in the United States and Australia, two countries that are not parties to the Kyoto Protocol, have been among the most active on greenhouse gas policy. U.S. states have adopted or proposed a variety of programs to address greenhouse gases, including renewable energy portfolio standards, energy efficiency programs, emissions registries. Perhaps most notably, nine states in the north eastern and mid-Atlantic U.S. have announced their intent to develop a regional cap-and-trade and three western states--California, Washington, and Oregon--may explore a similar initiative (Rabe, 2004, Pew Center, 2004, Peterson, 2004, McKinstry, 2004) Australian states have developed a broad array of programs to reduce, sequester, or measure greenhouse gas emissions.[46] For example, New South Wales has developed a credit-based emissions trading scheme for electricity retailers, generators, and some electricity users. (Fowler, 2004, Baron and Philibert, 2005). Victoria has adopted a series of programs to support renewable energy projects and the development of a "green power" market. (Northrop, 2004).

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[45] In the U.S. literature, this issue is usually referred to as "environmental federalism" See Oates, 2001, Revesz, 2001. In Europe, the issue is known as environmental policy "subsidiarity." See Jordan and Jepsen, 2000.

[46] Australian state greenhouse gas strategies can be found at http://www.epa.qld.gov.au/environmental_management/sustainability/greenhouse/greenhouse_policy/other_states_and_territories/

Northrop (2004) finds that more than 600 cities worldwide have participated in programs to implement measures to reduce local greenhouse gas emissions. [47] These include cities in developing countries. 18 cities in South America,[48] 12 cities in South Africa[49] and 17 cities in India[50] are becoming more active in developing environmental measures at local level. Kousky and Scheider (2003) find that cities have primarily adopted greenhouse gas policies with co-benefits, including more efficient energy use. Fleming and Webber (2004) describe a variety of greenhouse gas measurement and energy efficiency measures undertaken at the regional and local level in the U.K., and Pizer and Tamura (2004) summarize measures undertaken by the Tokyo city government to reduce greenhouse gases and control the "heat island" effect.

13.4.1.3 Litigation related to climate

There has been an explosion of scientific articles on the potential for litigation in the area of climate change (Mank B.C. 2005; Penalver 1998; Grossman 2003; Allen 2003; Gillespie 2004; Weisslitz 2002; Hancock 2005; Jacobs 2005; Marburg 2001; Lipanovich 2005; Burns 2004; Thackeray 2004; Verheyen 2003; Gupta 2005). These articles highlight that although there are often strong legal grounds for taking action, there may be also reasons for a strong defence.[51] Nevertheless, they point out that litigation is likely to be used increasingly as countries and citizens become dissatisfied with the pace of international and national decision-making on climate change.

Meanwhile, there are a number of court cases in Kyoto Protocol developed country Parties (Germany), developing country parties (Nigeria) and non-Parties (Australia and the U.S). For example, in the German case, NGOs have sued the export credit support agencies for not disclosing information regarding the greenhouse gas emissions of the projects they support in the developing countries.[52] The Nigerian case is one where NGOs have sued the major oil companies and the state for continuing gas flaring which contributes to greenhouse gas emissions amounting to about 70 million tonnes of CO_2 annually (Climate Justice Programme 2005)[53] and which is seen as a violation of the Convention and the human rights of the local people. [54] In Australia, NGOs have filed a suit against a minister for permitting a mine expansion project without examining the greenhouse gas emissions.[55] In a similar vein, there are cases in the United States where states (e.g. Massachusetts, Connecticut and Maine) argue that the US EPA should regulate carbon dioxide as a pollutant under the Clean Air Act.[56] Attorneys General from 12 states, three cities (including New York City), one island group (American Samoa) and environmental NGOs have also challenged the EPA for failing to regulate greenhouse gases. There is literature being developed about whether small island states

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47 These cities participate in the International Council for Local Environmental Initiatives (ICLEI), Cities for Climate Protection (CCP) program. See http://www.iclei.org

48 http://www.iclei.org/index.php?id=528.

49 http://www.iclei.org/index.php?id=700.

50 http://www.iclei.org/index.php?id=1089.

51 The literature highlights a variety of possible causes of action in litigation, including the customary law principle of state responsibility, the nuisance and the no-harm principle, violation of international agreements including the World Trade Organization and the United National Convention on the Law of the Sea (UNCLOS), the violation of human rights, and the abdication of authority by states to legislate on environmental issues based on the existing environmental legislation in the country concerned.

52 www.climatelaw.org/media/german.suit.

53 The Climate Justice Programme (2005). Gas Flaring in Nigeria: A Human Rights, Environmental and Economic Monstrosity, The Climate Justice Programme, Amsterdam.

54 Suit No. FHC/CS/B/126/2005; filed in the Federal High Court of Nigeria, in the Benin Judicial Division, Holden at Benin City.

55 www.climatelaw.org/media/CANA.Australia (CHK.)

56 108 Complaint 06-04-03, Commonwealth of Massachusetts, state of Connecticut and State of Maine, plaintiffs versus Christine Todd Whitman, in her capacity as Administrator of the United States Environment Protection Agency.

could successfully request the International Court of Justice to give an advisory opinion on whether the climate change negotiations are being conducted in good faith and protecting the most vulnerable countries (Gillespie 2004). Others are arguing that possibly a failure to ratify the Kyoto Protocol may be seen as a violation of elements of the World Trade Organization agreements and or the United Nations Convention on the Law of the Sea (Burns 2004; Doelle 2004). Still others are exploring whether small islands could successfully take the developed countries to the International Court on the grounds of the no harm principle (Jacobs 2005; Verheyen 2003). Finally, legal scholars and jurists are preparing a court case that is likely to be filed by the Innuit Circumpolar Conference before the Inter-American Court of Human Rights against the US government for human rights violations of the Innuit people's way of life.[57] A similar case is being prepared for the Inter-European Court of Human Rights[58]. In the meanwhile, Peru, Belize and Nepal have requested UNESCO to recognize specific areas within their national boundaries as World Heritage in Danger. This could be a first step towards strengthening their position in future climate litigation. The table below sums up the existing and potential legal action in the world.

13.4.1.4 Voluntary Standard Setting and Certification Activities

Levy and Newell (2005) describe how the business sector, sometimes in partnership with non-governmental organizations, has initiated environmental certification or standardization regimes to fill a quasi-governmental role or to augment the role of governments. One of the most prominent examples of this type of standard setting process is the Greenhouse Gas Protocol, an initiative organized by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) to develop an internationally accepted accounting and reporting standard for greenhouse gases. (WRI/WBCSD, 2004)[59] The WRI/WBCSD reporting standard has been used by corporations, non-governmental organizations, and government voluntary programs. The International Standards Organization (ISO) is also developing a standard for company level and project level reporting of greenhouse gases.[60]

Other standardization or certification efforts have been formed to support markets for project based mechanisms or emissions trading. For example, the International Financial Reporting Interpretations Committee (IFRIC), which is the interpretive arm of the International Accounting Standards Board (IASB), has issued guidance on financial accounting for emission allowances.[61] The International Emissions Trading Association, together with the World Bank Carbon Finance Group/Prototype Carbon Fund have developed a validation and verification manual to be used by stakeholders involved in developing, financing, validating and verifying CDM and JI projects. IETA is also working to develop criteria for certification of training courses for greenhouse gas assessors for the EU ETS (Phillips, 2004).

13.4.2 Interactions between private, local and non-governmental initiatives and national/international efforts

The preceding sections have touched on some of the interactions between private, sub-national, and non-governmental initiatives and national and international climate change efforts. As discussed,

[57] http:??www.inuit.org/index.asp?lang=eng&num=244
[58]

[16] WRI/WBCSD (2004)
[60] The ISO standard is ISO 14064 Part 1: "Greenhouse gases: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals." More information on the development of ISO greenhouse gas standards is found at http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=38381&scopelist=PROGRAMME
[61] See http://www.iasb.org/news/index.asp?showPageContent=no&xml=10_262_25_02122004_31122009.htm

some of these efforts have been designed, at least in part, to influence the development of national programs or the international climate regime. Other programs have been designed to fill roles in these regimes that may be appropriate for private or non-governmental entities. Finally, other legal or programmatic initiatives have been launched because of the perceived inadequacy of national or international efforts.

One of the most important drivers of these interactions is the development of a global greenhouse gas emission trading market. Many of the standardization and certification efforts described above have been designed to build institutions for the emerging greenhouse gas market. The emerging greenhouse gas market may also facilitate interactions between sub-national initiatives and national or international climate regimes. For example, there has been an exploration of the possible linkage of the NSW Greenhouse Gas abatement scheme with the European Emission Trading System and with the Kyoto mechanisms. (Fowler, 2004) Similarly, states in the northeastern U.S. are examining issues associated with integrating the Regional Greenhouse Gas Initiative emissions trading market with the EU ETS. (Kruger and Pizer, 2005 forthcoming)

Box 13.9. *Private Partnerships and Programs for Emission Reduction and Reporting*

Chicago Climate Exchange:[62] The Chicago climate exchange is a greenhouse gas emission reduction and trading pilot program for emission sources and offset projects in the United States, Canada, and Mexico. Projects also include Brazil. It is a self-regulatory, rules based exchange designed and governed by the members. These members have made a voluntary, legally binding commitment to reduce their emissions of greenhouse gases by four percent below the average of their 1998-2001 baseline by 2006. They include around 60 businesses and around 10 other organizations.

WWF Climate Savers:[63] The NGO World Wide Fund of Nature (WWF) has build partnerships with individual leading corporations that pledge to reduce their global warming emissions considerably, worldwide 7% below 1990 levels by the year 2010. Six companies have entered this programme, including Lafarge, whose target includes aims to reduce energy-related emissions, increase the proportion of renewable energy sources and use materials substitution to reduce the GHG intensity of final products (WWF 2002).

Environmental Defence Partnership for Climate Action:[64] The NGO Environmental Defence has mobilized the business community to form the Partnership on Climate Change. The eight member companies publicly declare a global GHG emissions limit and the management actions, policies and incentives necessary to achieve that goal. They measure, track and publicly report net GHG emissions. Together they are working on effective strategies to cut greenhouse gas emissions.

Keidenren Voluntary Action Plans: Thirty-five Japanese industries have adopted voluntary emission reduction targets under the umbrella of a program established by the Keidenren association of Japanese industries. The industries participating cover 45% of total emissions in Japan, and the total target for the program is 1990 emissions levels or lower. (Pizer and Tamura, 2004).

World Economic Forum Greenhouse Gas Register:[65] The World Economic forum is providing with its Greenhouse Gas Register a global platform where businesses can make their GHG emission information public. Thirteen companies 13 companies are committed to disclose their global emissions.

Business Leader Initiative on Climate Change, BLICC:[66] Under this initiative, five European companies monitor and report their greenhouse gas emissions and set a reduction target.

World Summit on Sustainable Development Type II Agreements: NGO’s, private companies, and governments have also formed partnerships to help implementation of the World Summit on Sustainable Development (WSSD). These partnerships, known as “type II agreements” are self organized and are formed as voluntary cooperative initiatives. between NGO's, private companies or with the government. They integrate the economic, social and environmental dimensions of sustainable development. Each partnership defines its intended outcome and benefits. To date, some 300 partnerships are registered.

Offset Programs: A number of organizations offer services to offset the emissions of companies, communities and private individuals. Typically, these organizations first calculate the emissions of companies, communities or private individuals. They then undertake emission reduction or carbon sequestration projects or acquire and retire emission reduction units or emission allowances. Braun and Stute (2004) identified 35 organizations that conduct these services, and compared 13 of them in detail

[62] http://www.chicagoclimatex.com
[63] http://www.panda.org/about_wwf/what_we_do/climate_change/our_solutions/business_industry/climate_savers/index.cfm
[64] http://www.pca-online.org/
[65] http://www.weforum.org/site/homepublic.nsf/Content/Global+Greenhouse+Gas+Register
[66] http://www.respecteurope.com/rt2/BLICC/

Cement Sustainability Initiative: Ten companies have developed "The Cement Sustainability Initiative" for 2002-2007 under the umbrella of the World Business Council for Sustainable Development. This initiative outlines individual or joint actions to set emissions targets and monitor and report emissions.

13.5 Implications for Global Climate Change Policy (To be completed after the FOD)

Note to the Expert reviewers of the FOD: a lot of very useful information will become available after the first COP/MOP in December 2005. Therefore this section will be written in the Second Order Draft.

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