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Policies, Instruments and Cooperative Arrangements

Contents

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. It reviews national policies, international agreements and initiatives of sub-national governments, corporations and non-governmental organization.

National Policies

The literature continues to reflect that a wide variety of national policies and measures are available to governments to limit or reduce GHG emissions. These instruments include: regulations and standards, emission taxes and charges, tradable permits, voluntary agreements, phasing out subsidies and providing financial incentives, research and development and information instruments. 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 in both developed and developing countries.

Reducing emissions across all sectors and gases requires a portfolio of policies tailored to fit specific national circumstances. While the literature identifies advantages and disadvantages for any given instrument, four main criteria are widely used by policy makers to select and evaluate policies: environmental effectiveness, cost effectiveness, distributional effects (including equity) and political feasibility. Other more specific criteria, such as effects on competitiveness and administrative feasibility, are generally subsumed within these four.

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

- Regulatory measures and standards generally provide environmental certainty, but their environmental effectiveness depends on their stringency. They may be preferable when information or other barriers prevent firms and consumers from responding to price signals. However, they are generally viewed as inferior to price-based instruments in inducing innovation and technological change and provide less flexibility to stakeholders.
- Taxes and charges (which can be applied to carbon or all greenhouse gases) 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. As with regulations, their environmental effectiveness depends on stringency. Uncertainty in the relationship between price and behaviour can make selecting the right level challenging, but conceptually taxes can be designed to be environmentally effective. As is the case with nearly all other policy instruments, care is needed to prevent perverse effects.
- Tradable permits are becoming increasingly popular as a mechanism to control conventional pollutants and 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 competitiveness. Experience has shown that banking provisions can provide significant temporal flexibility and that compliance provisions must be carefully designed, if it a permit system is to be effective. Uncertainty in the price of emission reductions under a trading system makes it difficult, a priori, to estimate the total cost of meeting reduction targets.
- Voluntary agreements between industry and governments and information campaigns are politically attractive, raise awareness among stakeholders, and have played a role in the evolution of many national policies, but to date have generally yielded only modest results. On balance, it appears that the majority of voluntary agreements have achieved little emissions reductions beyond business as usual. The successful programs include, among other elements: clear targets, a baseline scenario, third party involvement in design and review and formal provisions of monitoring.
- Financial incentives are frequently used by governments to stimulate the diffusion of new, less GHG emitting technologies. While the economic costs of such programes are often higher than other measures, they are often critical to overcome barriers to the penetration of new technologies. As with other policies, incentive programmes must be carefully designed to avoid perverse market effects. Direct and indirect subsidies for fossil fuel use and agriculture remain common practice in many countries, although those for coal have declined over the past decade in many OECD countries.
- Government support for research and development is a special type of incentive, which can be an important measure to ensure that low GHG emitting technologies will be available in the long-term. To be environmentally effective, R&D needs to be supplemented with policies to promote technology deployment and diffusion. However, funding for many energy research programs, such as renewables has been flat or declining for nearly two decades, and there is little evidence to indicate that governments are capable of providing sustained support over 30-50 year time periods.
- Information instruments -sometimes called public disclosure requirements- may effect environmental quality by allowing consumers to make better-informed choices. While some evidence indicates information provision can be an effective environmental policy instrument, we know less about its efficacy in the context of climate change.

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, transport and energy, and in many cases require more than one instrument. Applying an environmentally effective and economically efficient instrument mix requires a good understanding of the environmental issue to be addressed, the links with other policy areas and the interactions between the different instruments in the mix.

International Agreements

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. Its economic impacts on the participating countries are yet to be 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 increasingly applied implementation mechanism for addressing climate change in nations around the world, but a fully global system has yet to be implemented.

However, the Kyoto Protocol has some limitations. For example, its effect on atmospheric concentrations will be limited unless its first commitment period is followed-up by measures to achieve deeper reductions and the implementation of policy instruments by all major emitters.

Numerous options are identified in the literature for achieving emission reductions both under and outside of the Convention and its 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 because they can contribute to sustainable development and attract additional investments and participants and may be more cost effective than project based mechanisms; although they are generally less efficient than broad based market policies. As in the case of project based mechanisms like CDM, there may be methodological challenges in setting baselines and determining additionality. International R&D programmes can induce cost savings, build national capacity and create goodwill. However, they may benefit only a few sectors and may target the wrong technologies. There is no evidence that investments in R&D activities will achieve the same level of emission reductions as quantitative emission objectives, such as those of the Kyoto Protocol, unless supplemented with policies to promote technology adoption. Integrating elements such as technology development and cap and trade programmes in an agreement is possible, but comparing the efforts made by different countries would be 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 proposals for future agreements in the literature include a discussion of goals, specific actions, timetables, participation, institutional arrangements, reporting and compliance provisions. Other elements address incentives, non-participation and non-compliance penalties.

Numerous authors note the need for goals as an important element of any climate agreement. They determine the extent of participation, the stringency of measures and the timing of actions. There is considerable literature assessing different goals and the pathways to reach them. There is a broad consensus that to limit global temperature to a goal of 2°C above the pre-industrial level, developed countries would need to reduce emissions in 2020 by between 10% to 30% below 1990 levels and in 2050 by approximately 40% to 95%.” Emissions in developing countries would need to deviate from their current path by 2020, and emissions in all countries would need to deviate substantially from their current path by 2050.. Reaching lower temperature levels requires earlier reductions and greater participation compared to higher levels of greenhouse gases.

Initiatives of sub-national governments, corporations and non-governmental organization

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 sectoral cap and trade 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 indicating that independent actions by corporations, sub-national governments, NGOs or other civil groups can, by themselves, lead to significant national emission reductions, unless supplemented by national government policies.

Implications for Global Climate Change Policy

Climate change mitigation policies and actions taken by national governments, the private sector and civil society in other areas are inherently interlinked. For example, some of the most significant emissions reductions in both developed and developing countries occur as a result of actions by governments to address energy security or other national needs (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). However, non-climate policy priorities can overwhelm climate mitigation efforts (e.g., decisions in Canada to develop the tar sands reserves, in Brazil to clear forests for agriculture, and in the US to promote coal power to enhance energy security) and lead to increased emissions. New research and future international agreements focusing on promoting sound inter-linkages might encourage politically feasible and environmentally beneficial outcomes.

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 of 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 environmental effectiveness, cost-effectiveness, distributional considerations, institutional feasibility and other factors. This chapter does not discuss either details of sectoral policies, which can be found in other chapters of this report, or 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 trade and development assistance. Box 13.1 Sterner (2003), Hahn (2001) Depending on the legal frameworks available to countries; these may be implemented nationally, at the sub-national level or through bi-lateral 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 four principal criteria by which environmental policy instruments can be evaluated:

- Environmental effectiveness – the extent to which a policy meets its intended environmental objective or realizes positive environmental outcomes.
- Cost-effectiveness – the extent to which the policy can achieve its objectives at minimum cost to society, broadly defined.
- Distributional considerations – the incidence, or distributional consequences. Fairness is an obvious dimension of this though there are other dimensions to distribution. Some patently unfair policies may be more likely to succeed politically because their benefits accrue to the politically connected.
- Institutional feasibility – the extent to which a policy instrument is likely to be viewed as legitimate, gain acceptance, and be adopted and implemented.

There are a number of additional criteria which could be explicitly considered as well, such as administrative costs and dynamic considerations. 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*

Regulations and Standards – Specify abatement technologies (technology standard) or minimum requirements for pollution output (performance standard) to reduce emissions. Because performance standards require specific emission levels but often allow firms some discretion in how to meet those requirements, they are regarded as more flexible than technology standards.
Taxes and Charges – A levy imposed on each unit of emissions by a source.
Tradable Permits – Also know as marketable permits or cap-and-trade systems, this instrument 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.
Voluntary Agreement – An agreement between a government authority and one or more private parties to achieve environmental objectives or to improve environmental performance.
Subsidies and Incentives – Direct payments, tax reductions, or the equivalent from a government to an entity for implementing a practice or performing a specified action.
Information Instruments – Required public disclosure of environmentally related information, generally by industry to consumers. Includes labelling programs and rating and certification.
Research and Development (R&D) – Direct government spending and investment on mitigation, or physical and social infrastructure to reduce emissions through innovation. Includes prizes and incentives for technological advances.
Trade and ODA – Focused lending and other policies that are explicitly designed to guide countries in a climate-friendly direction.
Non-Climate Policies – Other policies not specifically directed at emissions reduction but that may have beneficial climate-related effects. These include: structural reform policies, liberalization and restructuring of energy and other markets, and population policies.

13.2 National policy instruments, their implementation and interactions

The policy making process by almost all governments involves complex choices involving many stakeholders. 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. For example, permits allocated free to existing firms represent a valuable asset transferred from government to industry, while auctioned permits and emission taxes generally impose heavier burdens on polluters. As a result, it is likely that a candidate instrument will face both support and opposition. Voluntary measures are often favoured by industry because of their flexibility and potential lower costs, but are often 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 to choose a particular instrument differs for each government.[1]

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. 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 firms or individuals to adjust. Performance standards mandate specific environmental outcomes but often allow some flexibility in how those outcomes are met (Sterner 2003). For example, where a technology standard might mandate specific carbon sequestration

[1] The design of most instruments assumes effective compliance and penalty provisions.

methods on a power plant, a performance standard would limit emissions to a certain number of grams of CO_2 per kWh of electricity generated.

Technology standards may be inefficient because they reduce operational flexibility and require firms to undertake more costly emission control steps than are necessary to achieve a given level of environmental performance. An underlying reason for this is that the regulators who develop standards inevitably have less information about a firm's abatement options and costs; thus, they are unable to equalize marginal abatement costs across facilities. Also, regulators often impose uniform requirements on all firms. This raises costs, although some firms may find it easier than others to reduce emissions.

Performance standards can reduce these inefficiencies compared to technology standards by providing more flexibility (IPCC 2001b). 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 a single mandated technology and may include process changes, reducing output, changes in fuels or other inputs, and selecting alternative technologies. Despite this increased flexibility, performance standards are often rigid and fall short of the ideal, least-cost way of attaining an environmental goal across an economy or even within 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 government mandates a certain technology, there is no economic incentive for firms to develop more effective technologies. Moreover, there may be a "regulatory ratchet" whereby firms are 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 SO_2 control.

Although relatively 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 2001b). Energy efficiency applications include fuel economy standards for automobiles, appliance standards, and building codes[2]. 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).

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). See Box 13.2 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 has long-run, irreversible effects; and where monitoring emissions is difficult but track-

[2] For example the Green Building Council in the United States.

ing 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 SO_2 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 are informational 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 2003d). See chapter 6 for additional information

Box 13.2 *China Mandates Energy Efficiency Standard in Urban Construction*

Approximately 2 billion m^2 of floor space is being built annually in China, or half of the world's total. Based on the growing pace, China will see another 20 to 30 billion m^2 of floor space built from now to 2020. The building construction industry is rated as one of China's biggest energy consuming industries, which is accountable for 37 percent of the country's total energy consumption. China's recognition of the need for energy efficiency in the construction sector started as early as 1980s, but was impeded due to the lack of feasible technology and funding. Boosted by a nationwide real estate boom, huge investment has flown into the building construction sector in recent years.

On 1 January, 2006, China introduced a new building construction statute that includes clauses for the first time on mandatory energy efficiency standard for buildings. The Designing Standard for Energy Conservation in Civil Building requires construction contractors to use energy efficient building materials and to adopt energy saving technology in heating, air conditioning, ventilation and lighting systems in civil buildings. Energy efficiency in building construction has also been written into China's 11th five-year national development program (2006-2010), which entails 50 percent less of energy use than the current level, and 65 percent for municipalities such as Beijing, Shanghai, Tianjin and Chongqing as well as other major cities in northern parts of the country Whether the future construction of buildings can comply with the requirements in the new statute will be a significant factor in determining whether the country will be able to tackle the overall energy shortage.

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 initial capacity for emissions 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 2001b, Bell and Russell 2002). Willems and Baumert (2003) present this case but also note that technology approaches, 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.[3] An emitter must pay this per-unit tax or fee regardless of how much emission reduction is being undertaken.[4] Each emitter weighs the cost of emissions control against the cost 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 2001b, Section 6.2.2.2; Kolstad 2000). Since every emitter faces a uniform tax on emissions per tonne of CO_{2eq} (if energy, equipment, and product markets are perfectly competitive), emitters will undertake the least expensive reductions throughout the economy, equalizing marginal cost of abatement (a condition for efficiency).

In the real world, markets—especially energy markets—deviate from this ideal (e.g., some firms may have economic power in the market place or some firms may be state enterprises less sensitive to price signals). Consequently, a uniform emissions tax may not be as economically desirable as one that varies somewhat within 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 when it 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, but it does not guarantee a particular level of emissions.[5] 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). Over time, an emissions tax needs to be adjusted for changes in external circumstances, like inflation, technological progress, and new emissions sources (Tietenberg 2000). Because inflation increases abatement costs, the tax rate needs to be continually adjusted for inflation to achieve a target emission reduction. 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 emissions reductions and increasing the level of reductions made. 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).

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[3] Because GHGs have different effects on atmospheric warming per unit of emissions, carbon dioxide equivalent ($CO_{2eq)}$ is one way of measuring relative impact. While this suggests that policymakers adopt standard global warming potentials (GWP) to determine efficient taxes and charges, Eckhaus (1992) demonstrates that these are inefficient. In a second-best world, $C0_2$ equivalent targets using GWP should be more stringent than with optimal economic equivalences (De Cara et al. 2006). Baranzini et al. (2000) provide guidance on adjusting existing tax rates to account for the carbon content of different energy sources.

[4] An important alternative is the idea of threshold taxes, where the tax per unit of emissions is only assessed on emissions greater than a set threshold (Pezzey 2003). In other words, infra-marginal emissions would be tax-exempt. This type of tax would generate less revenue but could be more politically acceptable.

[5] Conversely, emissions trading, unlike an emissions tax, does not guarantee a level of incremental costs of control.

To implement a domestic emissions tax, governments must consider a number of issues. At the most basic level, there is the issue of the level at which the tax 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, but in others it is not tax and may even be subsidized. In the case of the former, 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 institutional feasibility and environmental effectiveness. Should the tax revenue go into government treasury, be used to offset other taxes (ie, the double-dividend effect), or be transferred across national boundaries to an international body, be earmarked for specific abatement projects like renewable energy, be allocated to those most adversely impacted by either the costs of emission reduction or damage from climate change? Additionally, the question of where 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, and the answer is as much political or practical as it is economic. See Box 13.3 for examples of CO_2 and energy taxes.

The magnitude of the behavioural responses to environment related taxes can be measured in terms of the relevant price elasticities.[6] Demand for energy in total is rather inelastic in the short term (OECD, 2000), with short run elasticity ranging between -0.13 and -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.

Box 13.3 *Examples of CO_2 and Motor Fuel Taxes*

According to the Nordic Council of Ministers (2002), notes that 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

Most environmentally related taxes with implications for GHG emissions in OECD countries are levied on energy products (150 taxes) and on motor vehicles (125 taxes), rather than on CO_2 emis-

[6] 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 percent, the own-price elasticity in this particular case is -0.2.

sion directly. There is also a significant number of waste-related taxes in OECD countries (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.

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. 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 a local environmental point of view, this leads to adverse consequences, 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. OECD 2005(d)

13.2.1.3 Tradable permits

Tradable permits have become a 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. With the recent development and launch of the EU Emission Trading System (ETS) Box 13.4, 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 and Vesterdal 2003) and to the applicability of cap and trade approach to GHG emissions (Ellerman 2005, Tietenberg 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.

Tradable permit systems can be designed to cover emissions from only some sectors of the economy or virtually the entire economy.[7] A number of analyses have found that economy-wide approaches are superior to sectoral coverage because they equalize marginal costs across the entire economy. Using a variety of sectoral models, Pizer et al. (2006) 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.[8] Researchers have found similar results for the European Union and the EU ETS. (Babiker et al., 2003, Klepper and Peterson, 2004, Bohringer and Andreas, 2005, Betz et al., 2004.

[7] 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.

[8] 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.

Box 13.4 *The European Union Emission Trading System*

The EU Emissions Trading System (EU ETS) is the world's largest tradable permits program. The program began on January 1, 2005, pursuant to Directive 2003/87/EC. It applies to approximately 11,500 installations across the EU's 25 Member States. The system covers about 45% of the EU's total CO_2 emissions and includes facilities from the electric power sector and other major industrial sectors. The share of emissions covered in individual countries ranges widely, from approximately 20% in France to nearly 70% in Estonia. There is a similar disparity in the number of covered installations: 2 in Malta, and 1849 in Germany[9], and there are also considerable differences in the size of installations; 55% of installations covered by the trading scheme emit only 3% of its total emissions.[10]

The first phase of the EU ETS runs from 2005 until 2007 and is sometimes referred to as a "warm-up" phase. The second phase will begin in 2008 and continue through 2012, coinciding with the five-year Kyoto compliance period. The program continues in five-year phases thereafter. Under the program, Member States develop National Allocation Plans, which detail how allowances will be distributed to different sectors and installations. During the first Phase, Member States may auction up to 5% of allowances; up to 10% of allowances may be auctioned during the second phase of the program. Following are some of the most important issues and lessons that are beginning to emerge from the first phase of the EU ETS. A full review of the EU ETS is currently underway by the European Commission; for a report see LETS Update Project, April 2006.

Market development and prices: Analysts have noted that a number of factors affect allowance prices in the EU ETS, including the overall size of the allocation, relative fuel prices, weather, and the availability of CERs from the CDM program. (Christiansen et al., 2005). Like other new commodity markets, the EU ETS has experienced significant price volatility during its start-up period. In 2005, 374 million tCO_2 equv., mainly of certified emission reduction (CERs), were transacted at a value of US$ 2.7 billion with an average price of over US$ 7.23.[11] Prices rose to over €30 euros ton in April 2006, but then dropped dramatically when emissions data from Member State were released. The sharp decline in prices has led to renewed attention to the size of the initial Phase I allocation. Several analyses have concluded that this initial allocation represented a very small reduction from business as usual emission (Grubb et al., 2005, Betz et al. 2004, Reilly and Paltsev, 2005).

Consistency in National Allocation Plans: Several studies have documented significant differences in allocation plans and methodologies of Member States (DEHSt, 2005, Betz et al., 2004, Zetterberg et al., 2004). For example, researchers have looked at the impact on innovation and investment incentives of different aspects of allocation rules (Mattes et al., 2005, Schleich and Betz, 2005) and have found that these rules can affect technology choices and investment decisions. Ahman et al. (2006 forthcoming) Neuhoff et al. (2006 forthcoming), and Betz and Schleich (2005) examine the impacts of different facility closure and new entrant policies. They find that when Member States have policies that require confiscation of allowances after facilities close; this creates a subsidy for continued operation of older facilities and a disincentive to build new facilities.

9 European Commission, press release, 20 June 2005. Emissions trading: Commission approves last allocation plan ending NAP marathon.
10 Seb Walhain, presentation at Chatham House conference - Emerging carbon markets, can they deliver? 16 June 2005.
11 World Bank and International Emission Trading Association State and Trends of the Carbon Market 2006, Washington, D.C. May 2006.

They further find that different formulas for new entrants can create market distortions and different incentives for investments across Member States. Finally, Baron and Philibert (2005) find large differences in volumes allocated to identical sectors across Europe, for example allocated emissions for the electricity sector range from 30.9% above the baseline (Finland) to 21.5% below the baseline (UK).

Implications of free allocation on electricity prices: Researchers are beginning to study the implications of free allocations to the electric power sector on power prices in the EU. Sijm et al. (2006 forthcoming) and Sijm et al. (2005) found that a significant percentage of the value of allowances allocated to the power sector was passed on to consumers in the price of electricity. They further found that this pass through of costs could result in substantially increased profits at some companies. The authors suggest that auctioning a larger share allowances could address these distributional issues. In a report for the U.K. government, IPA Energy Consulting found a similar pass through of costs for the U.K. and other EU Member States. The report estimated increased profitability of £800 million for U.K. power companies over the course of Phase I (IPA Energy Consulting, 2005).

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").[12] The upstream system would require allowances to be held at the level of fossil fuel wholesalers and importers (Cramton and Kerr 2002). [13]

An important component of any tradable permit system is the method for initially distributing emission permits/allowances. There are two basic options available: free distribution of permits to existing polluters or auctions. 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 of auctions, 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.[14] 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 (see box on EU ETS).

Because permit auctions generate revenue, they may provide additional benefits beyond reduced emissions. 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. 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 revenues from auctions may be used to address equity issues through reduc-

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

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

[14] A hybrid of free allocation and auctioning or emissions taxes is also possible (Pezzey 2003). Bovenberg and Goulder (2001) and Burtraw et al. (2002) find that allocating only a small portion of allowances at no cost while auctioning the remainder can compensate industry for losses due to a carbon policy.

tions in taxes or other distributions to low income households. Ahman et al. (forthcoming) argue that a gradual transition from free allocation to auctioning might be a politically feasible way to develop a fairer distribution of allowances.

Despite the potential benefits of auctions, the U.S., in its trading programs for conventional pollution, and the EU ETS Member States distribute emissions allowances almost entirely through free allocations.[15] This is done largely to gain industry support for emissions trading programs. For example, experience with the U.S. SO_2 program shows that the no-cost allocation of allowances was critical for gaining political acceptance for the emissions trading concept (Ellerman, 2005). 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. More broadly, the free allocation of allowances based on historic measures has a policy rationale based on the desire to compensate incumbent installations that are affected by the regulation (Tietenberg, 2003; Harrison and Radov, 2002). However, the exact amount of compensation that is required and the method for providing allowances as compensation is complex and subject to debate (Ahman et al. 2006).

As the most common form of allowance distribution, the free distribution of allowances has received significant research 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, equity and competitiveness implications of these different approaches. For example Burtraw (2001a) 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 (2003b) 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 when compared to a fixed allocation. Finally, Demailly and Quirion (2006 forthcoming) find that under certain assumptions, an output-based allocation in the European cement industry would reduce leakage with limited impacts on production.

A final issue associated with the distribution of allowances is whether excessive market power can distort prices. Tietenberg (2006) summarizes research on market power, including studies on whether different auction designs or initial permit allocation can lead to price manipulation by dominant firms. Maeda (2003) examines how initial permit distribution affects the potential emergence of firms with market power. However, despite substantial research on the topic, Tietenberg (2006) concludes that in practice, market power "typically has not been a problem in emissions trading."

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. 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).[16] Ellerman and Wing (2003) and Kolstad (2006) find that intensity targets can reduce

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[15] The SO2 trading program contains a small reserve auction, which was valuable for price discovery during the early years of the program (Ellerman, et al, 2000). Revenue from this auction was returned to the companies affected in the program. Only four EU Member States (Denmark 5%, Hungary 2.5%, Ireland 0.75% and Lithuania 1.5%) decided to auction off parts of their ET budget (Betz, et al, 2004).

[16] Intensity targets are also known as "rate-based", "dynamic" and "relative" targets.

uncertainties associated with the cost of emission reduction under uncertain economic growth levels. Additionally, Pizer (2005) finds that intensity targets may be more appropriate if the short-term objective is to slow, rather than halt, emissions growth. On the other hand, Ellerman and Wing (2003) and Jotzo and Pezzey (2005) show that an intensity target may be set stringently such that it can halt or reverse growth. Dudek and Golub (2003), 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) find 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. Finally, Quirion (2005) argues that in most plausible cases, both an emissions tax and an absolute target are superior to an intensity target, although the welfare gaps between the two types of targets are very small.

Although a tradable permits approach can provide certainty of the quantity of emissions that will be reduced, it does not provide certainty of price. Price uncertainty may be addressed by a “price cap” or “safety valve” mechanism, which guarantees that the government will sell additional permits if the market price of allowances hits a certain price (Pizer, 2002, McKibbon and Wilcoxin, 2002, Jacoby and Ellerman 2004).[17] The reasoning is that greenhouse gases are of concern as they accumulate over an extended period in the atmosphere. There may therefore be less concern about short-term increases in CO_2 as long as the overall trajectory of CO_2 emissions is downward over an extended period (Newell and Pizer 2003). While the safety valve mechansim shares some advantages with price based mechanisms, such as a tax, the safety valve may also have the added political advantage of providing emitters with an additional allocation of allowances, although at the price cap. (Pizer 2005).[18]

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).[19] Allowance banking can create a cushion that will prevent price spikes and can hedge uncertainty in allowance prices (Jacoby and Ellerman 2004).[20] 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.[21] On the basis of a simulation carried out in Germany with companies and with a student control group, Schleich et

17 It is also possible to have a “price floor” to ensure that prices don’t go below a certain level. For example, Hepburn et al. (2006 forthcoming) discuss how a coordinated auction measure for the EU ETS could be used to support a minimum price.

18 Canada has proposed a safety-valve mechanism for its domestic emissions trading program. See Government of Canada 2002.

19 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).

20 Price uncertainty may also be addressed by “borrowing” of allowances, i.e., using allowance allocations from future years (U.S. EPA, 2003).

21 Banking is restricted between the first and second phases of the EU ETS because of concerns that an excessive bank at the end of Phase 1 might compromise the ability of Member States to meet their Kyoto targets in Phase 2.(Kruger and Pizer, 2004).

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.

The literature describes several critical elements of an effective enforcement regime for emissions trading. First, the program can attempt to achieve strict adherence to the limits implied by the issued permits or it can allow 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). 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).[22] 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). A second component of an enforcement regime is reasonably accurate emissions monitoring (Stranland et al. 2002, Stavins 2003). San Martin (2003) and Montero (2005) found that incomplete monitoring can undermine the efficiency of trading programs. 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.

Finally, there have been several experiments with tradable permits for conventional pollution control in developing countries and economies in transition (Bygrave 2004, USEPA 2004). For example, Montero et al. (2002) evaluate an experiment with tradable permits for total suspended particulates (TSP) in Santiago, Chile and find that permit markets are underdeveloped due to high transaction costs, uncertainty, and poor enforcement. However, they also find improved documentation of historic emissions inventories and increased flexibility to address changing market conditions. 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, Sheekrant,(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 SO_2 in China and they note several areas of capacity building that would support national implementation. 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., 2003.)

13.2.1.3 Voluntary agreements

Voluntary agreements (VAs) are agreements between governments and one or more private parties to achieve environmental objectives or to improve environmental performance.[23] Voluntary agreements addressing all types of environmental problems are playing an increasingly important role in many countries as a means to achieve environmental and social objectives. In recent years, over 300

[22] The addition of a "make good" provision, i.e., the requirement that allowances from a subsequent compliance year or period are surrendered for any excess emissions, is a further design element used to ensure that an absolute emissions target is met (Betz and MacGill, 2005).

[23] 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 actions by industry as well as private agreements between industry and stakeholders. See section 13.4 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.

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 1999). In contrast to regulatory and even market-based approaches, voluntary approaches tend to be popular with those directly affected by these instruments. Thus, they can be used to address concerns in areas where other instruments face strong political opposition (Thalmann and Baranzini 2005).See Box 13.5 for examples.

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 improve their relationships with society and shareholders. 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 (Kågeström et al. 2000), establish a dialog between industry and government, and help to move industries towards best practices.

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 (OECD 2003c and IAI 2002). Others are much more sceptical about the effect of VAs in reducing emissions. Independent assessments of voluntary approaches—while acknowledging that there have been absolute emission improvements brought about by investments in cleaner technologies—indicate that there is little improvement over business-as-usual (BAU) scenarios, as these investments would have probably happened anyway (Rietbergen and Blok 2000), OECD 2003e). Moreover, the fact that some VA targets are met well ahead of schedule has led to questions about the validity of such targets (Buttermann and Hillebrand 2000). Other analysis has indicated that VAs work best as part of a policy package, rather than as a stand-alone instrument (Torvanger and Skodvin 2002, Krarup and Ramesohl 2002); OECD (2003e) and Braathen (2005) note that if voluntary agreements are not more than business as usual, then their environmental effectiveness is questionable and indicates that many VAs would perform better if there were a real threat of other instruments being used if targets are not met. Other scholars also express reservations about the actual effectiveness of such programs (Harrison, 1999; King and Lenox, 2000; Rivera and deLeon, 2004) In particular, there are concerns that some of the organizations that join a voluntary program "free ride" on the behavior of other participants.
There are a limited, although increasing, number of comprehensive reviews of the effectiveness of voluntary programs[24]. In general, studies of the design and efficacy of voluntary agreements assess only a single program (e.g. Arora and Cason 1996; King and Lenox 2000; Welch, Mazur and Bretschneider 2000; Price 2005, Rivera 2002, Khanna and Damon 1999; Croci 2005). Chidiak (2002) evaluates the French experience and suggests that the reductions in GHG emissions cannot necessarily be seen as a direct consequence of the commitments within the agreements. She argues that these improvements have been triggered largely as a result of other environmental regulations and cost reduction efforts. Johannsen (2002) and Helby (2002) present similar results for programs in Denmark and Sweden, respectively. They note that reductions in specific emissions correspond with industry's business-as-usual behavior and this suggests that the stated objectives in the agreements were not sufficiently ambitious. In particular, Helby concludes that EKO-Energi, which sought to highlight a new level of best practice and thus pose a challenge to other firms, was "at best a very modest success" with the overall direct effect on total industrial energy consumption being very small. Interestingly, Chidiak also finds that the agreements did not foster any intra-industry net-

[24] Comparing reviews and assessments is difficult because of the use of different metrics and evaluative criteria.

working and information exchange on energy management. Chidiak suggests that their failure to achieve more ambitious goals is a result of the lack of a well-articulated policy-mix.

The structure of a VA largely determines whether it is effective at reducing emissions beyond business-as-usual levels[25]. Rietbergen, Farla and Blok (2002) investigate whether the voluntary agreements in the Netherlands have resulted in improvements in energy efficiency beyond what would have occurred in the absence of such agreements. They estimate that, on average, between a quarter and a half of the energy savings in the Dutch manufacturing industry can be attributed to the policy mix of the agreements and supporting measures. They conclude that agreements are valuable policy instruments for energy efficiency improvements "if accompanied by ambitious target setting, effective supporting measures and reliable monitoring procedures." Farla and Blok (2002) recommend stricter enforcement of monitoring and independent verification as part of any new generation of agreements. The US Government Accountability Office (US GAO 2006) review the US Climate Vision and Leaders programs supported by the EPA and DOE and find that emission reduction goals vary as to how they are measured, the time periods covered, the requirements for reporting, and the means of tracking progress. As of November 2005, only 38 of 74 participants had set a goal. It also finds that some goals were intensity based and others emission based, some were domestic and others global and there was no policy for deciding on the consequences of not progressing to achieve the agreed upon goals. It further notes that while emission intensity is projected to decline by 2012, that total US emissions would increase by 14 percent between 2002 and 2012. Brouhle et. al. (2005) note that the difficulties in evaluating U. S. programs lie in the sorting the many programs, their goals, availability of adequate data, and measuring achievement relative to a baseline. Jaccard et. al. (2006) review various Canadian programmes consisting of offering information and subsidies to encourage voluntary reductions in emissions. They note that over a 15 year period the names of the programmes have changed but the basic approach has been the same. In that period emissions have grown by 25 percent.

Darnall and Carmin (2003) review sixty one governmental, industry and third-party general environmental agreements mainly in the United States. (Also see: Lyon and Maxwell 2000) Overall, the results demonstrate that the voluntary programs had low program rigor in that they had limited levels of administrative, environmental performance and performance 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.

It is also difficult to compare the “stringency” of agreements in different countries since they use 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. Krarup and Ramesohl, focused on five agreement schemes in the field of industrial energy efficiency: the French Voluntary Agreements on CO_2 Reductions; the Danish Agreements on Industrial Energy Efficiency; the Declaration of German Industry on Global Warming Prevention; the Swedish ECO-Energy Programme; and the Dutch Long-Term Agreements on Energy Efficiency. They note that all five schemes are "more or less successful in achieving their own targets". They suggest that they rarely represented the decisive initial impulse to introduce energy efficient management practice and that the most significant impact is raising general awareness and increasing management motivation. They conclude that agreements can have an impact on industrial energy efficiency and CO_2 emissions if they are embedded within a broader policy mix. They caution that effective agreement schemes impose significant institutional demands and that the process of devel-

[25] The economic efficiency of VAs can be low, as they seldom incorporate mechanisms to equalise marginal abatement costs between different emitters (Braathen 2005).

oping thorough agreements can be very time-consuming. In general, they argue that their empirical findings "give no hint that voluntary agreements are a cheap solution, or that there would be anything approaching a golden key to industrial energy efficiency."
There are a number of elements regarding the content of agreements that contribute to their overall effectiveness. The best voluntary agreements include (Hanks 2002; OECD 2003e): a clear definition of the subject and target; a business-as-usual (baseline) scenario; third party participation in the design of the agreement; an unambiguous description of the parties and their obligations; a defined relationship with the legal and regulatory framework; formal provision for monitoring, reporting and independent verification of results at the plant level; a clear statement of the responsibilities expected to be self-financed by industry; commitments that are defined expressly in terms of individual companies, rather than as sectoral commitments; and an explicit reference to sanctions or incentives in the case of non-compliance and links to other policy measures.

Box 13.5 *Examples of National Voluntary Agreements*

- Netherlands Voluntary Agreement on Energy efficiency: A series of legally binding long-term agreements based on annual improvement targets and benchmarking covenants between 30 industrial sectors and the government to improve energy efficiency
- Australia “Greenhouse Challenge Plus” programme: An agreement between the government and an enterprise/industry association to reduce GHG emissions, accelerate the uptake of energy efficiency, integrate GHG issues into business decision making and provide consistent reporting[26]. See http://www.greenhouse.gov.au/challenge
- European automobile agreement: An agreement between the European Commission and European, Korean and Japanese car manufacturing associations to reduce average emissions from new cars to 140 gCO2/km by 2008-2009
- Canadian automobile agreement: An agreement between the Canadian government and representatives of the domestic automobile industry to a reduce emissions from cars and light duty trucks by 5.3 MtCO2e by 2010. The agreement also contains provisions relating to research and development and interim reduction goals.
- Climate Leaders: An agreement between U.S. companies and the government to develop greenhouse gas inventories, set corporate emission reduction targets, and report emissions annually to the U.S. Environmental Protection Agency. See: http://www.epa.gov/climateleaders/
- Keidaren Voluntary Action Plan: An agreement between the Japanese government and 34 industrial and energy converting sectors to reduce GHG emissions. A third party evaluation committee reviews the results annually and makes recommendations for adjustments.[27] See http://www.keidanren.or.jp

13.2.1.4 Subsidies and incentives

Direct and indirect subsidies can be important environmental policy instruments, but they have strong market implications and may increase—not reduce—emissions. Subsidies can take different forms ranging from support for R&D, investment tax credits and feed-in tariffs[28]. Whatever their

[26] As of 1 July 2006, participation in the programme is a requirement for Australian companies receiving fuel tax credits of more than $ 3 million

[27] This programme is a cross between a mandatory and voluntary programme See Yamaguchi (2003b), Tanikawa (2004) and Saito (2001) for additional information. The characteristic relationship between the government and industry as well as the unique societal norm make this voluntary initiative unique. In the context of Japan there is *de facto* enforcement .

[28] One way of promoting the use of renewable sources of electricity is for the government to require electric power producers to purchase such electricity at favorable prices. The US Public Utility Regulatory Policy Act of 1978 required electric utilities to buy renewable energy at "avoided cost". In Europe, specific prices have been set at which

form, subsidies tend to expand the subsidized industry, relative to the non-subsidy case. If the subsidized industry is a source of greenhouse gas emissions, subsidies may result in higher emissions. Subsidies to the fossil fuel sector result in over-use of these fuels with resulting higher emissions; subsidies to agriculture can result in expansion of agriculture into marginal lands and corresponding changes in emissions. Conversely, incentives to encourage the diffusion of new technologies, such as for renewables or nuclear power, may promote emissions reductions.

The International Energy Agency (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.[29]

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. Coal subsidies in OECD countries fell by 55% between 1991 and 2000 (IEA, 2001).[30] For example, in Germany, subsidies fell from a peak of 7.5 B Euro in 1989 to approximately 2.0 B Euro in 2003, with a corresponding reduction in the number of support programmes from 35 to 6. Strochmann (2005) Subsidised production is expected to decline further in several OECD countries over the next few years, as they implement further reductions. See Figure 13.2 and Chapter 7 for additional information.[31]

utilities must purchase renewable electricity -- "feed-in tariffs." These tariffs have been very effective at promoting the development of renewable sources of electricity (Ackermann et al, 2001; Menanteau et al, 2003).

[29] In India, kerosene and LPG subsidies are generally intended to shift consumption from biomass to modern fuels, reduce deforestation and to improve indoor air quality, particularly in poor rural areas. In reality, these subsidies are largely used by higher expenditure groups in urban areas, thus having little effect on the use of biomass. Nevertheless, removal of subsidies would need to be done cautiously, in the absence of substitutes, as some rural households use kerosene for lighting. Gangopadhyay et al, (2005)

[30] Calculated using producer subsidy equivalents.

[31] It should be noted that a comprehensive analysis of subsidies, requires consideration of the net effect of susidies and taxes, including their point of allocation.

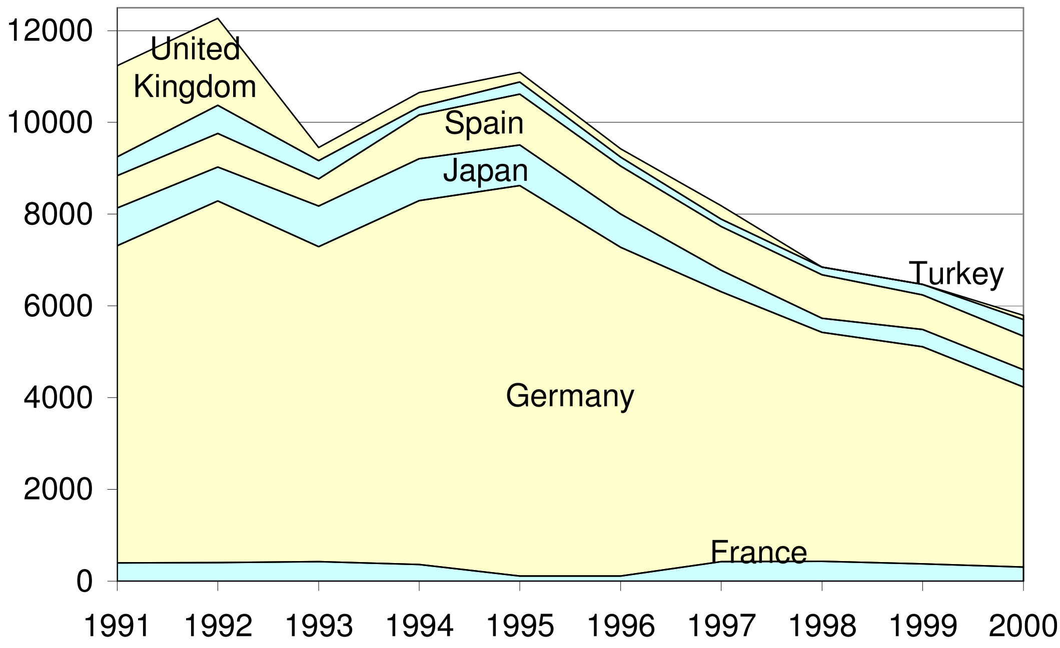
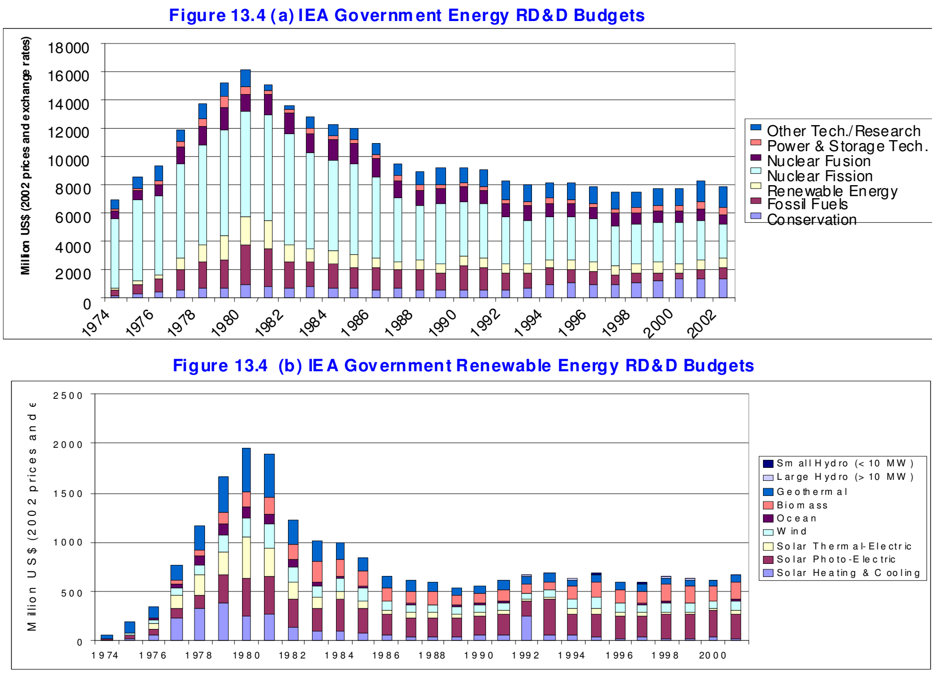


***Figure 13.1** Support for coal in selected OECD countries (USD million) (Source: IEA, 2001)*



***Figures 13.2 (a) and (b)** IEA member country public R&D expenditures for energy and renewable energy technologies (IEA 2004 and 2005)*

About $ 460 billion is spent on agricultural subsidies, excluding water and fisheries. Humphreys et al (2003), with OECD countries accounting for about USD 318 billion or 1.2 percent of GDP. To discourage overproduction and reduce trade distortions, support to agricultural producers has declined from 38% of the value of farm receipts in the 1986-1988 period to 31% in 2001. (OECD, 2002a) The OECD and the FAO have undertaken global studies of GHG emissions from agricultural land, but there is no global assessment of the effects of agricultural subsidies on GHG emissions in the literature. (FAO, 2001 and OECD, 2001) 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, but that a few states show increases. (Soares and Ronco, 2005).

13.2.1.5 Research and Development[32]

Many countries pursue technological research and development (R&D) as a national policy to, for example, foster the development of innovative technologies or help domestic industries to be competitive. Countries also chose to cooperate with each other in order to share costs, spread risks, avoid duplication, access facilities, enhance domestic capabilities, support specific economic and political objectives, harmonize standards, accelerate market learning and create goodwill. Cooperation, however, may increase transaction costs, require extensive coordination, raise concerns over intellectual property rights and foreclose other technology pathways (Fritsch and Lukas 2001, Sakakibara 2001, Ekboir 2003, Justice and Philibert 2005). Governments use a number of tools to support R&D, such as grants, contracts, tax credits and allowances, and public/private partnerships. Their effect on public budgets and their effectiveness in stimulating innovation will vary as a function of how they are structured and targeted.[33]

Worldwide nearly 600 billion USD was expended on R&D in all sectors in 2000, but nearly 85 percent of that amount was spent in only seven countries.[34] Over the last 20 years, the percentage of government funded R&D has generally declined while industry funded R&D has increased in these countries. Historically, R&D expenditures as a percentage of GDP have cycled up and down as government priorities have changed over the last 50 years, although in some instances comparisons overtime may be difficult. (OECD 2005a, US-NSF 2003, US-GAO 2005). .

Total public funding for energy technologies in IEA countries in the period 1987-2002 was 291 billion USD, with 50 percent allocated to fission and fusion, 12.3 percent to fossil fuels and 7.7 percent to renewable energy technologies (IEA 2004).[35] (Figure 13.2 (a) IEA (2004) The allocation of public R&D funds to different renewable technologies over time is shown in Figure 13.2 (b) IEA (2005) Funding has dropped after the initial interest created through the oil shock in the 1970s and has stayed constant, even after the UNFCCC was ratified.

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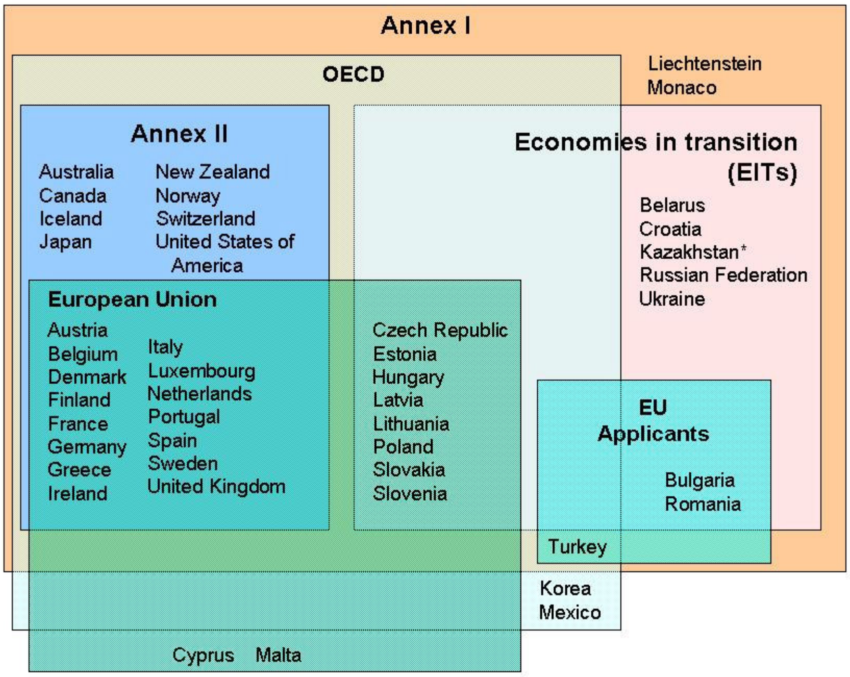
[32] As used in this section, the term R&D generally refers to research, development, demonstration and diffusion

[33] For example, R&D tax credits to industry totalled an estimated $6.4 billion in 2001 in the US. However, a closer look at industries associated with high GHG emissions suggests that they have not generally taken advantage of this opportunity, i.e., the utility industry received $ 23 M and the petroleum and coal products industry received $ 30 M in 2001. http://www.nsf.gov/statistics/inbrief/nsf/nst05316.

[34] Canada, France, Germany, Italy, Japan, the United Kingdom and the US.

[35] in year-2000 US$ and exchange rates.



*: Added to Annex I only for the purpose of the Kyoto Protocol at COP7

***Figure 13.3** Current country groupings under the UNFCCC, OECD and EU (Höhne et al. 2005)*

There are different views on the role of R&D. Watanabe (1999) argues that R&D can play a role in achieving breakthroughs in some areas, induce investments by industry in R&D, and generate trans-sectoral spill over effects. Others have noted, however, that the benefits of R&D may not be realized for two to three decades, which is beyond the planning horizons of even the most forward-looking companies (Anderson and Bird 1992) and that, for a variety of reasons, industry can only appropriate a fraction of the benefits of R&D investments[36]. In the energy sector in particular, technology "spill over" is large[37], investors face difficulties in evaluating intangible research and development outputs[38], and regulatory interventions can cap profits in the case of path-breaking research success.[39] Foxon and Kemp (2004), Grubb (2004), and 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

[36] Margolis and Kammen (1999) 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.

[37] 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.

[38] 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.

[39] 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.

Mansfield's (1968) counter argument that radical technological change will trigger more research overall and therefore increase economy-wide productivity rates. The OECD (2005b) finds that obligations/quotas, price guarantees, and tax preferences had the most influence on innovation and patent activities in the renewable energy sector. While public subsidies for R&D did not play a role, the overall level of investment in R&D within the economy of a country was important.

Sathaye et al. (2005) observe that government-funded research at government-owned facilities, private companies, and universities may help identify patentable technologies and processes. They reviewed the process of allocating patent rights to research organizations in the United Kingdom, United States, Republic of Korea, and Canada and found that such processes vary considerably. They also find that intellectual property rights (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 examines patent citations and finds 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.

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, he analyzes the effectiveness of subsidies such as the carbon tax—both with and without other climate policies. 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. While subsidies address the problem of knowledge as a public good, they neither address the environmental externality nor provide additional incentives 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. Fischer and Newell (2004) examine several policy options to promote renewables and indicate that research subsidies are the most expensive way to achieve emission reductions, in the absence of higher prices. They note that the process of technological change is less important than the direct incentives to reduce emission intensity or overall energy use. A more specific example arises from the Danish experience with wind technologies. Meyer (2004) notes that despite significant support for wind energy R&D during the 1980s, wind power only boomed in Denmark when favourable feed-in tariffs were introduced, procedures for construction allowances were simplified and priority was given for green electricity

In summary, national programmes and international cooperation relating to research and development can be a useful long-term measure to stimulate technological advances in selected technologies. However, to ensure reductions in GHG emissions, R&D needs to be supplemented with other policies to promote deployment and diffusion of low carbon and efficient technologies. There is little evidence to indicate that governments, in general, are capable of providing sustained support for energy R&D programmes over a 30-50 year time period, with the exception of nuclear power.

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)

13.2.1.7 Information Instruments

Consumers often lack sufficient information to make informed decisions about the products they purchase. If an individual does not know that consuming a particular product results in harm to the environment, then that product may be consumed at inefficient levels. Information instruments—sometimes called public disclosure requirements—may effect environmental quality by allowing consumers to make better-informed choices. While some evidence indicates information provision can be an effective environmental policy instrument, we know less about its efficacy in the context of climate change.

Examples of information instruments include eco- or green-labelling, the toxics release inventory (TRI) in the U.S., and nutrition or health-advisory labelling on food. In general, information instruments fall into two categories: labelling programs for consumer products or information disclosure programs for firms. The German Blue Angel program was one of the first national eco-labelling schemes (Sterner 2003). Another example is the dolphin-safe tuna program, which certifies that tuna are caught using fishing practices designed to reduce unintentional dolphin mortality.

One feature common to all information instruments that makes them unique from other environmental policies is that they do not impose penalties for environmentally harmful behaviour per se. A disclosure program like TRI requires only that firms document and report their emissions; it does not place limits on how much pollution they can emit. To the extent that they are effective, information instruments reduce environmental damage by inducing consumers to change their behaviour.

There is theoretical support for information policies. Kennedy et al. (1994) demonstrate that environmental externalities can be at least partially corrected through information provision. However, they also point out that when other corrective instruments, such as taxes, are available, those measures are preferable to information policies.

Evidence-to-date suggests disclosure mandates may be effective at changing a firm’s environmental practices, but other information instruments, like advisory programs, have less effect on consumer behaviour. One of the most well-known disclosure programs, TRI, has induced firms to reduce their emissions levels (Konar and Cohen 1997). Firms whose stock price declined significantly when pollution data became publicly available reduced their emissions more than other firms in the same industry.

For this and other reasons, information-based policies can be controversial. Firms may view these policies—whether based on disclosure or labelling—as overly burdensome and argue that voluntarily provided information is sufficient (Sterner 2003). Certainly, there is a cost to disclosure and labelling policies. Firm may have to collect and disseminate information they would not otherwise have gathered. In addition, government agencies need to be able to verify that the information firms report is accurate. Beierle (2003) argues that the level of information required by a policy has important impacts on benefits and costs.

13.2.1.8 Non-Climate Policies

There are a number of non-climate national policies that can have an important influence on GHG emissions. These include: policies focused on poverty; land use and land use change; energy supply and security; international trade, air pollution, structural reforms, and trade liberalization and population policies. Only a few types of "other policies" are touched on in this section.

For example, the literature indicates that poverty reduces the resilience of vulnerable populations and makes them more at risk to the potential impacts of climate change, but it also leads communities to take measures that may increase emissions. A strategy to reduce poverty is thus seen as a way to reduce emissions as well as enhance resilience (Heemst and Bayangos 2004). In order to develop good poverty policies, it is vital to recognize the different aspects of poverty (Satherthwaite 2001), the incidence of poverty (UNDP 2003, World Bank 2004b) and to understand the sources of such poverty. Empowering the poor requires increasing opportunities (jobs and services) through democratic, accountable, participatory institutions; social movements and community organizations; and enhancing their security (DFID 2002). Typical areas of synergy included small-scale renewables (Richards 2003) and community forestry (Smit and Scherr 2002) which may benefit the poor.

Land use policies (or lack thereof), whether terrestrial (agriculture, forestry, nature), aquatic (wetlands) or urban, can lead to enhanced emissions. Verhagen et al. (2004) note that policies that aim to integrate climate change concerns with the concerns of local people may yield major synergies. For example, within the Netherlands, a major programme is currently underway to understand how spatial planning and climate change policy can be effectively linked. Regional (acid rain abatement), local and indoor air pollution policies can also have climate change co-benefits (Bakker, de Concinck, and Jansen 2004).

The global population affects the consumption of natural resources, particularly energy, food and fibre, and hence can also affect greenhouse gas emissions. Consumption of natural resources varies significantly between developed and developing countries. Information on policies concerning population and development 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 Nations (2003), while the most recent data and estimates of the global population in 2050 may be found in United Nations (2002).

13.2.2 Criteria for evaluating instruments

13.2.2.1 Introduction

In Section 13.1.2 we introduced four main criteria for evaluating policy instruments: environmental-effectiveness, cost-effectiveness, distributional considerations, and institutional feasibility. While other criteria, such as public participation and cooperation (Davies and Mazurek 1998) or privacy issues (Harrington et al. 2004), may also be important in evaluating policy instruments, we limit our analysis to these four. Moreover, neither the economics nor political science literatures provide much guidance in terms of which evaluative criteria are most appropriate for environmental policy analysis. We can say, however, that many authors employ criteria similar to the four we have chosen (e.g., Keohane et al. 1998, Hahn 2001, Aldy et al. 2003, Sterner 2003, Michaelowa et al. 2005; IPCC 2001b). This section explains in greater detail these criteria and how they may be used to evaluate policy instruments.

13.2.2.2 Environmental-effectiveness

The main target of an environmental policy instrument is to reduce the negative impact of human action on the environment. A policy instrument that achieves an environmental quality goal better than alternative instruments can be said to have a higher degree of environmental-effectiveness. The specific goal, however, is taken as given. It should be noted that although climate protection is the ostensible environmental goal for any climate policy, there may be other environmental objectives achieved incidentally, as Burtraw et al. (2001) demonstrate for air pollution benefits in the U.S. In particular, urban air pollution levels are expected to decline as a ancillary benefit of efforts to reduce carbon emissions.

To determine an instrument's environmental effectiveness it is necessary to estimate how well it is likely to perform. Harrington et al. (2004) note the distinction between estimating how effective an environmental instrument will be ex ante and evaluating its performance ex post. The authors were able to find or re-create ex ante estimates of expected emissions reductions in a series of U.S. and European case studies. Comparison of the ex ante with ex post observations suggests a reasonable degree of accuracy in the estimates, and 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 the literature, suggests that regulators may be unduly pessimistic about the environmental performance of incentive-based instruments or unduly optimistic about the performance of regulatory approaches, or perhaps both. Recent evidence suggests that market-based approaches can provide equal if not superior environmental quality improvements over regulatory approaches (e.g., Ellerman 2006). As we discuss below, however, institutional constraints may alter the relative efficacy of market-based and standards-based instruments.

13.2.2.3 Cost-effectiveness

The cost-effectiveness of a policy instrument is a key decision parameter in a world with scarce resources. Given a particular environmental quality goal, the most cost-effective instrument is the one that achieves that goal at least cost. There are many components of cost, including the direct costs of administering and implementing the instrument, as well as indirect (e.g., dynamic) costs, such as how the instrument drives technological change.

It is important to note that cost-effectiveness is distinct from general economic efficiency. Where cost-effectiveness takes an environmental goal as given, efficiency involves the process of selecting a specific goal according to economic criteria (Sterner 2003). Consequently, the choice of a particular environmental goal will likely have dramatic impacts on the overall cost of a policy, even if that policy is implemented using the most cost-effective instrument.

Instruments are likely to vary considerably in terms of cost-effectiveness, and estimating costs can be challenging, even to knowledgeable practitioners. Cost-effectiveness estimates traditionally include the direct expenditures incurred as a result of implementing the instrument; however, instruments may also impose indirect social costs, which are more difficult to measure (Davies and Mazurek 1998). Moreover, costs for which data are limited are often ignored. Harrington et al. (2000) provide a summary of commonly excluded costs as well as examples of efforts to estimate them.

A common concern is that ex ante cost estimates may not reflect the actual costs of an instrument, from an ex post perspective. Harrington et al. (2000) show that the discrepancy between actual and estimated total costs of 28 environmental regulations in the US relatively low, and if anything, ex ante estimates tend to overstate total costs. While the authors do not systematically evaluate specific environmental instruments, they do find that estimates for market-based instruments tend to overstate unit costs, while unit costs estimates for other instruments are neither under- nor overestimates.

13.2.2.4 Distributional considerations

Policy instruments rarely apportion environmental benefits and costs evenly across stakeholders. Even if an instrument meets an environmental goal at least cost, it may face political opposition if it disproportionately impacts—or benefits—certain groups. Depending on a country's social goals, the relevant groups may be within a society, across societies, or across generations.

From an economic perspective, an instrument is considered beneficial if it improves overall social welfare. But this does not require that a policy actually make each individual better off than they were before the policy was implemented. Consequently, as Keohane et al. (1998) argue, aggregate cost-effectiveness is not likely to be the most important economic criteria in legislative policymaking. By incorporating distributional considerations into policy analysis, policymakers can judge an instrument based not only on whether it is likely to benefit society as a whole but by who is likely to receive those benefits. Farrow (1998) operationalizes this idea in a decision rule designed for use in benefit-cost analysis to evaluate intra-group equity. Some analysts, particularly in Europe, have used distributional weights in cost-benefit analysis to account for distributional issues (Drèze and Stern 1987, Layard and Walters 1994).

A regulation that is perceived as unfair or for which the incidence is unbalanced may have a difficult time making it through the political process[40]. However, distributional considerations are fundamentally subjective, and the most equitable instrument may not be the most politically popular. For example, an instrument that focuses the regulatory burden on a low-income subpopulation but directs the benefits at a wealthy interest group may sail through the political process. While highly inequitable in costs and benefits, such an instrument sometimes are attractive to politicians. Helfand et al. (2003) point out that campaign contributions can have a significant impact on political decision-making in the US and have implications for distribution. Bulkeley (2001) describes the different interests in the Australian climate policy debate and submits that industrial emitters managed to steer the country away from ambitious reduction target—and toward an emissions increase—at the third Conference of the Parties in Kyoto.

Because there is little consensus as to what constitutes optimal distribution, it can be difficult to compare—let alone rank—environmental instruments based on distributional criteria (Revesz and Stavins 2006). One exception is provided by Asheim et al. (2001), who construct an axiom of eq-

[40] The United States has acknowledged the role of distribution explicitly through Executive Order 12878 (1994), which requires federal agencies to address environmental justice in their missions and activities.

uity which, they argue, can be used to evaluate sustainability[41]. However, while sustainability may be important when evaluating environmental instruments, it only captures the intergenerational dimension of distribution and is imperfectly related to political acceptability.

13.2.2.5 Institutional feasibility

Institutional realities inevitably constrain environmental policy decisions. Environmental instruments that are well adapted to existing institutional constraints have a high degree of institutional feasibility. Policy choices must be acceptable to a wide range of stakeholders and must be supported by institutions, notably the legal system. Other important considerations include human capital and infrastructure as well as the dominant culture and traditions. The decision-making style of each nation is therefore a function of its unique political heritage. Box 13.6 provides an example for one country, taken largely a report prepared by Pearce. OECD (2005c).

Certain instruments may also be less popular due to longstanding institutional resistance. Although market-based instruments are becoming more common, especially in developing countries, they have often met with resistance from environmental groups. Even in the developed world market-based instruments continue to face strong political opposition, for example environmental taxes in the United States. Regulations that are outside of the norm of society will be more difficult to effect (e.g., high petrol taxes in the US or speed limits in Germany).

Economists traditionally evaluate instruments for environmental policy under ideal theoretical conditions; however, those conditions are rarely met in practice, and instrument design and implementation must take into account political realities. Andersen (2001) demonstrates this for water pollution policy in four European countries. He finds that while market-based instruments are powerful, institutions have a dramatic impact on their effectiveness. Others argue that institutional constraints can make market-based instruments less effective than regulatory approaches (Cole and Grossman 1999), especially in the developing world (Bell 2003).

Another important dimension of institutional feasibility deals with implementing regulations once they have been designed and adopted. Even if an instrument receives political support, it may be difficult to implement under certain bureaucratic structures. Eskeland and Jimenez (1991) discuss these issues in a developing country context. Montero (2004) shows how market-based policies may perform poorly when the regulator has incomplete information. He uses Santiago, Chile's particulate permits market to illustrate how standards may lead to lower emissions levels than tradable permits. Conversely, market-based instruments, such as tradable permits, have performed well in the United States (Ellerman 2006). While the debate between market-based and regulatory approaches has yet to be resolved, it is clear is that institutional constraints should not be discounted when choosing environmental policy instruments.

Box 13.6 *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

[41] For a summary of the economic literature on sustainability and intergenerational equity, see Pezzey and Toman (2002).

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 payments of 360 million € and yielded a de-facto payment of 27 € per ton of CO_2. Thus the trading scheme has design elements that strongly reflect the interest groups involved.

13.2.2.6 Criteria Assessment

Evaluating instruments based on the criteria we have discussed is challenging for two reasons. First, practitioners must be able to compare potential instruments based on each of the evaluative criteria. Unfortunately, in many cases it can be difficult if not impossible to rank instruments in an objective manner. For example, Fisher, Parry and Pizer (2003) conclude that is not possible to rank environmental policy instruments based on their technology-stimulating effects. Consequently, it will be difficult to determine which of the available instruments is the most cost-effective. Distributional considerations are also particularly difficult to evaluate[42].

Nevertheless, it is possible to make general statements about each instrument according to the criteria we have selected. For instance, it is generally believed that market-based instruments will be more cost effective than regulations and standards (Wiener 1999). However, this belief implicitly assumes that a country has well-functioning institutions, the lack of which can make market-based instrument more costly to implement (Blackman and Harrington 2000). Table 13.1 summarizes the seven instruments presented in this chapter for each of the four criteria we discuss. For other, similar summaries, see Sterner (2003) and Harrington et al (2004).

[42] Revesz and Stavins (2006) provide a discussion of the difficulty of evaluating instruments based on distribution or equity. They cite a number of authors that propose different ways to evaluate policies.

Table 13.1 *Environmental Instruments and Evaluative Criteria (Based partially on Sterner, 2003)*

Approach	**Environmental effectiveness**		**Cost effectiveness**		**Distributional / equity issues**		**Institutional feasibility**	
National emission targets and emission trading	Can be effective, depending on participation, stringency and compliance.	+	Highly efficient and cost effective; increases with broad participation and multiple gases and sectors	+	Depends on participation and initial allocation	?	Requires capacity to prepare robust national GHG inventories and mechanisms to ensure compliance /enforcement	+
Sectoral agreements	Not all sectors amenable to such agreements, limiting overall effectiveness. Additional risks of leaving out sector due to political difficulties	?	Lack of trading across sectors may limit overall efficiency, although may be cost-effective within individual sectors. Within-sector competitiveness concerns alleviated since sectors treated equally at global level.	0	All countries would be treated equally, which may run counter to the concept of "common but differentiated responsibility"	-	Requires many separate decisions and agreements. Within individual sectors, may require cross-country institutions to manage agreements	-
Coordinated policies and measures	Individual measures can be effective, but uncertain whether desired emission levels are met; success will be a function of stringency.	?	Risk of designing a policy package that is not efficient and does not fit all specific national circumstances. Cost- effectiveness of individual policies enhanced with coordination.	?	Coordination could allow for differentiation although if policies identical, could run counter to the concept of "common but differentiated responsibility"	-	Designing package that suitably stringent while meeting all national concerns may be difficult; high level of institutional agreement required, with multiple separate decisions	0
Technology cooperation	Can be effective, depending on rate of technology uptake and extent of new technology developed. Potential concern that technology emerges too late to achieve low stabilization levels	-	Studies are divided about the economic efficiency of postponing reductions to the future. Cost effectiveness historically low based on economic costs of R&D subsidies, and historic failure for government to pick winning technologies	?/-	Issues of intellectual property often subject to equity disputes; potential problem with large-scale transfer and diffusion of most advanced technology; does leave all countries the right to develop	-	Requires many separate decisions and agreements; often best handled by private sector - where less extensive systems exist to promote diffusion to lower income countries	-
Development oriented actions	Can be effective, but results uncertain. Some development policies may have negative effect on climate (e.g., producing electricity using local coal may increase energy security but increase climate damages)	?	Should be efficient and cost-effective, as climate change measures are supportive of economic development; should create synergies	+	Inasmuch as development is a key priority, synergies have positive feedback on social development and international equities	+	Institutional structures for development policies mostly in place, although capturing climate benefits not usually a priority for existing institutional systems	0

Second, policymakers must determine how much weight to assign each of the evaluative criteria. Consider two instruments that are equally environmentally effective and both institutionally feasible, but one has unfavourable distributional implications while the other is less cost-effective. To choose one instrument over the other one must assess the relative importance of distribution vs. cost-effectiveness. Determining what these weights should be is a subjective question, left to policymakers to decide. However, it would be helpful to be able to say something about what weights are most common. Unfortunately, as Davies and Mazurek (1998) argue, this is an empirical question that has, so far, not been investigated.

Some authors do provide guidance on how policymakers can determine which evaluative criteria are most important. Sterner (2003) argues that distributional considerations will likely be less important in an economy with relatively less inequality than in countries with large income disparities.[43] Bell (2003) and Bell and Russell (2002) argue that institutional feasibility is of critical importance in developing countries, where environmental effectiveness and cost-effectiveness may be determined in large part by a government's institutional capacity. In general, the criteria that receive the most weight will be those that are most important given each country's specific circumstances.

13.2.2.7 National policy interactions/ linkages and packages

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 potential synergies 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). Climate change considerations also 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.

In theory, a perfectly functioning market would need only one instrument (e.g., a tax) to address a single environmental problem like climate change. In such a situation, the application of two or more overlapping instruments could diminish economic efficiency while increasing administrative costs. In practice, however, there are market failures that might make a mix of instruments desirable. This section describes some of these cases and addresses situations in which multiple or overlapping objectives might justify a mix of policies.

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 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 complex. A tax can affect the total demand for a product and the choice between dif-

[43] Sterner provides additional guidance on other criteria, including institutional flexibility and incentive compatibility. He summarizes these results in his policy selection matrix as well as a discussion in Chapter 32.

ferent product varieties, but is less suited to address, for example, how a given product is used and when it is used. Hence, other instruments could 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.

Several authors describe situations in which a combination of policies might be desirable. Johnstone (2002) argues that the price signal from a tradable permits or tax system may not be sufficient to overcome barriers to technological development and diffusion and that additional policies may be warranted. These barriers include (1) credit market failures that discourage lenders from providing capital to firms for high risk investments associated with research and development of new technologies and (2) reduced incentives for private investment in R&D if firms can not prevent other firms from benefiting from their investments (i.e. "spillover" effects).[44] Fischer and Newell (2004) finds that the combination of a technology policy such as government sponsored R&D with a tax or tradable permit instrument could help overcome this type of market imperfection.

A second market failure that may require more than one instrument is the lack of information among consumers about the environmental or economic attributes of a technology. In such a case, a price signal alone may not be sufficient spur the diffusion of these types of technologies. One solution to this type of barrier is an eco-labelling system, which can help increase the effectiveness of price instrument by providing better information on relevant characteristics the product. (Braathen, 2005, OECD 2003b) Sijm (2005) notes that this type of market failure may exist for households who may lack information to invest in energy efficiency measures and may not respond to a price signal.[45]

With the implementation of the European Emissions Trading Scheme, there has been particular attention to the interaction between a tradable permits mechanism and other policies. Sijm (2005) and Sorrell and Sijm (2003) argue that an emissions trading scheme can co-exist with other instruments as long as these other instruments improve the efficiency of the trading mechanism by addressing market failures or contributing to some other policy objective. However, they argue that the combination of an emissions trading scheme with other instruments could also lead to "double regulation," reduced efficiency, and increased costs if policies are not designed carefully. NERA (2005) and Morthorst (2001) assess the interaction of renewable energy policies with tradable permits programs and conclude that if not designed properly, these policies can lower allowance prices but raise the overall costs of the program.

There may be cases where a package of CO_2 mitigation policies is justified if these policies serve multiple policy objectives. Sijm (2005) gives several examples of policies and objectives that may be compatible with the EU ETS, including direct regulation that also reduces local environmental effects from other pollutants. Renewable energy policies can be used to expand energy supply, increase rural income, and reduce conventional pollutants. Policies that encourage bio-fuel production and automobile fuel efficiency have also been advocated for their advantages in encouraging energy security and fuel diversity as well as greenhouse gas mitigation. In the U.S., these types of energy policies have been proposed in conjunction with a tradable permits system as part of a package to address energy, security, and environmental objectives (NCEP, 2004).

[44] For a more extensive discussion of these issues, see Jaffe et al., 2003.
[45] Another market failure in the residential sector may be caused by split incentives where neither the landlord or tenant has an incentive to invest in energy efficiency measures (Sorrell and Sijm, 2003).

13.3 International climate change agreements and other arrangements

13.3.1 Context for Climate Change and Related Agreements

The context of and reasons for an international agreement were relatively well covered in the IPCC TAR. Authors of more recent work cite older publications as to why agreements are necessary, namely: the global nature of the problem and the fact that no single country has more than approximately 20% of global emissions. This means that successful solutions will need to engage multiple countries. Similarly, the fact that no one sector is responsible for more than about 25% of global emissions (the largest sector is that of electricity generation and heat production at 24% of the global, 6-gas total; see Baumert et al, 2005) implies that no single sector will be uniquely required to act.

13.3.2 Evaluations of Existing Climate Agreements

In contrast, recent literature has devoted considerable attention to the limitations of existing international agreements to address the climate change. In fact, there are no authoritative assessments of the UN Framework Convention on Climate Change or its Kyoto Protocol that assert these agreements have succeeded – or will succeed without changes – in fully solving the climate problem. As its name implies, the UNFCCC was designed as a broad framework and the Kyoto Protocol's first commitment period for 2008 to 2012 only as a first detailed step. Both the Convention and the Kyoto Protocol include provisions for further steps as necessary.

A number of limitations and gaps in existing agreements are cited in the literature, namely:

- The lack of an explicit long-term goal means countries do not have a clear direction for national and international policy (for example, Corfee-Morlot and Höhne, 2003)
- The targets are inadequately stringent (Den Elzen and Meinshausen, 2005), who argue for more stringent targets);
- The agreements do not engage an adequate complement of countries (Baumert et al, 1999), who suggest a need to engage developing as well as developed countries, or Bohringer, 2006, who suggests that with the US withdrawal, the Kyoto Protocol's effect is reduced to zero)
- The agreements are too expensive (Pizer, 1999, and 2002);
- The agreements do not have adequately robust compliance provisions (Aldy at al, 2003)
- The agreements do not adequately promote the development and/or transfer of technology (Barrett, 2003)
- The agreements, as one consequence of failing to solve the problem, do not adequately propose solutions to adapt to the forthcoming changes (Muller, 2002).

Reviews of the current agreements take several forms. Some, (e.g., Depledge, 2000) provide detailed article-by article reviews of the existing agreements, seeking to interpret the legal language as well as to provide a better understanding of their historical derivations. In this manner, they offer insight into how future agreements might be developed. Some studies assess the effect of required emission reductions of the Kyoto Protocol on global greenhouse gas concentrations and conclude that the effect is small today (Manne & Richels 1999) but may be large in the future as they set the stage for future reduction efforts, which would not have happened otherwise (Höhne & Blok 2006). Others (e.g., Cooper, 2001), evaluate the basic underpinnings of the two climate agreements, looking at problems with establishing binding targets, differentiating between countries, and difficulties in operationalizing the concept of emissions markets. These kinds of assessments, by far the most common, not only assess current limitations, but usually proceed to put forth counter arguments, outline improvements that should be made and propose alternative mechanisms for addressing the climate problem. See the following sections for responses to and alternatives to the solving the climate problem.

13.3.3 Elements of international agreements and related instruments

A large number of proposals have been made in the literature on possible future international agreements on climate change. Table13.2 provides a summary review of such recent proposals for international climate agreements in the literature (see also Bodansky 2004, Kameyama 2004, Blok et al. 2005, Philibert 2005a), although not all proposals cover all elements that are necessary to describe a full regime. To make the list of proposals more accessible, they are grouped by the following themes:

- National emission targets and emission trading
- Sectoral approaches
- Policies and measures
- Technology
- Development oriented actions
- Adaptation
- Financing
- Proposals focusing on negotiation process and treaty structure

Perhaps unsurprisingly, the majority of these treatments build on (and evaluate) existing multilateral agreements, in particular, the UNFCCC and its Kyoto Protocol. See Table 13.3 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"), and 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).

Considering the proposals in Table 13.2, it is possible to derive a set of common elements for international climate change agreements. These are listed in Box 13.7, and expanded upon in the sections below.

Table 13.2 Overview of recent proposals for international climate agreements the literature based on earlier overviews (Bodansky 2004; Kameyama 2004; Blok et al. 2005; Philibert 2005)

		Name (reference)	Description
National emission targets and emission trading			
National emission targets and emissions trading	Staged systems	Staged systems	
		Multistage with differentiated reductions (Gupta 1998; Berk et al. 2001; Blanchard et al. 2003; Criqui et al. 2003; den Elzen et al. 2003; Gupta 2003; Höhne et al. 2003; Blok et al. 2005; den Elzen 2005; den Elzen et al. 2005; Höhne et al. 2005; Höhne et al. 2005; Michaelowa et al. 2005; Den Elzen et al. 2006)	Countries participate in the system with different stages and stage-specific types of targets; countries transition between stages as a function of indicators; proposal specify stringency of the different stages
		Differentiating groups of countries (Claussen et al. 1998; USEPA 2002; CAN 2003; Ott et al. 2004)	Countries participate in the system with different stages and stage-specific types of targets

Name (reference)	Description
Converging Markets (Tangen et al. 2005)	Scenario with regional emission trading systems converging to a full global post 2012 market system
Three-Part Policy Architecture (Stavins 2001)	All nations with income above agreed threshold take targets (fixed or growth); agreement includes long-term targets (flexible but stringent) as well as short-term, firm, but moderate targets; and market-based policy instruments would be part of the package (e.g., emissions trading, carbon taxes, or hybrids).
Allocation methods	
Equal per capita allocation (Agarwal et al. 1991; Baer et al. 2000; Wicke 2005)	All countries are allocated emission entitlements based on their population.
Contraction and convergence (Meyer 2000; GCI 2005)	Countries participate with quantified emission reduction or limitation targets based on a path that leads to an agreed long-term stabilization level for greenhouse gas concentrations ('Contraction'). Targets for individual countries set so per-capita emissions converge from the current levels to a level equal for all countries within an agreed period ('Convergence').
Basic needs or survival emissions (Aslam 2002; Pan 2005)	Emission entitlements based on an assessment of emissions to satisfy basic human needs.
Adjusted per capita allocation (Gupta et al. 1999)	Allocation of equal per capita emissions with adjustments for the short- and medium-term; allocation based on emissions per GDP relative to Annex I average
Equal per capita emissions over time (Bode 2004)	Allocation on the basis of (1) converging per capita emissions and (2) that the *average* per capita emissions for the convergence period are equal for all countries. This may result in negative quantities of emission rights for countries with high per capita emissions and high allocation for countries with low per capita emissions.
Common but differentiated convergence (Höhne et al. 2006)	Annex I countries' per capita emission allowances converge (to an agreed, low level) within a fixed period. Non-Annex I countries' participate in the system when their per capita emissions reach an agreed percentage of the global average ("differentiated"); from this time forward, participating country allowances converge to the same level ("common convergence"). Other non-Annex I countries may voluntarily take on "no lose" targets.
Grandfathering (Rose et al. 1998)	Reduction obligations based on current emissions
Global preference score compromise (Müller 1999)	System for determining allocation: countries voice preference for either per capita allocation or allocation based on current national emissions. Allocation for all countries then based on global population weighted average between the two.
Historical responsibility - The Brazilian Proposal (UNFCCC 1997; Rose et al. 1998; Meira Filho et al. 2000; Pinguelli Rosa et al. 2001; den Elzen et al. 2002; den Elzen et al. 2002; Rovere et al. 2002; Andronova et al. 2004; Pinguelli Rosa et al. 2004; Trudinger et al. 2004; den Elzen et al. 2005; den Elzen et al. 2005; Höhne et al. 2005;	Reduction 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.
Ability to Pay (Jacoby et al. 1998; Jacoby et al. 1999; Lecoq et al. 2003)	Participation above welfare threshold. Emission reductions as a function of ability to pay (welfare)

Name (reference)	Description
Equal Mitigation Costs (Rose et al. 1998; Babiker et al. 2002)	Reduction obligations between countries are differentiated so that all participating countries have the same welfare loss
Triptych (Blok et al. 1997; Berk et al. 1998; Groenenberg 2002; den Elzen et al. 2004; Höhne et al. 2005)	National emission targets are allocated based on sectoral considerations. Beginning from different baselines, 'electricity production' and 'industrial production' are assumed to grow with equal efficiency improvements across all countries. 'Domestic' sectors, are assumed to converge to an equal per-capita level (to take into account the converging living standard of the countries). National sectoral aggregate emissions are then adopted.
Multi-sector convergence (Sijm et al. 2001)	Per-capita emission allowances of seven sectors converge to equal levels based on reduction opportunities in these sectors. The sectoral targets are added to form an absolute national target. Only the national target is binding, not the sectoral ones. Countries participate only when exceeding per capita threshold
Multicriteria (Blanchard et al. 1998; Ringius et al. 1998; Torvanger et al. 2000; Helm et al. 2001)	Emission reduction obligations based on a formula that includes several variables such as population, GDP and others.
Alternative types of emission targets for some countries	
Dynamic targets (Hargrave et al. 1998; Baumert et al. 1999; Lutter 2000; Müller et al. 2001; Bouille et al. 2002; Chan-Woo 2002; Lisowski 2002; Ellerman et al. 2003; Höhne et al. 2003; Müller et al. 2003; Jotzo et al. 2005; Pizer 2005; Kolstad 2006)	Targets are expressed as dynamic variables – including as a function of the GDP ("intensity targets") or variables of physical production (e.g. emissions per tone of steel produced).
Dual targets, target range or target corridor (Philibert et al. 2001; Kim et al. 2002)	Two emission targets are defined: (1) a "selling target" : allows countries to sell into an international market if their national emissions fall below this level; and (2) a "buying target" (proposed to be set significantly higher than the selling target) which, if exceeded, would require nations to purchase allowances from the international market.
Dual Intensity Targets (Kim et al. 2002)	A combination of intensity targets, where an emission target adjusts in response to GDP, and a target range, above which allowances have to be bought and below which allowances can be sold
„No lose", "non-binding"[46], one way targets (Philibert 2000)	Excess emission rights can be sold if the target is reached, while no additional emission rights would have to be bought if target is not met. Allocations are made at a business as usual (BAU) level or at a level below BAU. Structure offers incentives to participate for countries not prepared to take on full commitments, but still interested in joining the global trading regime. In any "no lose" target, a global market price would only exist if there is other demand – i.e., countries that have binding targets and allocations below BAU levels.
Growth targets, headroom allowances (Frankel 1999; Stewart et al. 2001; Oppenheimer et al. 2004; Viguier 2004)	Secure the participation of major developing countries by giving them intentionally not ambitious allocation or allocations in excess of their likely BAU emissions. To ensure benefit to the atmosphere, a fraction of each permit sold can be banked and definitely removed

[46] There is some potential conflict with the terminology here; "non-binding" targets may be interpreted by some as restricting the capacity of countries to trade as they do not necessarily set up caps that impose prices and thus established tradable commodities

	Name (reference)	Description
	Action targets (Goldberg et al. 2004)	A commitment to reduce GHG emission levels by an agreed percentage below an agreed baseline by an agreed date. A country would have to prove that it reduced its projected emissions – which could be accomplished either through "actions" taken domestically, or through purchases of emission allowances on the market.
	Flexible binding targets (Murase 2005 ref missing)	A framework for reaching targets modelled after the WTO/GATT scheme for tariff and non-tariff barriers; targets negotiated through rounds of bilateral and multilateral negotiations
	Modifications to the emission trading system or alternative emission trading systems	
	Price cap, safety valve or hybrid trading system (Pizer 1999; Aldy et al. 2001; Pizer 2002; Jacoby et al. 2004; Philibert et al. 2004)	Hybrid between a tax and emission trading: after the initial allocation, an unlimited amount of additional allowances are sold at a fixed price.
	Buyer liability (Victor 2001)	If the seller of a permit did not reduce its emissions as promised, the buyer could not claim the emission credit. Enforcement is argued to be more reliable as buyers are anticipated to developed countries with more robust legal procedures.
	Domestic hybrid trading schemes (McKibbin et al. 1997; McKibbin et al. 2002)	Regime with two kinds of emissions permits: (1) long term permits that entitle the owner of the permit to emit 1tC every year for a long period; permits are distributed or auctioned once. (2) Annual permits allow 1tC to be emitted in a single, specified year. An unlimited number of these permits are given out at a fixed price (price cap). Both types of permit would be valid only within the country of issue. Each year, governments would require firms within a country to have a total number of emissions permits, in any mixture of long term and annual permits, equal to the amount of emissions they produced that year. Authors argue system provides incentive (through property rights) for long-lived regime that would likely be less subject to government tampering.
	Allowance purchase fund (Bradford 2004)	An international fund is created that buys the cheapest emission reductions and retires them. Countries can sell reductions below their business as usual levels. Cost of the fund are shared between countries.
	Long-term permits (Peck et al. 2003)	Emission permits are given out for a long period of time, e.g. until 2070. Within that period, the gases can be emitted equivalent of a ton of each of the important gases in 2070, depreciated for atmospheric decay (e.g. CO_2 is removed from the atmosphere at about 1% annually, the carbon dioxide permit would allow the emission of 1 ton of carbon in 2070, 1.01 tons in 2069, 1.01^2 in 2068 and 1.01^{60} (1.71) tons in 2010). Each permit could be used once at any time between 2010 and 2070.
Sectoral approaches	Sectoral approaches	
	Sector CDM, sector crediting mechanism (Philibert et al. 2001; Samaniego et al. 2002; Bosi et al. 2005; Ellis et al. 2005; Sterk et al. 2005)	Allowing a country to participate with emission of only one sector. If emissions are below a baseline, excess allowances can be sold.

Name (reference)		Description
	Sector pledge approach (Schmidt et al. 2006)	In this approach, the ten highest-emitting developing countries in the electricity and other major industrial sectors pledge to meet voluntary, "no-lose" GHG emissions targets in these sectors. Targets are differentiated, based upon national circumstances, from sector-specific energy-intensity benchmarks that have been developed by independent experts. Industrialized nations offer incentives for the developing countries to adopt more stringent emissions targets through a Technology Finance and Assistance Package, which helps these nations to overcome financial and other barriers to technology transfer and deployment.
	Transnational sectoral agreements (Watson et al. 2005)	An emissions intensity target that is set based on production processes of a sector; can be linked to an input or output variable e.g. (kilowatts of electricity used or tonnes of coal consumed, tonnes of cement produced). Target can be imposed on a sector directly or indirectly (through an efficiency or technology standard).
	Caps for multinational cooperation (Sussman et al. 2004)	Tradable allowance system to cap emissions associated with the operations of enterprises in developing countries that are affiliated with a parent enterprise in a developed country.
	Carbon stock protocol (WBGU 2003)	A separate protocol for the protection of carbon stocks. Option: establish a worldwide system of "non-utilization obligations" to share the costs of foregoing the degrading use of carbon stocks among all states. Thus countries that (no longer) host sufficiently intact ecosystems would have to buy non-utilization commitments from other, resource-rich countries.
	"Non binding" targets for tropical deforestation (Persson et al. 2004)	Non-binding commitments for emission from deforestation under which reduced rates of deforestation could generate emissions allowances that could be sold on the international market
Policies and measures	Policies and measures	
	Carbon emission tax (Cooper 1998; Nordhaus 1998; Cooper 2001; Nordhaus 2001; Newell et al. 2003)	All countries agree to a common, internationally harmonized GHG emission tax; several of the proposals suggest beginning with a carbon tax limited to emissions from fossil fuel combustion.
	Dual Track (Kameyama 2003)	Countries choose either non-legally binding emission targets with submission of a detailed list of policies and measures or legally-binding emission caps with full participation in international emissions trading
	Human development goals with low emissions (Pan 2005)	First, identify development goals in terms of basic human needs satisfaction. Second, commitment to low carbon paths (*voluntary* commitment for no-regret emission reductions, emission cuts in developing countries *conditional* to financial and *obligatory* discouraging luxurious and wasteful emissions). Third, review of the goals and commitments. A progressive and internationally coordinated taxation on carbon as an incentive mechanism
	Climate "Marshall Plan" (Schelling 1997; Schelling 2002)	Financial contributions provided by developed countries to support climate friendly development; similar in scale and oversight to the Marshall Plan
	Technology	
	Technology research and development (Edmonds et al. 1999; Barrett 2003)	Enhanced coordinated technology research and development
	Energy efficiency standards (Barrett 2003; Ninomiya 2003)	International agreement on energy efficiency standards for energy-intensive industries

Name (reference)		Description
	Backstop Technology Protocol (Edmonds et al. 1998)	Any new power plant installed after 2020 must be carbon neutral (e.g., produce electricity from non-fossil sources, or scrub and dispose of the carbon from its exhaust stream). Any new synthetic fuels capacity must capture and dispose of carbon released in the conversion process. Non-Annex I nations that participate must undertake the same obligations that Annex I nations undertake when their per capita income, measured by purchasing power parity, equals the average for Annex I nations in 2020
	Development oriented actions	
	Sustainable development policies and measures (Winkler et al. 2002; Baumert et al. 2005)	While preparing and implementing development plans, nations would integrate policies and measures to reduce greenhouse gas emissions (e.g., developing rural electrification programs that are based on renewable energy, or mass transit systems in placed of individual cars)
	Adaptation	
	UNFCCC impact response instrument (Müller 2002)	The three branches of disaster response – relief, rehabilitation and recovery – would be the focus of a new "Impact Response Instrument" under the auspices of the UNFCCC; focus of instrument would be on reforming international disaster relief funding mechanism
	Insurance for adaptation; funded by emission trading surcharge (Jaeger 2003)	A portion of the receipts from sales of emissions permits would be used to finance insurance pools; pools would pay out in case of climate disasters, providing insurance in regions of the world where otherwise no viable insurance markets could be established
	Financing	
	Greening investment flows (Sussman et al. 2004) Technology Prizes for Climate Change Mitigation (Newell and Wilson 2005	Government supported investments through Export Credit Agencies made conditional on project development being "climate friendly". Incentive or inducement prizes targeted at applied research, development and demonstration
	Quantitative finance commitments (Dasgupta et al. 2003)	Annex I countries would take on quantitative finance commitments, e.g. expressed as percentage of GDP, in addition to emission reduction targets.
	Negotiation process and treaty structure	
	Bottom-up or multi-facet approach, Reinstein 2004)	Each country or stakeholder group creates its own initial proposal of a package of what it might be able to commit to. Individual actions accumulate one by one. Collective effect of proposals periodically reviewed for adequacy – and if necessary , additional rounds of proposals undertaken
	Portfolio approach (Benedick 2001)	Proposal to create mixed package including emission reduction policies, government research and development, technology standards and technology transfer.
	Elements of a future regime (PEW 2005)	A portfolio of elements including: Aspirational long-term goal (non-binding long-term objective), adaptation (new assistance to help highly vulnerable countries), targets and trading (in which targets could vary in time, form, and stringency including intensity, "no-lose," or conditional targets, sectoral approaches for power, transportation, or land use as emission targets, performance- or technology-based standards, or "best practice" agreements), policy-based approaches (integrating climate and development objectives, and a pledge and review of national measures), technology cooperation (coordinate and increase support for research and development)

Name (reference)		Description
	Orchestra of Treaties (Sugiyama et al. 2003)	A system of separate treaties among like-minded countries (Group of Emission Markets to realize low-cost mitigation opportunities, Zero Emission Technology Treaty to foster long-term technological change and Climate-wise Development Treaty to promote development, technology transfer, adaptation and mitigation) and among all parties to UNFCCC (Emissions Monitoring Protocol, Information Exchange Protocol, targeted funding)
	Case study approach (Hahn 1998)	Implementation of multiple case studies of potential policy instruments in industrialized countries to learn by doing. Cases include coordinated measures, an emissions tax, tradable emission permits with and without CDM and a hybrid system. Participation is voluntary but binding.

Table 13.3 Elements of Agreements

Agreement	Goal	Action	Participation	Compliance Provisions	Other Elements
UNFCCC	"Stabilization of concentrations"	Annex I Parties to "return emissions to 1990 levels by 2000"; all Parties to inventory emissions and take policies and measures	Open to all Parties, commitments differentiated between Annex I, non-Annex I and Annex 2 Parties	No provisions for non-compliance	Contains principles and preambular language
Kyoto Protocol	Achieve quantified emission reduction limits	Set quantitative caps (emission limits and a timetable for achieving them) for Annex B Parties	Annex B Parties	Contains compliance provisions including the establishment of a compliance committee	Contains preambular language, but no new principles
Convention on International Trade in Endangered Species of Wild Fauna and Flora	No explicit "Goal" although preambular language includes focus on protection of species of fauna and flora	Regulation of trade in species listed in appendix	Open to any State	Contains compliance provisions, including at State level and provisions for dispute resolution	Includes preambular language and "Fundamental Principles"
Convention on Biological Diversity	Conservation of biological diversity and the sustainable use of its components	Develop strategies to identify, monitor and seek to protect biological species and ecosystems, as well as use components of biological resources sustainably	Open to any State	No compliance/non-compliance provions	Includes preambular language and Principle (State's sovereign right to exploit resources)
Montreal Protocol on Substances that Deplete the Ozone Layer	No explicit "Goal" although preambular language includes text calling for the "protection of the Ozone Layer"	Each party is to reduce production of an agreed list of ozone depleting substances	Open to all States taking on obligations	Has both compliance provisions for Parties and non-Parties	Contains preambular language, but no new principles

Stockholm Convention on Persistent Organic Pollutants	Protect human health and the environment from persistent organic pollutants	Each Party is to prohibit and/or take legal and administrative measures to eliminate production and use (including import and export) of listed persistent organic pollutants	Open to all Parties taking obligations	Convention calls for development of non-compliance procedures	Contains preambular language, but no new principles
Directive of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading	No explicit Goal, although a statement in text calls for "Promot[ing] reductions of greenhouse gas emissions in a cost-effective and economically efficient manner."	Establish a system for trading greenhouse gas allowances	Open to all members of the European Union	Contains detailed compliance provisions; implementation primarily a role for States	Preambular language, but no separate section on principles
European Commission recommendation on the reduction of CO_2 emissions from passenger cars (note: separate agreements with European, Japanese and Korean automobile manufacturers)	Achieve CO_2 emissions targets for average new cars sold in the EU	European, Japanese and Korean vehicle manufacturers , through technological development and market changes, improve average vehicle emissions sold in European market	European Commission, and automobile manufacturers of Europe, Japan, and South Korea	No separate provisions, but preambular language indicates that legislative proposals would be forthcoming if achievement of goal is not met voluntarily	Preambular language, but no principles

Box 13.7 *Elements for climate change agreements*[47]

A number of elements are commonly incorporated 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.

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 (e.g., regional in nature, or limited to arrangements between private sector partners). Obligations can be uniform across participants, or differentiated among them.

Actions: All agreements call for some form of action. Actions range widely, from obligations to: set national caps on emissions, establish standards for certain sectors of the economy, provide financial payments and transfers, develop technology, create specific programs for adaptation, and to report and monitor. The actions can be implicitly or explicitly designed to support sustainable development. Timing for actions varies considerably, from those taking effect immediately, to 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).

Institutions and compliance provisions: 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 adjudicating compliance, to serving as clearing houses for market transactions or information flows, to managing financial arrangements. 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 be points of contention during negotiations.

13.3.3.1 Goals

As noted in Box 13.4, most agreements (including those on climate change such as the UNFCCC and the Kyoto Protocol), include specific goals and objectives to guide the selection of actions and timing, as well as the selection of institutions. They can both provide a common vision about the near term direction, and offer longer term certainty, which is called for by business. .

The choice of the long term ambition level influences significantly the necessary short term action and therefore the design of the international regime. For example, if the goal is set at low levels of

[47] While not an element, agreements often contain specific information as to the time for initiating actions, and often, a date by which actions 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.

stringency (e.g. stabilizing concentrations at 600 ppmv CO_2, scenario category D of Chapter 3 of this report), a technology focused approach that only reduces emissions in the future would be sufficient. For low stabilization goals (e.g. 400 ppmv CO_2 category A, or 450 ppmv CO_2, category B), strong incentives for short term emission reductions would be necessary (see as well as IPCC WG I)..

International regimes can incorporate goals for the short and medium term and for long-term stabilization of the climate system. One option is to set a goal for long-term GHG concentrations or a temperature stabilization level. Such levels might be set based on agreement of impacts to be avoided (see Den Elzen and Meinshausen, 2005), or on the basis of cost-benefit analysis (see Nordhaus, 2001). A number of authors have commented on the advantages and disadvantages of setting long-term goals. Pershing and Tudela (2003) suggest that it may be difficult to gain a global agreement on any "dangerous" level due to political and technical difficulties. Corfee-Morlot and Höhne (2003) believe such goal-setting is desirable as it helps structure commitments and institutions, provides an incentive to stimulate action, and helps establish criteria against which to measure the success of implementing measures.

An alternative to agreeing on specific CO_2 concentration or temperature levels is an agreement on specific long term actions (such as a technology oriented target – e.g., "eliminating carbon emissions from the energy sector by 2060"). An advantage of such a goal is that it might be linked to specific actions. While links between such actions, GHG concentrations and climate impacts can be made, there are uncertainties in the precise correlation between them. Additionally, several different targets would have to be set to cover all climate relevant activities (Schelling, 1997, Pershing and 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 (Corfee-Morlot and Höhne 2003, Pershing & Tudela 2003, Yohe et. al. 2004)

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 (see Chapter 3.3, figure 2.2-6).

13.3.3.2 Participation

As noted in Box 13.4, participation of states in international agreements can vary. At one extreme, participation can be universal. At the other extreme, participation could just be limited to two countries. At any point in time, participation can be differentiated in different tiers (see staged systems in Table 13.2). States participating in the same tier would have the same type of commitments. For example, in the UNFCCC regime, there are several tiers of commitments (mainly Annex I and Non-Annex I, but special arrangements are made for economies in transition or least developed countries). See Figure 13.3 The allocation of states into tiers can be made according to quantitative or qualitative criteria or be "ad hoc". According to the principle of sovereignty, states may also choose into which tier they want to be grouped (see Kameyama 2003, Reinstein, 2004).

An agreement can have static participation[48] or participation in the agreement may dynamically change over time. In this latter case, states can "graduate" from one tier of commitments to the next. Graduation can be linked to passing of quantitative thresholds for certain parameters (or combinations of parameters) that have been predefined in the agreement such as emissions, cumulative emissions, GDP per capita, relative contribution to temperature increase or other measures of development, such as the human development index (see Gupta 1998, 2003a, Berk and Den Elzen 2001, Höhne et al., 2003 for a review of per-capita emissions thresholds; Criqui et al., 2003 and Michaelowa et. al. 2005(b) for discussion of a composite index using the sum of per-capita emissions and per-capita GDP and Torvanger et. al, 2005, for further composite indices). Qualitative thresholds such as adherence to certain country groupings (OECD, Economies in Transition) have already been used in many agreements. Ott et al. (2004) combine quantitative and qualitative thresholds. Thresholds can be derived from agreed greenhouse gas concentration targets or global emissions paths or be based other parameters such as willingness to pay or capacity to pay.

Some have argued that an international agreement needs to include only the major emitters to be effective, since the largest 15 countries (including the EU25 as one) make up 80 percent of global GHG emissions (PEW 2005, Baumert et al, 2005, Torvanger et al. 2005, Schmidt et al. 2006, Stewart and Weiner 2003). A similar approach has been taken by authors comparing climate change agreements to other multilateral instruments, including disarmament treaties, and the Antarctic Treaty (see Murase, 2002). In these analyses, 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 – noting that the benefits of participation accrue to all countries, including those not part of the agreement. Murase 2002a 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.

Much game theory literature suggests that the conditions for achieving large scale stable coalitions means that they achieve relatively modest emissions reductions. (e.g., Barrett, 1994; Carraro and Siniscalco, 1993; Hoel and Schneider, 1997). Cooperative game theory emphasises the prospect of building stable coalitions if a transfer scheme (for example by emissions trading) can allocate the gains from cooperation in proportion to the benefits from reduced climate impacts (e.g., Chander and Tulkens, 1995; Chander and Tulkens, 1997; Germain et al., 1998; Germain et al., 2003). Eykmans and Finus (2003) note that much of the literature focuses on a "grand (all party) coalition, analyses stability in terms of the aggregate payoff to coalitions and rests on very strong assumptions about implicit punishment of any free-riding countries".

Modifying assumptions in relation to responses to payoffs from cooperation, including spillover and trade effects, allowing for the development of multiple coalitions, recognising trade and the role of technology transfer, and the potential for other transfer schemes (eg emissions trading) to foster cooperation (Finus 2002, Kemfert et al 2004, Tol et al), provides a richer understanding of possible factors relevant to agreement making. They raise the possibility that partial cooperation (including

[48] For example, participation in the tiers of commitments of the Kyoto Protocol can only be changed by an amendment which has to be ratified by all member states. As this is extraordinarily difficult, membership of the tiers is essentially fixed.

involving more than one coalition) can close the gap between the global optimum (full cooperation) and "no cooperation" by a substantial amount. While this is essentially a theoretical conclusion (based in some cases on modelling reflecting some empirical evidence), it provides some basis for suggesting that any assumption that a single, all encompassing global intergovernmental agreement is a *necessary* condition for effective mitigation action is too restrictive.

Others (seem, for example, Muller, 2002, Jaeger, 2003) suggest that a climate regime is not exclusively about mitigation, but also encompasses adaptation – and that far wider arrays of countries are vulnerable to climate and must be included in any agreement. Further, several authors (see for example, Meira Filho and Gonzales, 2000, or Pan, 2005) argue that even if the majority of emissions are the responsibility of only a few nations, all countries must share the commitments to reduce for reasons of equity and fairness (recognizing that such actions should be differentiated according to responsibility and capability). Other rationales for global engagement are also used: If only some major countries participate, emissions of non-participating countries could increase by migration of emission intensive industries. Therefore most proposals aim to provide incentives for countries to participate. Some aim at pull incentives such as temporary over-allocation or no regret structures. Others mention push incentives such as trade sanctions or border tax adjustments (Biermann & Brohm 2003, Kuik 2004a).
Others argue that countries have differentiated historical responsibility and that such a sub-global participation can be effective: Grubb et al. (2002) argue that under some scenarios one can expect that 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, or using the Clean Development Mechanism.

In general the literature suggests that actions can occur in parallel, and that international agreements could have multiple components, since national circumstances are so diverse. But the literature suggests that care will be needed, particularly for countries with limited institutional capacity, to avoid creating too many simultaneous international activities.

13.3.3.3 Regime stringency: linking goals, participation and timing

Several studies have analyzed the regional emission allocations or requirements on emission reductions and time of participation in the international climate change regime to be able to ensure different concentration or temperature stabilization targets (Berk and den Elzen, 2001; Blanchard, 2002; Böhringer and Löschel, 2005; Böhringer and Welsch, 2006; Bollen et al., 2004; Criqui et al., 2003; den Elzen et al., 2005a; den Elzen et. al., 2005b; den Elzen and Meinshausen, 2005; Groenenberg et al., 2004; Höhne, 2006; Höhne et al., 2005; Michaelowa et al., 2005b; Persson et al., 2006; WBGU, 2003; Winkler et al., 2002a). They analyzed a large variety of system designs for allocating emission allowances / permits, including Contraction and Convergence, Multi-Stage, Triptych and intensity targets. The studies cover a large variety of parameters and assumptions that influence these results: future emission, population, GDP development of individual countries or regions, global emission pathways that lead to climate stabilization (including overshooting the desired concentration level), parameters about thresholds for participation or ways to share emission allowances. For example, they include very stringent requirements for developed countries with less stringent requirements for developing countries as well as less stringent requirements for developed countries and more ambitious constraints for developing countries within a plausible range. (A detailed review of the global modeling and scenario work can be found in Chapter 3). The conclusions of these studies (and their implications for international regimes) can be summarized as follows:

- Under regime designs for low and medium concentration stabilization levels (i.e. 450 and 550 ppm CO_2-eq, category A and B, see Table 3.3-2.) developed country greenhouse gas emissions would need to be reduced substantially during the next century. For low and medium stabilization levels, developed countries as a group would need to reduce their emissions below 1990 levels in 2020 (in the order of -10% to -40% below 1990 levels for most of the considered regimes) and to low levels by 2050 (-40% to -95% below 1990 levels). The reduction percentages for individual countries vary between different regime designs and parameter settings and may be outside of this range. For high stabilization levels, reductions would have to occur, but at a later date (see Box 13.8).
- Under most of the considered regime designs for low and medium stabilization levels developing country emissions need to deviate from what we believe today would be their baseline emissions as soon as possible. For the advanced developing countries this occurs by 2020 (mostly Latin America, Middle East, and East Asia). For high stabilization levels deviations from reference are necessary only at a later date.
- 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 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.
- The wide diversity of approaches means that not all countries participate under all regimes – even if an identical concentration target is achieved. Obviously, required national actions differ enormously depending on whether a country participates in a system. However, the difference in reductions required between the various approaches is small for participating countries.
- The parameters of most of the approaches are stretched to their limits for the low stabilization levels and resulting emission reductions are very ambitious. For 450 ppm CO_2eq., category A, parameters are very strict: almost immediate participation of many Non-Annex I countries in a staged approach and emission reductions of 4-5% per year from participating countries. The parameters are more relaxed for 550 ppmv CO_2eq, category B: e.g. participation of Non-Annex I countries at Annex I average per capita emissions and reductions of a few percent per year from participating countries.

Box 13.8 *Difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for the Annex I and non-Annex I countries as a group*

Scenario category	Region	2020	2050
A-450 ppm CO_2 eq	Annex I	-25% to -40%	-80% to -95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2 eq	Annex I	-10% to -30%	-40% to -90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, specially in Latin America and Middle East
C-650 ppm CO_2 eq	Annex I	0% to -25%	-30% to -80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

Only the studies aiming at stabilization at 450 ppm CO_2-eq. assume a (temporary) overshoot of about 50 ppm. See: Den Elzen, M.G.J and Meinshausen, M., 2006

Several studies have gone one step further and have, based on emission allocations, calculated emission reduction costs and possible trades of emission allowances at a regional level for different concentration or temperature stabilization targets (Böhringer and Löschel, 2005; Böhringer and Welsch, 2004; Böhringer and Welsch, 2006; Bollen et al., 2004; Criqui et al., 2003; den Elzen and Lucas, 2005; den Elzen et al., 2005b; Nakicenovic and Riahi, 2003; Persson et al., 2006; WBGU, 2003. Also, see Chapter 3 for additional details on models and model results). Researchers also analyzed a large variety of system designs. With cost analysis even more assumptions are relevant, e.g. detailed assumptions on emission reductions costs per sector and region. Cost have been calculated with a variety of models ranging from those with detailed sectoral representation focussing on the technological aspects to macroeconomic models focussing on the economy as a whole. How costs are calculated plays a role. Some studies present annual direct mitigation costs (only direct abatement costs) or energy costs, i.e. mitigation costs and costs of losses of fossil fuel exports, or gains from increased exports of biofuels. Other studies present full macro-economic costs, calculated as (cumulative) GDP-losses in a specific target-year. The cumulative impact of climate policies on GDP may be lower than expected from the annual abatement costs levels due to the fact that climate policy leads mostly to substitution of investments and activities, and much less to an overall reduction of GDP. The conclusions of these studies on costs can be summarized as follows:

Global Costs

- The total global costs are highly depending on the baseline scenario, marginal abatement costs estimates, participation level in emission trading and assumed concentration stabilisation level (see also Chapters 3 and 11).
- The total global cost do not vary significantly for the same global emission level, however cost will vary with the degree of participation in emission trading (how and when allowances are allocated). If, for example some major emitting regions do not participate in the reductions and in emission trading immediately, the global costs of the participating regions may be higher (see also Chapter 3: e.g., den Elzen et al., 2005b; Bollen et al., 2004)

Regional Costs

- Regional abatement costs are dependent on the allocation regime, particularly timing, but the assumed stabilisation level and baseline scenario are more important. (see Criqui et al., 2003; den Elzen and Lucas, 2005). If for example convergence of the per capita emissions were to occur by the end of this century, developing regions would incur high costs relative to what might occur (reference or baseline cases) Conversely, if convergence were to occur by the middle of the century, developed countries would higher costs relative to what they might occur (reference or baseline cases). (see Persson et al., 2006; Nakicenovic and Riahi, 2003; den Elzen et al., 2005)
- Abatement costs as a percentage of GDP vary significantly by region for allocation schemes that lead to convergence in per capita emissions by the middle of the century. The costs are above the global average for the Middle East and the Russian Federation, including surrounding countries and to a lesser extend Latin America. The costs are near the world average for the OECD regions and below the world average for China. The (other) developing regions, i.e. Africa and South-Asia (India) experience low costs or even gains as a results of financial transfers from emission trading. (den Elzen and Lucas, 2005; Criqui et al, 2003)
- In addition to the abatement costs they incur, fossil-fuel-exporting regions are also likely to be affected by losses of coal and oil exports compared to the baseline, while some regions could experience increased bio-energy exports (i.e. the Russian Federation and South America) (see Persson et al., 2006; van Vuuren et al., 2003; Nakicenovic and Riahi, 2003 and also Chapter 11)
- The economic impacts in terms of welfare changes show a similar pattern for different allocation schemes. For example, allocation schemes based on current emissions (sovereignty) lead to welfare losses for the developing countries. Allocation schemes based on a per capita convergence lead to welfare gains for developing countries, without leading to excessive burdens for industrialized countries. (Böhringer and Welsch, 2004)

13.3.3.4 Actions

13.3.3.4.1 Targets

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).

One crucial element is defining and agreeing on the level of the emission targets. Examples of processes to agree on a target include:

- Participating countries make proposals (pledges) 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 (this may subsequently 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, for example, has been applied to the EU for

the purpose of the Kyoto Protocol. It could, in principle also be applied to any other group of countries.

Many have raised concerns that the absolute targets may be too rigid and cap economic growth. (Philibert and Pershing 2001; Bodansky, 2003; Hohne et al, 2003). To address this problem, a number of more flexible national emission targets have been proposed (see alternative types of emission targets in Table 13.2).

- Dynamic targets
- Dual targets, target range or target corridor
- Dual Intensity Targets
- „No lose“, “non-binding”, one way targets
- Growth targets, headroom allowances
- Action targets
- Flexible binding targets

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) is 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 (see Pizer, 2003, and Jotzo and Pezzey, 2005). Other disadvantages are also mentioned, such a adding to the complexity of the system or, in the case of intensity targets, the difficulty to cope with economic recession.

Additional understandings come from political science literature which emphasizes the importance of analyzing the full range of factors bearing on decisions by nation states including domestic pressures from the public and affected interest groups, the role of norms and the contribution of NGOs (environment, business and labor) to the negotiation processesi. *Case studies* of many MEAs have provided insights particularly consideration of institutional, cultural, political and historical dimensions that influence outcomes. A weakness of this approach is that the conclusions can differ depending on the choice of cases and the way analysis is done. However, such ex-post analysis of the relevant policies often provides insights which are more accessible to policy makers since they are based on experience rather than theoretical thinking or numeric models. Studies of the European Acid Rain Regime revealed, for example, that agreeing upon an ambitious target can serve as a driver for policy implementation, but may not necessarily result in a good environmental consequence if countries do not have the capacity to comply with what they committed to in good faith. (Victor 1998).

13.3.3.4.2 Flexibility Provisions

Many environment agreements seek to address complex issues by allowing for additional flexibility as a means to achieve their goals. Flexibility has been suggested as to “how”, “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), “how” (i.e., choice of policy instrument), and “what” 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 13.3.3.3, while questions of “what” flexibility are examined in chapter 3.

The Kyoto Protocol incorporates three articles that provide flexibility as to 'where' emission reductions occur, namely through is provisions regarding international emission trading, joint implementation and the clean development mechanism. Under Kyoto's international emissions trading system, emission allowances may be traded between governments of Annex B parties if a surplus occurs in one country and a deficit occurs in another (for an overview of activities see Philibert and Reinaud 2004). Emission reductions achieved through projects between Annex I countries are called Joint Implementation (JI), while emission reduction projects located in non-Annex I countries are called Clean Development Mechanism (CDM) projects. Extensive rules have been agreed to ensure that credits created under these project mechanisms actually represent the emissions reduced.

International Emissions Trading

Emissions trading has become an important implementation mechanism for addressing climate change in many countries. The overall value of the global carbon market was over US$ 10 billion in 2005 and in the first quarter of 2006 the transaction level reached US$ 7.5 billion (World Bank and IETA, 2006).The most advanced international emissions trading system (ETS) is that developed by the European Union. While this system is an international one, it bears many of the characteristics of a national program, with oversight by the European Commission, and a centralized regulatory and review mechanism. See Box 13.2 for details. A larger global system of international trading is slowly developing through emission credits generated by the project-based mechanisms (see Section 13.3.3.4.2.)[49]. A fully global emissions trading system would provide market players and policy makers with information thus far absent from decision-making: the actual, unfettered, global cost of GHG mitigation in a range of economic activities. In this sense, at the international level, such a regime would mirror the information provided by national trading programs at a global scale.

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, regional, national and sub-national trading programs are operating under different rules, which could inhibit "market convergence" and increase the costs of trading. Others indicate that a global market can incorporate diverse domestic and regional systems despite differences in design; they reiterate the point made by others that such a system may be significantly less efficient that a single globally optimized regime (Baron and Philibert 2005).

A full assessment of the elements required to link multiple regimes is provided by Haites, 2003b. They identify only a few situations that might prevent linkages (a formal prohibition in one system to allow links, and circumstances where a single firm's membership in multiple programs creates the potential for double counting). However, they describe a number of other issues that could complicate links between two or more emissions trading programs, including concern over the effectiveness of compliance enforcement, and over whether the linked regimes provide adequate protection of either system's environmental objectives. Thus, linking regimes may need to address compliance questions, as well as relative stringency of system targets before agreeing to formalize links. As Bygrave and Bossi (2004, 2004b) note, links do not need to be formal to happen; market arbitrage can provide opportunities for purchasing allowances in multiple markets even if there is no specific recognition of one system's permits under another's structure.

Various authors have analyzed the size of the allowance surplus of the countries in transition, barriers to accessing allowances, the potential market power of cartels and links to energy security. Such

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

surpluses can alter the overall costs of compliance with the Kyoto commitments – but only if trade in such surplus allowances is undertaken. Victor et al. (2001a) estimated the joint Russian and Ukrainian surplus at 3.7 billion tons CO_2 for the entire commitment period 2008-2012. . Berkhout and Smith (2003) estimate the surplus level of the former Soviet Union though 2030 and state that it could only cover half of an assumed 30% reduction target for a 28-member state EU. 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, forward trading with OECD countries represents the only opportunity to raise initial capital to mobilize no-regret and low-cost GHG reductions Maeda (2003) shows that surplus emissions permits in the international emissions trading regime may affect the economic efficiency of the Kyoto mechanism; he suggests considerable market power exerted by sellers could affect the price (e.g., if all the economies in transition form a cartel, if Ukraine forms a cartel with Russia, or even if Russia acts alone). 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. One proposal for reducing concerns over trading in surplus allowances is that of the "Green Investment Scheme", in which revenues from sales of surplus allowances is spent on national policies, programs and projects to further reduce emissions; this option is explained further below.

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

Since 2000, the Clean Development Mechanism (CDM) has allowed crediting of project-based emission reductions in developing countries; it is the first of the Kyoto Protocol's market mechanisms to have been implemented. A number of analysts have estimated CDM volume and price. Chen (2003) derived prices of 2.6-4.9 \$/t CO_2 and annual volumes of approximately 600-1000 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. Haleness (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 May 2006, the volume of CERs estimated from nearly 1000 proposed projects in 69 countries was 200 Mt CO_2eq/y in 2008-2012 and 330 Mt pre-2008 (Ellis and Karousakis, 2006) (See Figure 13.4) They also indicate that almost half the proposed CDM projects are in the electricity sector and that many are small renewable projects, occurring in 40 countries. However, the majority of credits are expected to come from CDM projects reducing high GW_p gases, i.e., N_2O, HFC23 and to a lesser extent CH_4. Projects that have not yet had methodologies approved will be under-represented in the project mix – even if they represent opportunities for significant emissions reductions at the national or global level. Publicly committed budgets for CER acquisition stood at approximately 2 billion USD (World Bank 2006,). At such a scale, the CDM begins to reach the same order of magnitude as GEF and Official Development Assistance (ODA) resources. Not all projects proposed will ultimately be implemented; however the UNFCCC cites 186 registered projects, and expects 350,000,000 CERS from those projects through the end of 2012[50]

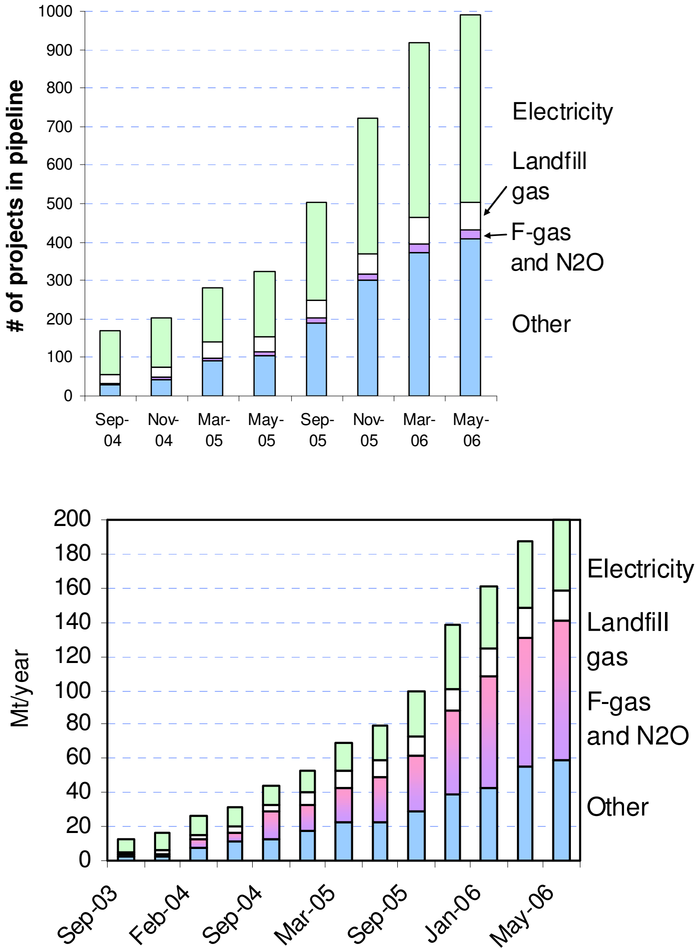


Figure 13.4 *Evolution of the CDM portfolio in CO_2 eq/year and number of projects (Ellis, J and Karousakis, K., 2006)*

While it was initially assumed that CDM projects would be undertaken as bilateral arrangements between Annex I and non-Annex I convention Parties (and private sector companies in those countries), a relatively large number of projects are being implemented unilaterally, indicating that developing country companies are procuring the financing to implement projects and sell the CERs to industrialized countries[51]. 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 organizations, credit procurement funds are summarized in Tables 13.4 and 13.5 Such funding could generate between 200 and 400 $MtCO_2e$ of credits, assuming a price between USD 5 and USD 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)

[50] http://cdm.unfccc.int.

[51] 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.

Table 13.4 *Overview of multilateral carbon funds as of July 2005 (mainly from Baron and Philibert, 2005)*

	Type	**Name**	**Investors**	**Launch**	**Investment Goal**
Multilateral Funds	**Public-Private Partnerships**	World Bank BioCarbon Fund	Public and private entities	May 2004	USD 100 million
		World Bank Community Development Fund	Public and private entities	July 2003	USD 128 million
		World Bank Pan-European Carbon Fund	European Investment Bank	June 2005	USD 100 million
		World Bank Prototype Carbon Fund	Public and private entities	July 1999	USD 180 million
		Andean Development Corporation's Latin American Carbon Program	Private and public entities, including the Dutch government	1999	USD 45 million
		Asian Development Bank's CDM Facility	Public and private entities	August 2003	USD 70 million current budget
		Baltic Sea Region Energy Co-operation (BASREC) Testing Ground Facility (TGF)*	Governments of Denmark, Finland, Iceland, Norway, Sweden. Germany intends to contribute	December 2003	EUR 30 million
		European Bank for Reconstruction and Development's Multilateral Carbon Credit Fund	Public entities, including 9 EU governments	July 2005	EUR 50-150 million
		KfW	Private and public entities, including the German Carbon Fund	June 2004	EUR 50 million
		Singapore-ASEAN Carbon Facility	Public and private entities	2003	USD 120 million
	Private Funds	Asia Carbon Fund	Public and private entities	March 2005	EUR 200 million
		EcoSecurities – Standard Bank Carbon Facility	Private and public entities, including the Denmark Carbon Facility	May 2003	DKK 59 million
		European Carbon Fund	CDC – Ixis, Fortis Bank	January 2005	EUR 105 million
		Japan GHG Reduction Fund JBIC-JGRF-JCF	Japan Carbon Fund	April 2005	Yen 22-57 billion/year
		Natsource's Greenhouse Gas Credit Aggregation Pool	Public and private entities	February 2005	USD 130 million
Approximate funding total: USD 1.67 billion					

****The TGF is also open to private investors.***

Table 13.5 *Overview of Government Carbon Funds as of July 2005, Baron and Philibert, 2005*

	Type	Name	Investors	Launch	Investment Goal
Single Government Funds	Own Tender	Austria JI/CDM Program	Austria	2003	EUR 72 million
		Belgium JI/CDM Tender	Federal Government of Belgium	May 2005	EUR 10 million
		Climate Fund	Canada	April 2005	CAD 1 Billion
		Denmark JI/CDM Program	Denmark	2004	EUR 100 million
		Finland JI/CDM Pilot Program	Finland	May 2003	EUR 20 million
		French Carbon Fund	France	February 2005	EUR 50 million
		CERUPT	The Netherlands	2001	EUR 32 million
		ERUPT	The Netherlands	2000	EUR 50 million
		Sweden International Climate Investment Program	Sweden	2000	SEK 350 million
		Government of Japan	Japan	March 2005	JPY 5.7-8 billion
		Swiss Climate Penny	Switzerland	June 2005	EUR 65 million
	Through Multilateral Institutions	World Bank Netherlands Clean Development Facility	Government of the Netherlands	May 2002	EUR 136 million
		World Bank Danish Carbon Fund	Danish investors only: public and private	November 2004	USD 30 million
		World Bank Italian Carbon Fund	Italian investors only: public and private	January 2004	USD 80 million
		World Bank Spanish Carbon Fund	Spanish investors only: public and private	November 2004	EUR 170 million
		IFC	Netherlands Carbon Facility	January 2002	USD 44 million
		IFC-IBRD	Netherlands European Carbon Facility	2002	USD 70 million
		Rabobank Carbon Procurement Department	Netherlands	Summer 2003	EUR 45 million
Approximate funding total: USD 2.06 billion					

A CDM project has to go through an elaborate project cycle with external validation that has been defined by a decision of the 7th Conference of the Parties to the (UNFCCC 2001) and in keeping with the decisions of the CDM Executive Board which is overseeing the project cycle (See for example 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 (see Greiner and Michaelowa 2003) and environmental additionality (see 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). Fischer (2006) argues that due to industry pressure, rules for standard emission rates are likely to be systematically biased to over-allocate, and also risk creating inefficient investment incentives. Focusing instead on costs and efficiency, 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. A number of other authors examine specific baseline issues in the energy sector, particularly the use of models, the need to consider size, vintage, generation type, and operational characteristics and issues relating to technology and sectoral approaches. See: Illum and Meyer (2004), Begg and Van der Horst (2004), Rosen et al. (2004), Fichtner et al. (2001), Sathaye et al. (2004), Kartha et al. (2004), Zhang et al. (2001a, 2005), Spalding-Fecher et al. (2002)

Indirect effects of CDM projects can lead to an overestimation of carbon credits; this is often termed "leakage" in the literature, and includes increased emissions outside the project boundaries that are a result of within-project reductions. Leakage issues have been discussed by a number of authors (see, for example, Geres and Michaelowa (2002), Kartha et al. (2002) for the electricity sector and Working Group on Baseline for CDM/JI Project (2001)). There is a general consensus that the determination of project boundaries is critical to evaluating leakage.

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, 2003a, for an overview of such issues in CDM host countries, Korppoo, 2005 for specific issues related to the Russian Federation, and Figueres, 2004, for issues specific to Latin America).

The coverage of forestry and forest related projects is a contentious issue under CDM. The problems primarily relate to the impermanence of the forest and to leakage to other regions. Dutschke (2002) suggest 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. (Nelson and de Jong 2003 note that a forestry project in Chiapas, Mexico shifted from a development emphasis with multiple species to two species when the focus changed to carbon sales by individual farmers. Vöhringer (2004) notes that establishing historical deforestation rates is a major problem in Costa Rica. Van Vliet et al. (2003) analyze six proposed plantation forestry projects in Brazil for uncertainty. In this work, they suggest that fluctuations in product prices cause variations up to 200% in CERs and net present value, lead to difficulties in determining the additionality of such projects and making five of the six projects ineligible for CDM.

The literature offers a number of suggestions with regard to enhancing or expanding CDM beyond the current framework, including:

(1) Efforts to improve the sustainable development benefits of CDM. One proposal[52] for doing this is the "Gold Standard", which calls for enhanced environmental assessment, stakeholder consultations to allow local concerns to be built in to the project, and develops a qualitative sustainability matrix which includes local environmental impacts, social impacts, and technology transfer components (Gold Standard, 2006);
(2) Expanding the CDM regime. One recent such option would allow "Programmatic" CDM – a concept elaborated on in a decision by the first meeting of the Kyoto Parties in 2005, and analyzed by the OECD (Ellis, 2006); it would allow projects implemented in more than one location and potentially involving more than one project type to be credited under the CDM rules, and
(3) Extending CDM project incentives beyond 2012 (the end-date for the current Kyoto Protocol commitments that create the incentives for project credit sales)

Perhaps the most critical issue regarding the viability of CDM projects is whether there will be an ongoing price signal – and thus both emission reduction commitments, and a market demand – over the longer term. The impact on the supply of CERs of a post-2012 emission target on host countries is analyzed by Olsen and Painuly (2003). 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. The authors further state that if a country's quota is related to its 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 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 EU 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". Transactions under Joint Implementation are seen as both cumbersome and beset with institutional obstacles (Korppoo 2005), nevertheless countries in Eastern Europe have started to grant surplus "Assigned Amount Units" to projects that reduce greenhouse gas emissions prior to or during the Kyoto Protocol commitment period(Taylor 2004) Under a GIS, revenues gained from trading would be recycled to further reduce emissions; as such it is almost a hybrid of the emissions trading and JI systems. Blyth (2003) suggests the scale of investment under a GIS in Russia could total as much as 1.25 – 3.5 billion annually – although as of 2003, no projects had been initiated under such a system.

Sectoral Approaches

A number of researchers have suggested that sectoral approaches may provide an appropriate framework for post Kyoto agreements (see sectoral approaches in Table 13.2). Under such a system, specified targets could be set, starting with particular sectors or industries that are particularly important, politically easier to address, globally homogeneous or relatively insulated from competition with other sectors..

Sectoral commitments have the advantage of being able to be specified on a narrower basis than total national emissions; Baumert et al, 2005, consider specific options in aluminium, cement, iron

[52] This is already being applied for some projects on a voluntary basis. See: http://www.panda.org/about_wwf/what_we_do/climate_change/our_solutions/business_industry/finance_investment/gold_standard/index.cfm

and steel, transportation and electricity generation – concluding that while not all sectors are amenable to such approaches, considerable precedent already exists for agreement both between companies and by governments. 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 Figures 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. Such sectoral targets might be fixed or dynamic, "no-lose", binding or non-binding (Philibert and Pershing 2001; Bodansky 2003). Bosi and Ellis (2005) and Baron and Ellis (2006) 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.

While sectoral approaches provide an additional degree of policy flexibility, comparing efforts between countries within a sector can be easier but efforts across sectors may be difficult (see Philibert, 2005a). Sectoral approaches may 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.

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 that reduce emission of greenhouse gases. A number of policies have been discussed in the literature that would achieve this goal, including taxes (such as carbon or energy taxes); trade coordination/liberalization; R&D; sectoral policies; and policies that modify foreign direct investment. Sectoral policies have been discussed above, R&D is discussed under section 13.2.1.5, and FDI is discussed below on financing. This discussion focuses on harmonized taxes as well as trade and other policy.

As discussed in section 13.2 above, a tax is considered one of the most efficient economic instruments to address climate change because it offers a flexible incentive to promote changes in behavior, induce development of 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. Section 13.2 discusses the political difficulties of applying taxes on a national scale, some of which may be amplified on an international scale.

One of the leading proponents of a harmonized tax has been Cooper (1998, 2001). Under his proposal, all participating nations – industrialized and developing alike – would tax their domestic carbon usage at a common rate, thereby achieving cost-effectiveness. However, Aldy et al (2003) have suggested a number of problems with Cooper's proposal, including issues of fairness (whether developed and developing countries should have identical tax rates given relative welfare and relative responsibilities); whether any incentive exists for developed countries to adopt a tax; and how to manage gaming behavior (in which government may change tax codes to neutralize its effects or to benefit certain economic sectors). Additional criticism of a common tax structure comes from the modeling community: Babiker et al (2003) note that while an equal marginal abatement cost across countries is economically efficient, it may not be politically feasible in the context of existing tax distortions. They also note that many countries applying taxes have exempted certain industries – significantly increasing the overall costs of the tax regime.

One area examined has been how to address competitive consequences when one country adopts a tax and a trading partner does not. Several solutions have been proposed, including the use of trade bans or tariffs to induce action. Governments may also seek to use border tax adjustments under such circumstances (Charnovitz, 2003). However, it has been argued that such a measure could be as disadvantageous to a target foreign country as a trade measure. Business groups (e.g., U.S. Council for International Business, 2002) and Mexico (CESPEDES, 2000) argue that such measures will have a deleterious effect on commerce. To date WTO case law has not provided specific rulings on climate related taxes. Any proposed border adjustments would need careful design, taking into account WTO law (Biermann and Brohm 2003) See Box 13.9 for a discussion of climate change issues and WTO

Esty and Ivanova (2002) pay special attention to the environmental standards harmonization. They conclude that both economic and ecological interdependence demand coordinated national policies and international collective action, and propose the creation of a Global Environmental Mechanism to help manage the environmental components of a globalizing world.

Box 13.9. Climate Change and the WTO

Although the trade and climate regimes have different aims and organization, they enjoy many common features. Both aim to promote greater economic efficiency in order to enhance public welfare, and both recognize linkages between the economy and the environment. There is a considerable history of international cooperation on environmental issues – including issues that are intimately linked to global trade[53] (see, for example, Frankel and Rose, 2003).

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. 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 Fischer et al, 2002).

Three examples demonstrate some of the possible pitfalls:

- In 1998, Japan introduced the "top-runner" program 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[54]. The legislation raised concern among other automobile exporting countries, most notably the United States and the

[53] 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.

[54] 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%.

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. After discussions between all parties over several years, 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. 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.

- A tax based on the carbon content of fuel has been advocated in a submission to the WTO Committee on Trade and Environment by Saudi Arabia as a means to reduce energy market distortions (Saudi Arabia 2002, paras. 17). Zarrilli (2003) has considered whether such differential taxes on fuel (with higher rates for oil than for natural gas, and higher rats for coal than oil) could lead to higher taxes being imposed on imports, in violation of GATT Article III. He concludes that governments seeking to defend themselves under GATT Article XX would not be successful.
- Murase (2002b) and Brewer (2002) consider potential conflicts between the use of the Kyoto Protocol's project-based flexibility mechanisms (CDM and JI) and various trader agreements; inasmuch as project-based offsets represent foreign direct investment (FDI), they may run counter to both the GATS and Subsidies and Countervailing Measures Agreement, as well as common practice application of the Trade Related Investment Measures (TRIMs) and Agriculture Agreements. Furthermore, Werksman et al. (2001) suggests that the effective functioning of the CDM may require discriminating among investors in a manner prohibited by the Most Favored Nation (MFN) clause of international investment agreements.

Assuncao and Zhang (2002) explore other areas of interaction between the domestic climate policies and the WTO, such as energy efficiency standards, eco-labels and government procurement. They suggest that an early process of consultations between WTO members and the Parties to the Climate Change Convention is necessary to enhance synergies between the trade and climate regimes. To this end, they recommend the establishment of a joint WTO/FCCC working group, specifically focusing on greater coherence between trade, climate change and development policy.

The WTO Committee on Trade and Environment (CTE) 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 trans-boundary or global environmental problems (Charnovitz, 2003). But according to Eckersley (2003), hopes that the CTE might emerge as a creative new space in which more environment-friendly trade rules might be developed have not been met. Furthermore, he argues that no consensus appears to be emerging as to how to even conceptualize successful future trade-environment linkages.

In contrast to those proposing formal consideration of climate issues within the trade arena, Whalley and Zissimos (2002) have argued that governments could bargain simultaneously on climate and trade in order to achieve deals that would be unattainable in either forum independently. An example of such parallel negotiations is cited by Kotov (2004), who suggests that the Kyoto Protocol ratification decision by Russia was tightly linked to the EU backing of its entry into the WTO. Micheli (2000) has suggested that possible 'deals' could arranged in which developing countries undertake climate commitments in return for increased market access to developed countries. However, Micheli argues that low-income countries would very likely resist the notion of "paying" for trade through a costly link to climate.

In additional to WTO, other fora can be a locus to exchange information and coordinate climate related policies and activities. For example, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) offers an opportunity for common efforts to both protect endangered species and the climate. Similarly, meetings of 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 provides information on environmental technology gathered by regional and local governmental authorities as well as companies and environment-related organizations. The North American Commission on Environmental Cooperation (the NACEC or CEC), created within NAFTA, offers another model: 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.

An other approach coordination of policies among many developing countries is one proposed by Winkler et. al. (2002b) and further elaborated by Baumert et. al. (2005b), that is, Sustainable Development Policies and Measures (SDPAMS). In its standard form, such an approach would be domestic and unilateral, and while focusing on developmental needs, while also bringing GHG benefits. However, the authors also suggest that simultaneous SDPAMS pledges (and possibly harmonized pledges) could be made by both developing and developed countries.

Technology

The literature explores a number of issues related to technology research, development and deployment (including transfers and investment). Many have asserted that a key element of a successful climate change agreement will be its ability to stimulate the development and transfer of new technology – without which it may be difficult or impossible to achieve emissions reductions at a significant scale (Pacala and Socolow, 2004; Edmonds and Wise, 1999; Barrett, 2003).

Technology Agreements

The literature makes clear that R&D support, price signals and other arrangements can all contribute to technology development and diffusion. Resources, often scarce in developing countries, will be needed to promote R&D, while institutional arrangements will be required to promote diffusion (See, in particular, the IPCC Special Report on Technology Transfer (IPCC 2000 which contains a comprehensive review of technology transfer issues, including proposals for improving international agreements.) Technology agreements may also seek to address barriers relating to both R&D and in diffusion. (For additional detail on specific sectors and technologies, see chapters 4-10).

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) and technology protocols (common standards) rather than targets and timetables. Barrett maintains that the departure from emissions commitments and market-based instruments is the necessary cost of encouraging participation and designing a compliance-compatible regime. While his proposal could potentially be environmental effective, depending on the payoffs to the cooperative R&D efforts and the rate of technology deployment, he 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.

The concept of regional technology specific agreements have also been explored by Sugiyama (2005), who suggests they may offer an interim path to promote cooperation and develop new, lower cost options to mitigation climate change – allowing a future negotiation on emission caps to proceed more smoothly. See Box 13.10 for examples of coordinated international programs

Box 13.10 *Examples of Coordinated International R&D and Technology Promotion Programs*

- 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. See : http://www.reeep.org
- Asia-Pacific Partnership on Clean Development and Climate: Inaugurated in January 2006, partnership between Australia, China, India, Japan, republic of Korea and USA is to focus on technology development related to climate change, energy security and air pollution. Eight public/private task forces are to consider (1) fossil energy, (2) renewable energy and distributed generation, (3) power generation and transmission, (4) steel, (5) aluminium, (6) cement, (7) coal mining, and (8) buildings and appliances. http://www.dfat.gov.au/environment/climate/ap6/index.html

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 under Article 4.5.

As part of the Marrakesh Accords, at the seventh Conference of the Parties (COP 7), Parties were able to reach an agreement to work together on a set of technology transfer activities, grouped under a framework for meaningful and effective actions to enhance the implementation of Article 4.5 of the Convention. This framework[55] has five main themes:

- Technology needs & needs assessments
- Technology information
- Enabling environments
- Capacity building
- Mechanisms for technology transfer

Actions to implement the framework include the organization of meetings and workshops, the development of methodologies to undertake technology needs assessments, the development of a technology transfer information clearinghouse, including a network of technology information centres, actions by governments to create enabling environments that will improve the effectiveness of the transfer of environmentally sound technologies, and capacity building activities for the enhancement of technology transfer under the Convention. Funding to implement the framework is to be provided through the GEF climate change focal area and the special climate change fund.
Other international efforts have also been undertaken to promote technology transfer in support of climate change mitigation efforts, including by the UN Industrial Development Organization (UNIDO), and by the Climate Technology Initiative (CTI) of the International Energy Agency. 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).

While the importance of the private sector has increased substantially, there continues to be a role for governments in providing an enabling environment for the technology transfer process and in linking the private sector into the process of formulating agreements. 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 13.6 above. In addition, 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.

13.3.3.5 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. The literature often categorizes financing in terms of public flows (including Development Assistance, government loan guarantees through export credit agencies) and private flows, or foreign direct investment (FDI). There are, however, other types of financial instruments. A World Bank survey of contingent financing and risk mitigation instruments for clean infrastructure projects describes the characteristics

[55] See UNFCCC decision 4/CP.7 on development and transfer of technologies.

and potential use of insurance, reinsurance, loan guarantees, leases, credit derivatives and other instruments and the barriers to renewable and energy efficiency financing[56]. World Bank (2003) (Also see IPCC SRTT 2000)

13.3.3.5.1 Foreign Direct Investments

OECD trade and FDI grew strongly in relation to GDP during the past decade: cumulative net FDI outflows between 1995 and 2005 amounted to $1.02 trillion. As a share of GDP, outward FDI grew from 1.15%of GDP in 1994 to 2.02% in 2004. However, while the total sums grew, only 35% went to non-Annex I countries – and of that, nearly 70% went to five: China (including Hong Kong), Brazil, Mexico, Singapore and South Korea.[57]

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. Empirical studies find little evidence that multinational corporations (MNCs) transfer either significant cleaner technology or 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.

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.[58] (Figure 13.5). Maurer and Bhandari (2002) report that during the mid- to late-1990s major developed countries co-financed energy-intensive projects and exports valued at over US$103 billion through their export credit agencies (ECAs). 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. 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 (2004a) review of 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. As a result of that review, 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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[56] See the website of the World Bank carbon finance unit for additional information on financial instruments http://carbonfinance.org

[57] See UNCTAD, Foreign Direct Investment Database. Http://www.unctad.org/Templates/Page.asp?intItemID=1923&lang=1

[58] An absolute increase in GHG emissions may be unavoidable, particularly when it is relates to development of poor countries; but investments should lead to sustainable development with prospect of relatively low emissions.

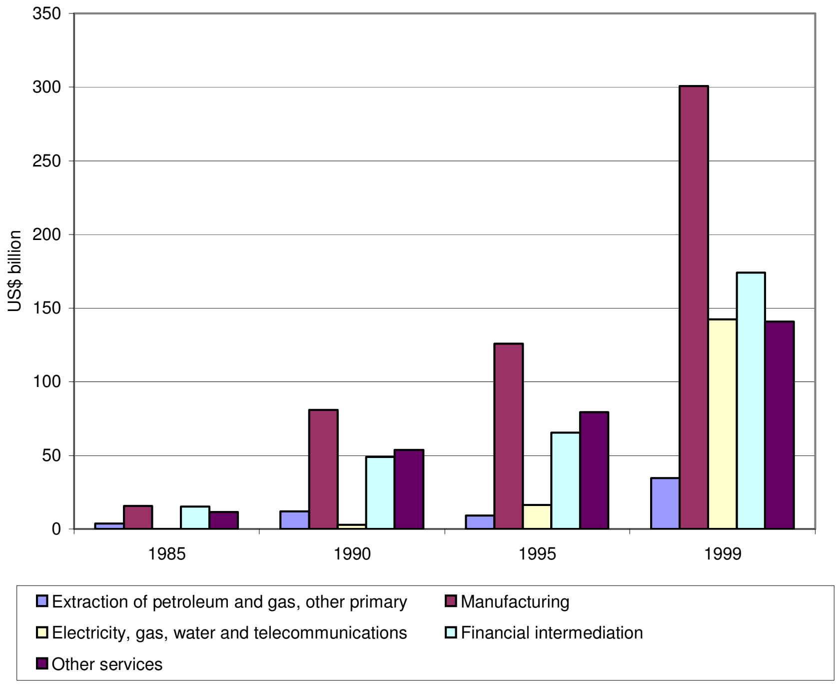

Figure 13.5 Total OECD FDI outflows to selected sectors (OECD, 1999)

13.3.3.5.2 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, although through the 1990s, ODA declined in both nominal and real terms (see Heller and Shukla, 2003). However, In 2005 ODA rose to an all time high reaching 106.5 billion dollars, in part influenced by the Tsunami, debt relief efforts and assistance to Iraq.[59] 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. Data from the OECD suggests that development assistance for energy projects from bilateral sources has remained relatively flat over the last six years while multilateral funding has increased. There has been a shift in support away from coal technologies to gas and to some extent renewables[60]. Figure 13.6

[59] www.oecd.org/document/40/0,2340,en_2649_37413_36418344_1_1_1_37413,00.html

[60] See OECD website for information on development activities, including statistics, data, indicators and methods for accessing data. http://www.oecd.org/topicstatsportal/0,2647,en_2825_495602_1_1_1_1_1,00.html

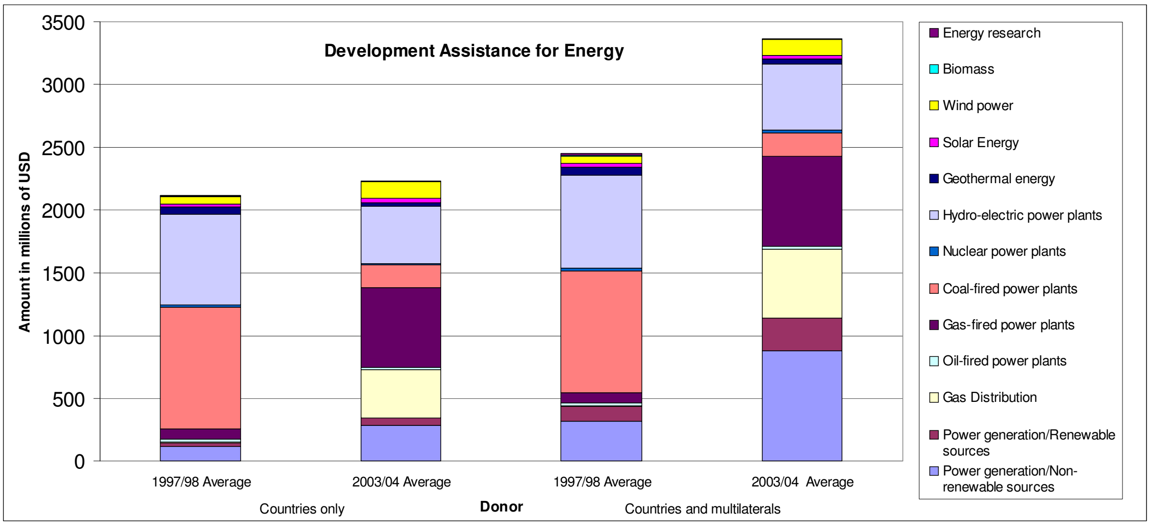

Figure 13.6 *Development Assistance for Energy (See OECD website for information on development activities, including statistics, data, indicators and methods for accessing data. http://www.oecd.org)*

Recent studies show that the effectiveness of aid depends on various factors (World Bank, 2004b), 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.

13.3.3.5.3 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[61].

Compared to the magnitude of the environmental challenges facing recipient countries, GEF efforts are of modest scale. From 1991 to 2004, GEF allocated $1.74 billion to climate change projects and enabling activities, even when matched by more than $9.29 billion in co-financing.[62] Funding goes to five project types, namely renewable energy, energy efficiency, sustainable transportation, adaptation, low GHG energy technologies, and enabling activities. 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 project types 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

[61] See the website of the Global Environmental Facility for additional information http://www.gefweb.org/
[62] http://www.gefweb.org/Projects/focal_areas/focal_areas.html#cc

technology partnerships. It has been suggested that GEF reform will be needed to enhance its effectiveness and transparency, particularly with respect to determining contributions and for evaluating priorities for disbursements (see, for example, Grafton et al, 2004). Meanwhile, Sohn et al (2005) suggest that Governments may use their leverage to direct the activities of multilateral development banks 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.

13.3.3.6 Capacity building

Capacity building has not been extensively addressed in the climate change related 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 the literature has defined capacity as the formal training of employees, technological gate-keeping 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 circumstances of countries. Gupta (1997 and 2003) argues that capacity building might also be needed to appropriately redefine elements of the development model to fit evolving circumstances.

Some recent research has 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). 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.

Najam et al (2003), note that capacity building is not only a key concern of developing countries, but must be an integral part of any future agreement if it is to have wide support from developing countries. In particular, they argue that inasmuch as efforts to combat climate change and promote sustainable development are “two sides of the same coin” enhancing capacities of communities and countries to fight climate change will have multiple benefits. They make the case that the most pressing need in this context is to strengthen the social, economic and technical resilience of the poorest and most vulnerable against extreme climatic events.

13.3.3.7 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) note 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. It is however pointed out that, from the legal point of view, any such punitive measures involving "binding consequences" cannot be implemented without an amendment of the Kyoto Protocol (Article 18)[63], and that, from the policy point of view, such measures introducing adversarial elements into the system are highly undesirable in view of the fact that the Kyoto Protocol currently covers in an obligatory form only one third of the total GHG emission of the world (Murase 2005).

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 favors 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. (Mitchell 2005; Bernstein 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) reviewing the Kyoto Protocol's compliance mechanism, argues that failure to comply over two compliance periods can essentially be equivalent to indefinitely postponing 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 affect other Parties.

[63] Note that Decision of the COP/MOP .1 at Montreal in December 2005 on "Procedures and mechanisms relating to compliance under the Kyoto Protocol" decided "to commence consideration of the issue of an amendment to the Kyoto Protocol in respect of procedures and mechanisms relating to compliance in terms of Article 18, with a view to making a decision by the third session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol" (para.2).

Hovi et. al. (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, 2005), while others more specifically focus on possible conflicts between climate agreements and trade agreements (see, e.g., Murase, 2002b) 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 a consensual basis. In part due to the disparity between these agreements, a number of authors (e.g., Murase, 2002b, 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.

13.3.3.8 Adaptation

The element of adaptation in international climate agreements has been far less explored to date compared to the issue of mitigation.[64] While most authors agree that adaptation is a vital part of a future agreement, the literature speaks little of concrete proposals detailing actions or obligations countries should undertake. Most proposals are around leveraging funding for adaptation activities.

Parry et al (2005) develop perhaps the most comprehensive assessment of how adaptation may be incorporated into a future climate change architecture. They begin by noting that much of the adaptive response is likely to be local – and thus is less conducive to a common international approach. Instead, they argue that a key need will be for efforts to incorporate adaptation into development policies and practices, including local, sectoral and national decision making – a process they refer to as "climate-proofing". At the local level, this would incorporate strategies for municipal planning, including developing and maintaining seed banks, emergency preparedness services and community social services. At the sectoral level, it would include efforts to build climate into infrastructure design and maintenance codes and standards. At the national level, it would include integration into national planning and budget processes – for example, by examining whether planned expenditures will increase exposure to the impacts of climate change – and by so doing, minimize the financial risk promote macro-economic stability and set aside sufficient funds to manage the consequences of climate shocks. Finally, at the international level, they suggest key opportunities exist for integrating adaptation into the Millennium Development Goals, into lending practices of international institutions and bilateral aid agencies.

Three funds have been created under the UNFCCC and the Kyoto Protocol to manage adaptation issues: the Least Developed Countries Fund and the Special Climate Change Fund (under the UNFCCC) and the Adaptation Fund (under the Protocol). In addition, the GEF has been requested to consider more flexible approaches to funding adaptation (though this may happen not with core GEF funds, but with new money from these other funds that would be disbursed by the GEF).

[64] See (IPCC 2001a) for a broad review of adaptation issues relating to climate change.

Corfee-Morlot et al (2002) have suggested that it would be unrealistic to expect the GEF to cover the full cost of adaptation; such expenses would quickly exhaust their resources. Huq and Burton (2003) have proposed integrating adaptation into the mainstream work of development agencies, allowing for more cost effective and wider ranging support. However, as noted by Huq and Reid (2004), doing so runs the risk of diluting other existing aid efforts – which are often considerably higher priority in-country than climate change adaptation.

The potential role for private (and public) insurance has also been suggested as a possible mechanism to pay for adaptation (Bals et. al. 2005). Parry et al (2005) list a suite of possible insurance schemes and risk transfer instruments, including:
an international insurance pool (a collective loss-sharing fund to compensate victims of climate change damages);

- public private insurance partnerships (where the insurer is the government but policies are developed and managed by the private sector);
- regional-catastrophic insurance schemes (regional cash reserves are pooled through mandatory contributions from member governments, and reserves are used for weather related catastrophes);
- micro-insurance (risk pooling for low income individuals affected by specific risks);
- catastrophe bonds (giving private insurers protection against extreme events; capital is provided by large institutional investors);
- weather derivatives (financial mechanisms to hedge financial risk from catastrophic weather events)
- weather hedges (providing protection for farmers; currently sold by banks, farm cooperatives and micro-finance institutions).

13.3.3.9 Negotiating Process

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. This may be true of any agreement that engages multiple countries.

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 2000; Gupta and Ringius 2001).

13.3.4 Evaluating international climate change agreements

A number of authors have developed proposals for different evaluation criteria, including Torvanger and Godal (1999), 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), Baron and Ellis (2006). Authors have also used different approaches to represent the application of different criteria.

This section reviews the literature using the same three criteria as in section 13.2: environmental effectiveness , economic efficiency/cost effectiveness, distributional considerations, as well as an additional criterion for institutional feasibility. The discussion is summarized in Table 13.6, and then discussed in greater depth in the sections below.

13.3.4.1 Environmental effectiveness

Environmentally effective international agreements lead to reductions in global GHG emissions, concentrations or climate impacts. The literature suggests that to achieve such success, agreements must provide incentives or deterrents to both State and individual behaviour in order to achieve a specific outcome. However, at the international level, there is some dispute as to whether agreements change trends, or merely codify actions already underway.

It has been argued that an instrument will be more environmentally effective if it:
- is legally binding, contains clear, ambitious and quantitative targets,
- includes clear definitions and principles and the uses of unambiguous language,
- elaborates the rights and responsibilities of countries,
- is supported by financial resources to operate the regime,
- contains mechanisms that promote implementation and bodies that promote collaboration with the scientific community,
- contains a non-compliance mechanisms, and
- provides for reporting, dispute resolution, access to courts, and options for coordinating with other relevant regimes

(See Chapter 3.5, Oberthur and Ott, 1999; Jacobson and Weiss 1997).

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). Agreements that promote ancillary objectives, such as, reductions in ordinary air pollution levels also have a higher chance of success.

The environmental effectiveness of agreements is contingent on design, implementation; participation, stringency and compliance. For example, an agreement that seeks to fully address the climate problem, yet deals only with some greenhouse gases or some sectors will be relatively less effective than one that treats all gases and all sectors. Similarly, an agreement that includes a limited group of countries (particularly if they are not major emitters) may be less effective – and this weakness may be exaggerated when emissions of non-participating countries increase by migration of emission intensive industries. Conversely, additional benefits may accrue due to technology spillover that may enhance environmental effectiveness (see section on participation).

The timing of an agreement's provisions may also affect its effectiveness: Focusing only on longer term emission reductions (as suggested under some forms of technology agreements) may preclude the possibility of reaching low climate stabilization levels, as many lower levels require immediate emission reductions. See Chapter 3.5

13.3.4.2 Cost-effectiveness

From the economic point of view, a successful international agreement would be one that is cost-effective in terms of implementation. Successful agreements 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. To achieve this, agreements would need to 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, not create significant distortions in competitiveness between countries).

Cost-effectiveness, including, economic efficiency can be enhanced with low transaction costs for compliance. This implies limiting the creation of new institutions and keeping implementation procedures as simple as possible while ensuring system integrity.

Many studies argue that a system that enables emission trading with the broadest possible participation of countries would be most cost effective. 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. The relatively limited requirements for government institutions and the flexibility provided to private actors in a trading regime also increases the system's cost-effectiveness.

Studies are divided about the economic impacts 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" to an emission intensive pathway that would be expensive to leave at a later point in time. (See also chapter 11)

13.3.4.3 Distributional considerations, including equity

The distributional considerations of an international agreement on climate change relate largely to equity. Equity can be defined in any number of ways in the climate context (see IPCC 2001b). Banuri et al. (1996) 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.

Although principles of equity are embodied in the UNFCCC (e.g., in the principle of common but differentiated responsibility and capability and in a number of articles focusing on vulnerable countries, technology transfer and financial assistance), the formal elaboration of this concept has been limited.

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. Also see: Muller (1999) These three principles have been used in the evaluation of possible international climate agreements by several authors (e.g. Höhne et al. (2003, 2005), Den Elzen et al. (2003), Torvanger et al. (2004)).

Whether a system of national emission targets can be conducive to social development and equity depends on participation and the initial allocation of emission rights. For example, Pan (2003) has suggested that all countries should participate – but that emissions associated with basic needs should be exempt from limits, while emissions associated with luxury activities should be constrained. Conversely, Gupta and Bhandari (2003) suggest that in the initial stages of an agreement, obligations should only be assigned to a limited set of (wealthier) parties. Exemptions to sectors or countries, and modifications to allocation of obligations can help address equity issues.

13.3.4.4 Institutional feasibility

Two aspects of institutional feasibility are critical: that required to negotiate and adopt an agreement, and that required in its subsequent (usually national) implementation.

Since international agreements are usually adopted by consensus, successful agreements are often relatively simple and require a limited number of separate decisions by international bodies. In addition, global agreements usually require that all data and tools necessary for enforcement be widely available and verifiable (or if not, that they become available in the future). While there has been no comprehensive critique of the proposals in Table 13.2 in terms of there institutional feasibility not all are simple. The proposals vary, for example, in the extent to which they try to accommodate national circumstances and different levels of technical sophistication; hence the feasibility of reaching agreements will also vary accordingly.

As further examples, a sectoral or technology approach would require multiple decisions: which sectors, which types of technologies, and how to regulate or support them. Picking the sectors (and determining sectoral boundaries) or technologies for agreement may be difficult – unless participation were voluntary (e.g., the current suite of IEA implementing agreements, or the bilateral and multilateral efforts on specific technologies). This may require may compromises on environmental effectiveness and equity. Assessing whether a country had fulfilled its obligations would be complex. (Philibert, 2005a) notes that determining the effectiveness technology or sectoral agreements could be difficult. In the case of a technology approach, definitive conclusions would likely be delayed until the technologies began to diffuse – and that could mean concomitant requirements for establishing long-lived institutions. Establishing international institutions to manage coordinated policies and measures, or development-oriented approaches may also be complex. While some private sector, international institutions exist (e.g., the Aluminium Institute, which has set targets for GHG reductions in aluminium processing among its member companies) most sectors do not have such institutional arrangements. Similarly, while there are institutions designed to promote development (e.g., the Bretton Woods institutions), few have integrated climate change into their portfolios (see Maurer and Bhandari, 2000)

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.[65] 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 explores the drivers of these actions, describe the types of initiatives underway, and examine the interactions between these activities and national and international programs. See Box 13.11 for examples.

13.4.1 Other climate actions and initiatives (including sub-national governmental, corporate, NGO and civil actions)

This section addresses voluntary actions taken by sub-national governments, corporations, NGO's and others that are largely independent of national government programs or policies. Note that in contrast, section 13.2 addresses voluntary agreements between national governments and private parties.

13.4.1.1 Sub-national initiatives

In some countries, regional, state, provincial, or local governments have developed greenhouse gas reduction policies and programs. These actions 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 initiatives 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.[66] For policies associated with greenhouse gases, there are particular 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, 2005a).

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[65] 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(e) and Lyon and Maxwell, 2004 for typologies of different types of voluntary agreements and initiatives.

[66] 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 Jeppesen, 2000.

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. Some U.S. states have adopted or proposed a variety of programs to address greenhouse gases, including renewable energy portfolio standards, energy efficiency programs, and emissions registries. Perhaps most notably, eight states in the north eastern and mid-Atlantic U.S. have announced their intent to adopt a regional cap-and-trade program known as the Regional Greenhouse Gas Initiative (RGGI), 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.[67] For example, Victoria has adopted a series of programs to support renewable energy projects and the development of a "green power" market. (Northrop, 2004). New South Wales has developed a credit-based emissions trading scheme for electricity retailers, generators, and some electricity users. (MacGill, et al., 2006, Fowler, 2004, Baron and Philibert, 2005). Finally, Australian states have announced their intention to explore the development of a multi-jurisdictional trading emissions trading system.[68]

Northrop (2004) finds that more than 600 cities worldwide have participated in programs to implement measures to reduce local greenhouse gas emissions.[69] These include cities in developing countries. 18 cities in South America,[70] 12 cities in South Africa[71] and 17 cities in India[72] are becoming more active in developing environmental measures at local level. Kousky and Schneider (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. These types of initiatives may influence sub-national and national governments policies and server as incubators for new approaches to achieve GHG emission reductions.

13.4.1.2 Corporate actions

There is a growing literature exploring the factors that lead corporations to adopt voluntary environmental action (Lyon and Maxwell, 2004, Thalmann & Barzini (2005). 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

[67] 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/

[68] See http://www.cabinet.nsw.gov.au/greenhouse/report.pdf

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

[70] http://www.iclei.org/index.php?id=528.

[71] http://www.iclei.org/index.php?id=700.

[72] http://www.iclei.org/index.php?id=1089.

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 imposition of government mandates.[73] 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.[74] 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, 2000).[75]

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.[76] (See Box 13.11) 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 as

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

[74] 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).

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

[76] 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?).

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

Box 13.11 *Private Partnerships and Programs*

Chicago Climate Exchange:[77] 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:[78] The NGO World Wide Fund of Nature (WWF) has build partnerships with individual leading corporations that pledge to reduce their global warming emissions worldwide 7% below 1990 levels by the year 2010. Six companies have entered this programme.

Top ten consumer information system.[79] This NGO-sponsored program provides consumers with information on the most efficient consumer products and services available in local markets. The service is available in 10 EU countries, with plans to expand to China and Latin America.

Environmental Defence Partnership for Climate Action:[80] Under this program sponsored by the U.S. NGO Environmental Defence, eight member companies have publicly declared 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.

Carbon Trust:[81] The Carbon Trust is an independent, not-for-profit company set up by the U.K. government to reduce carbon emissions and to develop low-carbon technologies. The organization provides technical assistance to companies on emission reduction strategies and provides investment funds and other services for the development of new technologies.

World Economic Forum Greenhouse Gas Register:[82] 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:[83] Under this initiative, five European companies monitor and report their greenhouse gas emissions and set a reduction target.

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

[77] http://www.chicagoclimatex.com.
[78] http://www.panda.org/about_wwf/what_we_do/climate_change/our_solutions/business_industry/climate_savers/index.cfm
[79] http://www.topten.info
[80] http://www.pca-online.org/
[81] http://www.thecarbontrust.co.uk/default.ct
[82] http://www.weforum.org/site/homepublic.nsf/Content/Global+Greenhouse+Gas+Register
[83] http://www.respecteurope.com/rt2/BLICC/

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

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.

Pew Center on Climate Change Business Environmental Leadership Council:[84] Under this initiative, 41 companies undertake a number of different activities, including establishing and meeting emissions reduction objectives; investing in new, more efficient products, practices, and technologies; and supporting action to achieve cost-effective emissions reductions.

13.4.1.3 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).[85] The WRI/WBCSD reporting standard has been used by corporations, non-governmental organizations, and government voluntary programs. The International Standards Organization (ISO) has also developed standards for company level and project level reporting of greenhouse gases.[86]

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.[87] 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).

13.4.1.4 Litigation related to climate

[84] http://www.pewclimate.org/companies_leading_the_way_belc/
[85] WRI/WBCSD (2004).
[86] The relevant ISO standards are ISO 14064 Part 1: "Greenhouse gases: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals" and ISO 14064 Part 2: "Greenhouse Gases: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements." More information on ISO greenhouse gas standards is found at http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=38381&scopelist=PROGRAMME
[87] See http://www.iasb.org/news/index.asp?showPageContent=no&xml=10_262_25_02122004_31122009.htm

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; Thackeray 2004; Verheyen 2003; Gupta 2005). These authors argue that the possible causes of action in litigation include customary law principle of state responsibility, 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) and 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. The authors highlight that although there are often strong legal grounds for taking action, there may be also reasons for a strong defense. 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.

Gillespie (2004) for example argues that if the international process is arguably not taking place in good faith, there is sound reason for requesting the International Court of Justice for an Advisory Opinion in this area, especially taking into account the significant (potential) harm faced by the small island states. Jacobs (2005) and Verheyen (2003) analyze the potential case for a small island state actually suing the US before the International Court of Justice. Burns (2004) and Doelle (2004) point out that not ratifying the Kyoto Protocol could imply illegal subsidies to national industries under the WTO and pollution of the seas under UNCLOS. Hancock (2005) sees the potential for liability suits increasing and advises companies to disclose their emission to the Securities and Exchange Commission as a way to limit liability. Issues of causality are being dealt with in the literature (Allen 2003) and through precedent (Lipanovich 2005).

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). See Table 13.7 For example, in Germany, 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.[88] A similar case was initiated in the US in 2002 by Friends of the Earth, Greenpeace, and the city of Boulder, Colorado, which have sued the Export-Import Bank and the Overseas Private Investment Corporation under the National Environmental Policy Act, alleging that these two US Government agencies had provided \$32 billion for supporting the finance and insurance of oil fields, pipelines and coal fired plants in developing countries over the previous ten years without assessing the impacts on the environment including global warming.[89] A Federal Judge in California has ruled in favor of the plaintiffs.[90]

The Argentinean case filed after the Santa Fe storms alleges a violation of Article 6 of the Climate Convention. 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 tones of CO_2 annually (Climate Justice Programme 2005)[91] and which is seen as a violation

[88] www.climatelaw.org/media/german.suit.

[89] Friends of the earth, Greenpeace, Inc. and City of Boulder Colorado versus Overseas Private Investment Corporation, Export-Import Bank of the United States, filed in the US District Court for the Northern District of California, August 26, 2002.

[90] Order Denying Defendants' Motion for Summary Judgment, in the case of Friends of the earth, Greenpeace, Inc. and City of Boulder Colorado versus Peter Watson (Overseas Private Investment Corporation) and Phillip Lerrill (Export-Import Bank of the United States), No. C 02-4106 JSW.

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

of the Convention and the human rights of the local people. [92] In Australia, NGOs have filed a suit against a minister for permitting a mine expansion project without examining the greenhouse gas emissions.[93]

There are two cases in the United States where a coalition of states[94] and environmental NGOs argue that the US EPA has authority to regulate carbon dioxide and other greenhouse gases as air pollutants under the Clean Air Act. [95] In addition, eight US States, New York City, and two land conservation trusts initiated a lawsuit in July 2004 against the five US power companies with the largest CO_2 emissions, on the grounds that those contribute to a public nuisance (global warming). That case, though dismissed by the trial court, is on appeal.[96]

NGOs in Australia have also given notice to the major GHG emitters in the US about their obligations under national an international law to reduce their emissions.[97] In July 2005, a Wildlife body has sued the Australian Government for failing to protect the Great Barrier Reef.[98]

While many of the above cases have not yet led to judgments in favour of the plaintiff, the cases show that there is an interest in pursuing the legal route to pushing for action on climate change. There are a number of legal grounds for doing so, but it may take some years before courts take a more positive attitude to such litigation.

A court case was filed in December 2005 by the Inuit people before the Inter-American Commission of Human Rights against the US government for human rights violations of the Inuit people's way of life.[99]

There have also been cases that have challenged allocation of emission allowances. With the entry into force of the EU Emissions Trading Directive,[100] there was some litigation in Germany that challenged the way in which the German Government interpreted and transposed it into its National Allocation Plan in 2004[101]. The courts have thus far decided that the Emission Allocation Law is in conformity with German law and with European rules on property rights.[102]

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

93 Australian Conservation Foundation vs. Minister of Planning 2004 VCAT 2029 (29 October 2004), 140 LGERA 100; available at www.austlii.edu.au/au/cases/vic/VCAT/2004/2029.html.

94 California, Connecticut, Illinois, Maine, Massachusetts, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont, and Washington), cities (New York City, Baltimore, and Washington, DC.

95 *Massachusetts v. Environmental Protection Agency,* 415 F.3d 50 (D.C. Cir. 2005). A petition for Supreme Court review is pending. This case concerns motor vehicle emissions. Another case has been filed in the U.S. Court of Appeals for the District of Columbia Circuit by a coalition of states and NGOs led by New York over an EPA decision not to regulate CO_2 from power plants.

96 Connecticut, et al. v. American Electric Power Company Inc., et al; 406 F.Supp.2d 265 (S.D.N.Y. 2005), appeal pending in the Court of Appeals for the Second Circuit.

97 http://www.cana.net.au/documents/legal/aus_fin_rev.doc.

98 http://www.climatelaw.org/media/Australia.emissions.suit.

99 Petition to the Inter American Commission on Human Rights Seeking Relief From Violations Resulting From Global Warming Caused by Acts and Omissions of the United States, December 7, 2005.

100 Directive 2003/87/EC of the European Parliament and the Council of 13 October 2003 (OJ L 275, 25-10-2003), establishing a scheme for greenhouse gas emission allowance trading within the community and amending Council Directive 96/61/EC (OJ L257, 10-10-1996); available at < http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_275/l_27520031025en00320046.pdf>.

101 Gesetz über den nationalen Zuteilungsplan für Treibhausgasemissionsberechtigungen in der Zuteilungsperiode 2005-2007 (Zuteilungsgesetz 2007 - ZuG2007), Bundesgesetzblatt Jahrgang 2004, Teil I, Nr. 45, 30. August 2004.

102 Beschluss vom 1.9.2004, NVwZ2004, S.1389 ff; Beschluss vom 18.10.2004, NVwZ2005, S.112 ff; BverwG, Urteil vom 309.6.2005, NVwZ2005, S. 1178ff.

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, 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, states in the U.S. RGGI program will allow use of CDM credits and EU ETS allowances under certain circumstances. (RGGI, 2005) Similarly, 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. (Betz and MacGill, 2005, Fowler, 2004)

In addition to international carbon markets, there are other frameworks that facilitate interactions between private, sub-national, and non-governmental initiatives and national and international climate change efforts. For example, NGO's, private companies, and governments have 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. The goal of these partnerships is to integrate the economic, social and environmental dimensions of sustainable development. To date, some 300 partnerships are registered.[103]

13.5 Implications for Global Climate Change Policy

This chapter has provided information on the national and international policy options available to governments and the global community to address global climate change. We note that there are many tools available and that each has advantages and disadvantages. While further studies are likely to yield additional insights, particularly with respect to implementation of policy choices, it is unlikely that the suit of policies available to governments will grow substantially in the future.

With this in mind, it is useful to ask several questions: Since the IPCC was formed nearly 20 years ago atmospheric concentrations have gone up by 25 ppm (7 percent)[104] as emissions of GHG have risen. We have measurement data that indicates that the world is warming and we can calculate, given the emissions that have already occurred, that there is now approximately 0.6 degrees of additional warming "in the bank" (See IPCC FAR 2007) So why has the application of policies been so modest? Why is the global community not on a faster implementation track? Why have, at a minimum, hedging strategies not emerged in many more countries? Is the scale of the problem too large for current institutions? Is there a lack of information on potential impacts or about low cost options? Has policy making been influenced by the special interests of a few?

[103] See http://www.un.org/esa/sustdev/partnerships/partnerships.htm
[104] http://cdiac.ornl.gov/ftp/trends/co2/maunaloa.co2

Assuming that policies are careful designed, there appears to be no need to delay implementing policies, indeed the literature continues to suggest many would have non-climate benefits and many non-climate policies could have climate benefits. Moreover, as outlined in other chapters of this report, with a few exceptions, they would have only a very small impact on national economic growth.

One answer may lie in the complex nature of the policy making processes – both for climate change policy, and even more importantly, in other areas at the national and sub-national level, and by the private sector and members of civil society. We note for example 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). Conversely, some of the most significant increases in emissions have been the result of non-climate policy priorities which have overwhelmed climate mitigation efforts (e.g., decisions in Canada to exploit the tar sands reserves, in Brazil to clear forests for agriculture, and in the US to promote coal powered electricity generation to enhance energy security). Assessing how these mega-decisions are made and how they can be joined with climate change policies is the topic of chapter 12 and may be crucial to the future.

Another answer may be linked to the over-riding drive by all governments (reflecting both corporate and individual desires) for cheap and secure energy and for economic growth, to the competitive nature of the global economy and the perception that any step, however modest, will disadvantage some special interest. Finding a way to make a few losers into winners may be a key to accelerating the pace of policy implementation. Perhaps most importantly, finding ways to eliminate the climate of 'fear' that prevents actions (or more aggressive actions) and to promote a climate of 'opportunity' may be crucial to moving beyond modest steps. In this respect, better estimates of the benefits of climate policies in terms of market and no-market terms, as well as ethical terms, may enable governments to make informed decisions.

From the literature reviewed in this chapter, it is clear that governments, companies and civil society have been actively grappling with these questions. The very diversity of the policy mix, the activism of non-governmental organizations, and the wealth of modelling, research and analysis (even if, to date yielding only modest changes in emissions), collectively offer a framework for taking additional steps.

New research might further examine why some policies have succeeded – and why others have not. Potential future agreements can take advantage of this learning to encourage economically prudent and politically feasible actions. As this chapter and others have noted, we have the technology and the policy tools to take a significant first step in addressing climate change; understanding how to accelerate their adoption may be the most important research topic for the immediate future.

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