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EVOLUTION OF MITIGATION COMMITMENTS: SOME KEY ISSUES

OECD and IEA Information Paper

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FOREWORD

The OECD and IEA Secretariats prepared this document in May 2003 at the request of the Annex I Expert Group on the United Nations Framework Convention on Climate Change. The Annex I Expert Group oversees development of analytical papers for the purpose of providing useful and timely input to the climate change negotiations. These papers may also be useful to national policy makers and other decision-makers. In a collaborative effort, authors work with the Annex I Expert Group to develop these papers. However, the papers do not necessarily represent the views of the OECD or the IEA, nor are they intended to prejudge the views of countries participating in the Annex I Expert Group. Rather, they are Secretariat information papers intended to inform Member countries, as well as the UNFCCC audience.

The Annex I Parties or countries referred to in this document refer to those listed in Annex I to the UNFCCC (as amended at the 3rd Conference of the Parties in December 1997): Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, the European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America. Korea and Mexico, as new OECD member countries, also participate in the Annex I Expert Group. Where this document refers to "countries" or "governments" it is also intended to include "regional economic organisations", if appropriate.

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OECD and IEA information papers for the Annex I Expert Group on the UNFCCC can be downloaded from: http://www.oecd.org/env/cc/

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1. Introduction

The successes of the Bonn and Marrakech meetings of the Conference of the Parties to the UNFCCC open the door to the ratification process by most industrialised country Parties and, presumably, to entry-into-force of the Kyoto Protocol. While implementation of the Kyoto Protocol will still require attention and effort from both national administrations and the international community, the focus of attention will increasingly begin to turn to the longer-term picture. It is clear that adaptation to climate change as well as wider issues of sustainable development are of increasing importance in the climate debate. This paper, however, focuses largely on issues of mitigation

Under any scenario, the Kyoto Protocol would only be a first step towards the ultimate objective of the Convention. Further progress will require significant reductions in net global emissions in the medium term (i.e. 2030 - 2050 timeframe) to avoid significantly higher levels of greenhouse gas concentrations in the atmosphere. Given this objective a broader participation of countries in future international action to address climate change will be needed to limit global emissions to acceptable levels.

Thus, one of the key issues of any new negotiations will be: how can we cover all, or nearly all, world emissions, including all significant emitting countries? Procedurally, there could be a number of possible outcomes from such negotiations. For example, the Parties could decide on an amendment to the Kyoto Protocol – both to cover subsequent periods and to widen participation in commitments. Alternatively, a new agreement might be adopted in the context of the UNFCCC. Finally, agreements might be undertaken outside of the UNFCCC framework – either bilaterally or regionally. Agreements, either under the UNFCCC or outside its framework, could be between a smaller number of countries around the world, limiting the agreement to only the major emitters.

When should these negotiations start? If one uses the Kyoto Protocol as the context for discussion, a reference may be found in Article 3.9. The COP/MOP "*shall initiate the consideration of such commitments at least seven years before the end of the first commitment period*". While Article 3.9 focuses on Annex I commitments only, another reference, found in Article 9, designates the second session of the COP acting as the Meeting of the Parties to the Protocol as the forum for undertaking a more general review of the Protocol. In fact, a number of lines of evidence would even support concluding the negotiations before the beginning of the first commitment period:

- One of the important compliance mechanisms under the Protocol is the restoration of excess emissions in the first period during the following period. This restoration process could be made meaningless if the commitments for the second period were not adopted before the first period starts, since countries may try to integrate possible failure to comply during the first period into their assigned amounts of the second.

- Agreement on commitments for the second period before the start of the first period would allow countries and companies to make full use of the banking provisions of the Protocol.

- The stringency of the second commitment period might influence the level of actions taken during the first period. For example, Parties might fear that the international carbon price that will result from achieving the Kyoto Protocol in the absence of the United States might be "too low" to trigger sufficient technical change to lower future abatement costs. A more "stringent" second commitment period could provide information to investors prompting them to shift investment patterns so as to achieve more reductions in the first phase and avoid stranded costs when making long term investment decisions. This would smooth the abatement pathway and help reduce costs.

If international deliberations or negotiations on the enlargement of the climate regime are undertaken outside the Protocol there are less well agreed guidelines on how to proceed and it might be difficult to build on or use the emerging institutions under the Protocol. However, the rapidly increasing trends in global emissions, and the lag-time inherent in changing such trends, argue for beginning discussions soon.

Whenever and however next steps take place, they will be politically complex and will need time. Negotiating the Kyoto Protocol took three and a half years from the adoption of the Berlin Mandate. The Marrakech Accords required three more years. A new regime would arguably take at least as long to build. To be successfully achieved by 2008 (e.g., if under the Protocol), or in a fashion that allows medium term reductions at all, even if negotiated outside the parameters of the Protocol – they would need a strong start very soon. This information paper, and analyses underway within the IEA and OECD, can provide some basis for preliminary discussions at informal, technical and formal levels. This paper outlines some of the main dimensions of concerns and objectives that will need to be considered in shaping next steps to limit global GHG emissions, and reviews a number of options for the future.

2. The broad, long term picture

The IPCC Third Assessment Report makes clear that most of the warming of the past 50 years is likely to be the result of human activities. The report projects that global temperature and sea level are projected to rise under all scenarios. Although uncertainties remain as to the strength and timing of climate change, all countries agree that remaining uncertainties should not prevent us from taking action. There is, however no consensus on the level, scope and timing of appropriate action. Decisions on long term emission pathways are unlikely if not impossible given today's knowledge, but conversely, countries recognise that insufficient action could lock-in irreversible environmental change. A key question is how to keep open options to significantly limit climate change in this century -- in other words, how to manage the risk of climate change in the context of significant uncertainties, in a manner that is consistent with broader social and economic welfare and sustainable development objectives.

As the IPCC (2001d) put it: *"Decision making has to deal with uncertainties including the risk of non-linear and/or irreversible changes and entails balancing the risks of either insufficient or excessive action, and involves careful consideration of the consequences (both environmental and economic), their likelihood, and society's attitude towards risk."*

2.1 Climate change damage and policy costs, risks and uncertainties

The long-term objective of the Convention is to stabilise greenhouse gas atmospheric concentrations at a level that would *"prevent dangerous anthropogenic interference with the climate system"*. Such a level *"should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.*"

CO_2 is the most important man-made, long-lived greenhouse gas. It originates mainly from fossil fuel burning, which provides more than three-quarters of world primary energy. Stabilising CO_2 concentrations in the long term will ultimately require near elimination of emissions. More importantly, the emission pathway to be followed in the next few decades will determine the level of stabilised CO_2 concentrations.

The level and timing of emissions (or alternatively levels of mitigation) will also drive all related climate costs: the level of climate change and associated damage costs, adaptation costs and mitigation costs. The literature on climate policy explores in some depth the link between mitigation costs and different levels of long term emissions and mitigation strategies, often using concentration targets as a proxy for long term objectives. Yet the links between climate change impacts, damage and adaptation costs and different global emission levels appear to be less developed in the literature and thus less well-understood in policy communities. These links concern the nature and level of climate change associated with one level of emissions or another.

Climate change and future impacts are characterised by uncertain and complex relationships between natural, socio-economic and technological systems.[1] An assessment of impacts combines assessment across uncertain and complex relationships and across enormous spatial and temporal scales of climate change. This "complex system" defies the straightforward use of conventional policy assessment tools -- such as economic forecasting and cost-benefit or cost-effectiveness assessment -- to define economically "optimal" targets or emission pathways (Corfee Morlot 2002; Schneider et al. 2000; Costanza 2000).

An example may demonstrate this point. Suppose we consider the implications of leaving open the option to achieve 450 ppm CO_2 in the 2100 timeframe. According to the IPCC, this could require limiting peak emissions to about 10 Gt C no later than 2015 (IPCC 2001d; see Table 1). However, the IPCC suggests that peaking at this level, and then rapidly reducing emissions might be substantially costlier than seeking levels that would allow concentrations to rise to 550 ppm. As a policy matter, governments may not choose to pay the price for the additional mitigation, arguing that the costs of such additional mitigation may outweigh its benefits to society, particularly in the short and medium term. However, by not choosing more stringent mitigation, there is a risk of imposing significant environmental and socio-economic damages, as well as adaptation costs, upon society and future generations to come. Yet the specific nature of the trade-offs of going from one level of mitigation to another in coming decades remain highly uncertain at the global level, and are even more uncertain at the regional level.

Table 1. Level and timing of required global emission reductions

WRE CO2 Stabilisation profiles (ppmv)	Accumulated CO2 emissions 2001 to 2100 (Gt C)	Year in which global emissions peak	Year in which global emissions fall below 1990 level
450	365 – 735	2005 – 2015	<2000 – 2040
550	590 – 1135	2020 – 2030	2030 – 2100
650	735 – 1370	2030 – 2045	2055 – 2145
750	820 – 1500	2040 – 2060	2080 – 2180
1000	905 – 1620	2065 – 2090	2135 – 2270

Source: IPCC (2001d)

On the damage and adaptation cost side, an uneven distribution of climate change costs stems from different levels of economic development and vulnerability to climate change. That is, people in poorer regions are less likely to be able to adapt effectively and efficiently to climate change. The regional specificity of vulnerability to climate change, combined with uncertainty in climate models at that spatial

[1] For example, we do not know the planet's climate sensitivity: would a doubling of pre-industrial CO_2 concentrations be associated with an equilibrium temperature change of 1,5°C or 4,5°C? Any intermediate value is as likely, according to the IPCC. The key links in tracing changes in emissions to changes in impacts must be carried out by looking at how emission changes drive concentrations, how concentrations drive radiative forcing, on to main climate change indicators and then impacts assessments. Each of these "assessment" steps is characterised by different forms of uncertainty.

scale, makes it difficult to characterise the "benefits" of mitigation policy and challenges conventional economic assessment and aggregation of such benefits (IPCC 2001d).

On mitigation costs, some economists have suggested that even the most pessimistic estimates of costs associated with stringent abatement would represent only a small share of GDP (approximately 1% over the long term) (Azar and Schneider 2002). As an example, Azar and Schneider write that stabilising CO_2 concentrations at 350 ppm could cost US$ 18 trillion over this century (discounted 1990 dollars). Although this cost looks enormous by comparison to the world domestic product in 1990 of 20 trillion dollars, it would still only represent a few percent each year of a rapidly growing world product. They conclude that "*…the cost of climate insurance amounts to 'only' a couple of years delay in achieving very impressive growth in per capita income levels.*"

A key question is whether such an argument will *"increase the acceptability and willingness amongst politicians to adopt much stricter abatement policies than is currently considered politically feasible"* (Azar and Schneider, 2002). A number of reasons suggest that such an argument will not succeed. First, it has been pointed out that such studies do not take into account the potential costs of inefficient climate change policies. Second, point estimates made by such studies may contain other large uncertainties. Third, aggregate mitigation cost estimates are only one of many important drivers of policy decisions. Another driver is the uneven distribution of costs, across time as well as among countries and within countries among industrial sectors and consumers of energy. A particular concern, for example, is how to minimise the economic impact on the fossil energy and energy-intensive industries, most of which would stand to "lose" from aggressive mitigation policies[2]. Finally, these costs might not fully reflect problems of availability of low cost energy to stimulate economic growth, a concern that could further limit the acceptance of stringent agreements by developing countries.

On both the mitigation and the adaptation cost sides, clearly short-term adjustment costs exist and they raise important and quite different political and social issues, depending on national circumstances. All these issues should influence policy decisions in addition to the aggregate costs of mitigation.

Despite the difficulty of assessment over long time frames, an important objective of international policy decisions is to effectively limit the long-term risk of climate change and the associated adaptation and damage costs. One suggestion that has attracted attention is that of "safe levels" (Azar and Rodhe, 1997): should we aim at defining global emission paths compatible with "safe levels" of GHG concentrations – that is, levels that would not entail overly damaging climate change consequences? Defining such levels remains a difficult, if not impossible, task given the numerous uncertainties and differences in viewpoints. In addition to difficulty of foreseeing complex trade-offs among mitigation, damage and adaptation costs, differences in viewpoints makes the task of defining what is "safe" value-laden. We are not even sure that current GHG concentrations could be considered "safe" since we know they are sufficient to drive some climate change – which may already be affecting ecosystems (see, e.g., Parmesan & Yohe, 2003).

For these reasons, it is unlikely that agreement could be reached soon in the context of the formal negotiations on a particular concentration level as a stabilisation target, or on a specific timetable for global emission ceilings. There are also a number of good reasons for not fixing strict emission targets

[2] It might be noted that not all fossil fuels emit the same quantity of greenhouse gases per unit of energy delivered; the ratio of coal:oil:gas is approximately 4:3:2. Furthermore, because of the currently known reserves of the three fuels, it appears likely that the majority of the world oil supply would be consumed prior to the implementation of strict climate policies that would phase out its use. These facts, taken in conjunction with the known environmental advantages of gas suggest that the fuel most significantly impacted will be coal. It is in part for this reason that the coal industry (along with other fossil fuel industries) is aggressively supporting new research to promote the capture and storage of emissions. See Pershing (2000) and IEA Greenhouse Gas R&D Program (2001) for further details.

prematurely. In the short run, fixed emission targets, if set at too stringent a level in the context of uncertain costs, could have adverse economic consequences, as will be further discussed below. Concerns about possibly (too) high costs could prevent the timely emergence of an effective mitigation regime. Further, as new information becomes available on climate change risks and mitigation costs, views will change about acceptable levels of climate change and mitigation.

One alternative is to consider whether, in the absence of firm targets based on long-term concentration targets, there may be a role for the use of indicative targets to provide useful guidance for the negotiations on medium term mitigation commitments (Corfee Morlot, 2002). Such an approach could set out upper bounds for both global emission levels and for cumulative emissions in the coming decades that would leave open multiple options for the long term. An alternative way of leaving long-term options open could be to define appropriate dates for global emissions to reach a peak level or to return to, say, 1990 levels. In both cases, the discussion would likely deal with some "mid-term" objectives – sufficiently far ahead to make a real difference with business-as-usual trends, but sufficiently near-term to consider the concrete implications for technologies, costs, economic and social consequences of climate change. Another variation of these approaches might be to set a relatively stringent indicative concentration target, but to use a price cap or dynamic targets to limit the costs that might be incurred in meeting such a target to a politically acceptable level (see IEA, 2002a). Various mechanisms, such as dynamic targets or a price cap (discussed below), might be employed in setting and meeting these goals while alleviating concerns about remaining cost uncertainty.

However, reaching an agreement on any of these options could be difficult, in part because governments have short-term horizons. Negotiations over long-term, or even medium-term targets, in contrast to those relating to specific near-term actions, will primarily involve different perceptions of risk, to which countries bring markedly different values and assumptions – and impacts indeed will likely differ among countries and regions.

In the absence of consensus about risks, it is quite possible that the international effort may need to proceed along lines of the current status quo. That is, given that current net emissions are known to be too high, emissions reductions associated with current agreements are known to be inadequate to stabilise greenhouse gas concentrations (ultimately stabilising atmospheric concentrations will require reducing emissions 80% or more from current levels[3]). Thus, incremental agreements, iterating on the combined political and economic acceptability of interim steps, will be used to gradually approach the levels of reductions required.

Any combination of the issues outlined above could drive the development of negotiations on the form, timing and level of future mitigation commitments. They include not only differing perceptions of risk but also perceptions of the costs stemming from climate change and from climate change policies. Even with the best of intentions, uncertainty in our understanding of the natural system that drives atmospheric change, and of the socio-economic system that determines emission levels and policy costs, could lead to unexpected outcomes. Unexpected outcomes could, for example, come in the form of missed targets or costs that vary significantly from projections. No matter what the nature of policy decisions on future commitments, there will be a need to monitor progress, assess experience and readjust policies from time to time.

Despite all the difficulties related to setting medium and long term targets, scientific work assessing long term climate change and links to various development pathways, provides very valuable information to the negotiations and should continue to inform the negotiating process. For example, such analysis has shown

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[3] Reductions required may be less should technologies (such as, e.g., energy production from biomass with CO_2 capture and storage) capable of pumping carbon dioxide out of the atmosphere be developed.

that even if Annex-I countries were to suppress all their emissions, increases from the rest of the world would be sufficient to prevent stabilisation of concentrations at any level, and that the participation of all major emitting countries is essential to achieve stabilisation goals. This type of analysis can provide guidance on where constraints lie for future negotiations on new mitigation commitments.

2.2 Inducing technical change and shaping the future

A primary effect of near-term emission limitation commitments is to send signals to the market and to establish a price on greenhouse gases that will stimulate technical and behavioural change. Such pricing will advance the development of new technologies and provide firms and consumers with information to take into account carbon costs in day-to-day decisions – though other policy means could also have similar effects (as discussed in section 3 below). Over time, the cumulative effect of these developments would bend the path of global emissions downward and could bring the ambitious objective of the Convention into reach.

The timing of mitigation policy as well as the level of action may be a key issue for technology change. This is because the long lifetimes of technologies means that there is a risk that investments in technology or processes today will lock society into high emission futures for the coming decades – or even longer. This is especially important in the transport and power sectors, where public infrastructure and planning policies also play an important role, such as highways for road transport and electricity production, transmission and distribution. Infrastructure investments often have some of the longest lifetimes, reaching 50 or more years. Conversely, overly aggressive mitigation policies in the near-term could force immature, or even inappropriate, technologies into the market at excessive prices.

“Learning-by-doing” is an important dimension of this debate. Most new technologies exhibit a “learning rate” – a cost reduction factor associated with expansion of markets IEA, 2000a. An argument has been made that deferring action might be less expensive; that is, over time, research and development policies will lead to the emergence of new technologies in the future at lower cost (see Wigley, Richels and Edmonds, 1996). Lessons from past technical developments suggest that research and development may not be optimal and, acting alone, these policies would not suffice to bring new technologies into markets. For instance, a recent IEA alternative scenario shows that even with fairly rapid technological progress, emissions continue to rise over the next 30 years (IEA, 2002c). There seems to be a need for technology deployment in niche or subsidised markets to bring costs down and to allow new technologies to reach competitiveness (IEA, 2002a). This view calls for early policy action to stimulate change such that low-emission technologies will be commercially available in the coming decades to begin to limit and shift downward global emissions.

The role of technology change also relates to the breadth of participation in GHG mitigation commitments. Some argue that the absence of a large segment of the global community from emissions targets will not critically affect the development of such technologies. According to this view, a substantial share of the technology development occurs in Annex I (industrialised) countries, and is diffused to the rest of the world over time. Thus, as long as industrialised countries have suitable incentives to act, global emissions will ultimately move in the right direction[4]. These incentives are presumably in the form of domestic policies to limit emissions and stimulate low-emission technologies. Under such a view, international co-operation and policy action is also needed to accelerate the transfer and diffusion of new technologies to developing countries. Development and technology co-operation programs, public-private partnerships and host country efforts to remove barriers to diffusion are all relevant.

[4] For example, Grubb et al. (2002) suggest that spillover effects from the Kyoto Protocol, although they include notably leakage as well as technology diffusion, will, in aggregate, be important and environmentally beneficial.

Conversely, others argue that competitiveness concerns, the growing share of investment that occurs in the South and a concomitant lock-in to potentially "bad" technologies once these investments have been made requires broader participation in mitigation from the outset. Further there may be a need to develop specific technologies, appropriate to specific national circumstances. In this view, all (or at least all major emitting) countries would need to co-operate to control emissions and collectively stimulate new technology development. This perspective brings somewhat different obligations for support. It assumes that internal investment provides the majority of the funding required to build infrastructure, and additional foreign direct investment is promoted by opening markets to international trade and removing tariff barriers to the exports of goods and services. Some capacity building programs may be needed and could be supported by development assistance or financial transfers under the Convention. One focus for inducing technological change would thus be the adoption of national targets in all countries where they would promote technology development and diffusion.

Clearly, in both cases, specific policies that might be adopted to motivate technology development and behavioural change need not be limited to the negotiation and agreement of emissions caps under the UNFCCC. For example, national policies, such as taxes and other economic instruments, provide incentives for dynamic efficiency, and for ongoing investment in clean technologies. R&D – and various supports to it – are also a potential tool to induce change – including through partnerships with the private sector. Other measures could also be part of the mix, for example voluntary measures, or standards.

In addition, bilateral and regional co-operation on climate change, beyond the formal UNFCCC process, can play an important role in technology transfer, particularly for developing countries. Such co-operation might enhance financial resources, technical expertise, education and training related to technology transfer. Co-operative arrangements may also be developed under the auspices of existing bilateral initiatives, as well as under wider international (although not global) technology initiatives (such as the IEA implementing agreements)[5].

Whichever policy tools or forms of commitments are chosen, there is a broad consensus on the need to implement policies at a level consistent with the global, long-term objective reflected in Article 2 of the Convention, thus taking into account the magnitude of the transition required. In this context, it may be important to connect climate to other (often more pressing) policy objectives of governments. In OECD countries, this may be principally other environmental problems such as urban air quality or energy security or national security interests (OECD, 2002a and 2002b; IEA 2002a). In developing countries, these interests may also include more fundamental links to economic development strategies, such as poverty reduction, human health and access to vital energy services such as those that electricity can provide (Beg et al., 2002). In this way, shifts in technology pathways would serve multiple sustainability objectives rather than those driven principally by climate change concerns.

2.3 Institutional and social change

Countries' abilities to fairly negotiate and successfully implement different forms of mitigation commitments are another important consideration in the design of the climate regime. Institutional and human capacity is required for any nation or group of nations to analyse and negotiate international climate

[5] The IEA's "implementing agreements" (IAs) consist in more than 40 international collaborative energy research, development and demonstration projects. Gathering various sets of Member and non-Member countries, 15 IAs cover the energy end-use technologies, 9 IAs cover the renewable energy technologies (including one IA on hydrogen), 8 IAs cover the nuclear fusion technologies, 5 IAs cover the fossil fuels technologies (including clean coal and CO_2 capture and storage) and 4 IAs are devoted to the dissemination of information. For more information see the IEA website: www.iea.org.

policies from the perspective of their broad social and political interests. Institutional capabilities will also be required to estimate and track emissions with accuracy at different levels of mitigation activity (e.g. at the project-, legal entity- or national-level) as well as to develop, implement and enforce national abatement policies that are consistent with international obligations.

Institutional and social change, including the formation of individual and collective views or values with respect to climate change, takes time and requires learning at the firm, community and individual level (Corfee Morlot, 2002; Gardner and Stern, 1996). The public sector has an important role to play as do non-governmental or community-based organisations. Policy can assist such learning, but it is also facilitated by other factors that may not be directly related to policy, such as “crisis” situations or cultural biases. The wide range of human values influencing climate policy points to the importance of the processes that lead to value formation and social change over time (Toth et al, 2001, Azar, 1998; Rayner and Malone, 1998). Human experience and individual engagement is key. Over time, non-governmental associations or religious organisations may play a role (Gardner and Stern, 1996; USCCB, 2001).

Social change and acceptance may also need to accompany technological change, especially if it is to move quickly, which would imply changes in human preferences and values. Inevitably, the time required for social change is not reflected in empirically based studies. For example, most stabilisation scenarios imply a transition to a largely fossil-fuel free world over the next fifty years. Consideration of the magnitude of social change embedded in such a transition is likely to drive a conclusion that near term mitigation policies are required to jump-start necessary social learning (Toth et al., 2001).

Leaving climate policy strictly in the domain of international negotiators or even national policy-makers makes it difficult to connect key issues to the daily lives of people (Rayner, 2001). Yet this is exactly the case today in most non-OECD (and even some of the OECD) countries. In countries with economies in transition and in developing countries a main problem is that climate change is simply not on the policy agenda nor is it something that the average person relates to. Instead it is in the hands of a few negotiators who have the power to negotiate but may not have the power to influence change at a national or more local level once negotiations have concluded.

One approach to building support for climate policy is to link it to community, local and regional policy issues (Taenzler and Carius, 2002). This will make it easier to build understanding about the need for change and to influence consumers and firm-level decisions. Working both from the bottom up at the community level, and from the top down at the international level, may build a stronger basis for national and international policy (Toth et al., 2001; Gardner & Stern, 1996).

A key climate policy goal may be to promote the ability for society to cope with the types of rapid change that responding to climate change may require. This concept is embodied in discussion about “coping” strategies or means to extend social resilience (Rayner, 2001; Banuri & Weyant, 2001). The nature of the challenge is likely to differ significantly among countries and groups of countries. For example, OECD country governments would have the option to use well-developed systems of local and regional governmental institutions as well as non-governmental networks to raise awareness and support for the necessary change. Even if action does not come from government itself, “watchdog” consumer or environmental groups in civil society may bring it about (Corfee Morlot, 1998). In many countries with economies in transition, such governmental and non-governmental institutions are much weaker, lacking information and on-going resources to bring about change (Willems, 2001). Though not well studied, a similar “capacity” problem is likely to also exist in developing countries and will need to be addressed in the design of future commitments.

As part of the design of next steps under the Convention, consideration is needed of information and resources that would be required for countries to fully participate in negotiations as well as to comply with the different aspects of alternative mitigation climate commitments. The need for such work is greatest in developing countries. These requirements are likely to be different from country to country, depending on the strength of their institutional, legal and resource base. Such an institutional perspective may also provide insights in terms of what forms of commitments are most appropriate. Such an analysis might thus facilitate the negotiation and adoption of commitments that have a better chance to be implemented and will prove to be more robust in the longer term.

In the longer term, it is also important to define ways to strengthen national institutional capacities as well as to educate, stimulate debate and raise awareness about climate change among citizens, business and community leaders about climate change. An aim of new commitments should therefore also be to generate a better ability to cope with climate change at the regional, national and local level in different countries.

3. Near term commitments

While long-term or medium term objectives may guide action, near term commitments – those directly post-2012 – will determine how emission trends evolve over the coming decades. Key questions include: What is required to broaden the geographical coverage as well as to deepen the level of mitigation achieved? And, what form might future, internationally negotiated agreements take?

While not fully comprehensive, this section outlines a variety of possible forms for future mitigation commitments, including quantified and non-quantified objectives. Each of these options can be implemented at various levels of stringency. However, the potential for some options to facilitate the adoption of relatively more stringent commitments than other options is considered as well. As part of this consideration, the analysis considers how the design of future commitments may promote a gradual increase in reductions (both through increased stringency and wider participation) over time. .

3.1 Various forms of quantified objectives

Quantitative commitments offer the possibility to reconcile cost-effectiveness and equity in allocating assigned amounts.

While negotiating processes that are fair and open with broad participation should yield an equitable outcome (according to the concept of procedural equity), there is no reason such an outcome would necessarily be cost-effective. It is likely that the willingness and ability to pay varies widely among countries and, for a variety of reasons, may be lowest where abatement costs are also low – i.e. the developing countries. On the other hand, if there were a cost-effective allocation scheme, a large part of emission reductions would occur in countries where marginal abatement costs are lower. Even if emission “reductions” might mean here “below baseline” and not “below current levels”, an acceptable allocation for most developing countries is likely to differ substantially from the most cost-effective one.

Emissions trading, however, could redirect abatement efforts where they cost less, regardless of the cost-effectiveness of the initial allocation of emission allowances. Thus emission trading could help to ensure cost-effective outcomes even when, for equity reasons, allocation of emission allowances does not.

3.1.1 Fixed targets

There is a long tradition of negotiating fixed, absolute targets in the framework of international environmental agreements. In the climate change context, fixed targets have also proven negotiable, at least for the subset of countries that have accepted such commitments in the first commitment period of the Kyoto Protocol. Although fixed targets may be negotiated in many different ways, the familiarity of the international community with this form of commitment may be an important advantage in the discussion on future commitments, as it may help build confidence among participants. In addition, fixed targets provide a relatively simple form of quantitative objective to negotiate as well as to implement, in particular when combined with emission trading at domestic level. They provide “certainty” on emission levels, provided they are fully implemented and are complied with.

However, certainty about environmental performance may or may not be the priority at a particular time or for a particular country or group of countries. Rather, countries may be more interested in trade-offs between certainty about environmental performance and certainty about the costs of mitigation – the latter of which can limit the acceptance of fixed targets. When abatement costs are uncertain, quantitative instruments (such as fixed targets) offer certainty on emission levels while leaving uncertain the marginal and total costs of abatement. Conversely, price instruments offer certainty on marginal costs while leaving uncertain the level of actual emissions.

In the case of climate change, it has been argued that uncertainty on short-term emission levels should be preferred over uncertainty on abatement costs (see Newell & Pizer, 2000; IEA, 2002a). This arises from the "stock" nature of the greenhouse effect: climate change damages result from the slow, long-term build-up of GHG atmospheric concentrations, while abatement costs are linked to near-term efforts. As a consequence, marginal policy benefits are expected to grow at a slower pace than abatement costs in any short period. Thus, fixed quantitative instruments entail the risk that, at the margin, too large a price would be paid for too small an incremental environmental benefit.

The rest of section 3.1 investigates whether other forms of quantity-based instruments may be able to reduce cost uncertainty and could thus help countries adopt more ambitious targets – dynamic targets (for all countries), the price cap (for developed countries) and non-binding targets (for developing ones).

3.1.2 Dynamic targets

Dynamic targets are indexed according to an agreed variable, for example on the actual economic growth. In other words, using this example, assigned amounts would be adopted in advance and based on some expectation relative to GDP growth. Then, if the economic growth were more or less than expected, these assigned amounts would be revised upward or downward. Dynamic targets could, in principle, be an option for both developed and developing countries, since they allow for full differentiation – either through varying assigned amounts or indexation formulas.

So-called "intensity targets" (defined as a ratio of greenhouse gas emissions to GDP) represent a particular form of dynamic targets. However, the indexation of assigned amounts could take various forms, and other variables (e.g., population, exports, energy consumption, etc.) could also enter the picture and take into account, e.g., the role of agriculture in non-CO_2 GHG or the carbon intensity of energy consumption.

Concerns have been voiced that dynamic targets could lead to absolute increases in emissions in the case of very strong economic growth (Müller et al., 2002, Moor et al., 2002). These authors thus recommend allowing dynamic targets for developing countries only. However, everything rests here on the stringency of the targets – as is the case with fixed, Kyoto-like targets.

Clearly, the economic attractiveness of dynamic targets arises from the fact that they allow higher emissions in cases of higher economic growth (which itself drives higher than expected marginal abatement costs). Thus, there may still be an environmental benefit to using a dynamic approach: the decrease in uncertainty regarding cost may allow the adoption of relatively more stringent targets than under a fixed target regime.

The case is clearest for the situation of economic growth. In this case, dynamic targets would allow emissions to increase, essentially keeping the level of effort needed to achieve compliance relatively constant. This is in sharp contrast to the situation of fixed targets, where the cost of abatement would increase with the quantity of abatement required. In fact, the supplementary costs incurred in case of higher-than-expected growth under a fixed targets system are likely to be much more than costs saved in case of lower-than-expected growth. Thus, not only cost uncertainty, but more broadly, expected costs[6],

[6] An expected cost is the average of all possible cost outcomes arising from any investment (or policy) weighted by their probability of occurrence, before uncertainty is resolved.

will likely be reduced with dynamic targets. Given lower expected costs, countries might be willing to adopt relatively more stringent targets. The environment benefits are clear under this scenario: if the economy grows at the rate expected, the more stringent targets lead to lower emissions. If the economy grows at a rate higher than expected, emissions will still be reduced – and compliance may be more likely because the certainty of costs is higher.

However, countries facing lower than expected growth or, worse, recession, could be penalised by pure intensity targets. Two primary factors influence such an outcome. First, GHG emissions may not be strongly correlated to economic growth: a slowing economy may not immediately lead to slowing emissions. Thus, as basic energy needs are not proportional to GDP, and capital stock turnover slows, baseline carbon intensity of the economy may grow, increasing the costs of achieving compliance. Also, countries might find it difficult to face even low costs of abatement when economic conditions deteriorate. However, there may be solutions to the case of declining growth that still make use of the dynamic target structure. One solution is to apply a "less-than-directly-proportionate" indexation of assigned amounts on economic growth. Ellerman and Wing (2003) suggest that a more general and flexible emissions cap that combines the effects of both fixed and intensity targets may be most appropriate. The degree of indexing, or the relative weights of the two opposite forms, can take any value between zero (pure fixed targets) and one (pure intensity targets).

Divergent views have also been expressed on the compatibility of dynamic targets with emissions trading. Some have argued that uncertain assigned amounts could make trading more difficult (e.g., Moor, 2002). Others (e.g., Philibert & Pershing, 2001) have suggested that dynamic targets would keep assigned amounts closer to emission trends. This would likely reduce the gap between emissions and assigned amounts (be it a sellable surplus or a deficit to cover) and the associated uncertainty. Thus, trading would be made easier, not more difficult, although the size of the market would presumably be smaller.

Finally, another difficulty arises from measuring GDP and growth rates (or other variables used in the indexation formula). In developing countries in particular, such measurement is often difficult and sometimes controversial.

3.1.3 The Price Cap

Another option is to introduce a "price cap". This could take the form of making supplementary permits available in unlimited quantity at a fixed price – at country level (for domestic entities) or at the international level (for countries).

With a price cap, all emission abatement needed to achieve the quantitative commitments would be undertaken as long as the marginal cost of abatement is lower than some agreed price. If abatement costs reach this price, then economic agents and/or countries would be able to cover excess emissions with supplementary permits at the agreed fixed price.

Concerns have been raised that a price cap could undermine the environmental "integrity" of any agreement. However, the amount of actual abatement in any near term period must be a function of abatement costs. Given the uncertainty in these costs, countries may legitimately choose to adjust the level of abatement as a function of actual costs with a price cap[7]. If abatement costs remain high this will lead to higher concentration levels – as a cost benefit analyses would have justified were actual costs known in advance.

[7] It might be noted that such a case would mimic the effect of a carbon tax – which automatically adjusts abatement to match costs (see the discussion on carbon taxes in section 3.2.3 below)

A single international price is necessary for unrestricted global trading. However, trading might still be possible, albeit under more constrained circumstances, if prices vary across countries. One solution to ensuring the integrity of the system is that net sellers do not make “use” of the price cap (i.e. their actual emissions remain below their assigned amounts). Thus, no Party or entity would “resell” supplementary permits.

However, even in this case, the economic efficiency of the global regime might be reduced if too many different price cap levels were instituted. Suppose a Party with a low level price cap cannot fulfil its obligations, and uses supplementary permits. Even if there are abatement options at a cost only slightly higher than its price cap level, these will be unavailable to another country once the restriction on selling permits is imposed (Philibert & Criqui, 2003).

It is clear that negotiating a common price cap could be a contentious task – perhaps equally difficult to negotiating a quantity target. However, the fact that willingness-to-pay likely differs from one country to another does not necessarily mean agreement on a single price (particularly between comparable countries) is impossible. For example, given that the total costs incurred will be a function of both price and assigned amounts, differentiation of assigned amounts may provide sufficient flexibility to negotiate an agreed price. Moreover, given that one of major constraints against negotiating a quantity target has been the uncertainty in the cost that might be incurred, the price cap approach could allow an outcome at a more environmentally effective level.

While dynamic targets might help deal with cost uncertainty driven by economic growth and other factors, price caps might help deal more broadly with abatement cost uncertainty. In particular, price caps could also accommodate uncertainties in future technology developments and relative energy prices.

3.1.4 Non-binding targets

Non-binding targets offer another way to reduce cost uncertainty. They may take a form similar to that adopted in the UNFCCC, where Annex I Parties were to “aim” to return emissions to 1990 levels – but where there were no penalties for exceeding the goal. This option is essentially similar to the price cap option, in which the price is set to zero. By alleviating cost concerns it may allow adopting relatively more stringent targets. This may help eliminate or reduce the risk (and the need) to allocate some excess allowances to countries willing to take on new commitments.

Non-binding targets may also provide – though emissions trading – an incentive for emission reductions, where sales could occur if (and only if) actual emissions are less than the targets (Philibert, 2000). The option may be particularly attractive for some developing countries. However, the existence of such an incentive requires that other countries be potential buyers, that is, be bound by firm targets.

There are different ways to ensure that countries only sell emission allowances that exceed the coverage of their actual emissions. The most attractive may be to make countries responsible for buying back any selling beyond what they have left at the end of the commitment period (Philibert & Pershing, 2001). A commitment period reserve similar to that instituted by the Marrakech Accords would also limit the possible size of inadvertent mistakes.

The primary failing of the non-binding target option lies in the limited certainty it provides on environmental benefits. As far as developing countries are concerned, however, the possible environmental benefits may be higher than with fixed, binding targets, as these are likely to be rejected, or only accepted if they provide excess allowances. Non-binding targets may thus be a better choice.

3.2 Alternatives to quantified objectives at country level

The Kyoto Protocol rests on quantified emissions limitations and reduction objectives of a fixed and binding nature. To date, most developing countries have rejected such targets as a near-term option for themselves. They also may not be the only option for future commitments by industrialised countries. We consider in turn some alternatives to quantified objectives at a country level as well as some alternative forms of quantified objectives.

3.2.1 Policies and measures

An existing obligation in the UNFCCC commits all Parties to undertake policies and measures that help mitigate climate change. A wide number of policies and measures leading to emission reductions have been undertaken in both developed and developing countries (see e.g. IEA, 2002b; Reid & Goldemberg, 1998; Biagini, 2001). Identifying specific policy requirements may be a logical extension from existing commitments.

One possible approach would be to invite developing and/or developed countries to identify a set of win-win policy reforms, according to their national circumstances (Baumert et al. 2001). These policies could become part of an international agreement. Similar policies across countries might also be adopted under new international agreements. Such policies and measures could cover various sectors and take numerous forms. Two specific forms are further considered here: technology agreements and carbon taxes.

3.2.2 Technology agreements

Stabilising greenhouse gas concentrations will ultimately require phasing in what is termed "backstop" technologies – technologies fulfilling energy and other needs while not emitting carbon dioxide or other greenhouse gases. It has thus been suggested that, as one means of promoting the development and diffusion of advanced technologies, international co-operation could focus on an agreement – or a set of agreements – promoting some of these backstop technologies (see, e.g., Edmonds and Wise, 1999).

Such agreements may themselves have different forms. They could tend to impose specific standards in some sector (e.g. power sector); more directly tend to subsidise research and development efforts; or aim at broadening existing markets for technologies such as renewable energy sources, as discussed during the World Summit on Sustainable Development. A future consideration of this option might usefully further examine certain key sectors faced with international competition for which other nationally based approaches may be less successful.

Such technology agreements could possibly build on and link together current initiatives with similar aims, such as the IEA implementing agreements, the Climate Technology Initiative, or some programmes of the Global Environment Facility.

While such agreements would certainly be useful, they face a number of hurdles if they are to be successful at achieving stabilisation at acceptable levels. Perhaps the principle concern is that of timing. There is enormous scope in the next decades for large emission reductions through technology advances (e.g., efficiency improvements, notably at end-use level and through "hundreds of technologies", according to the IPCC Third Assessment Report, IPCC, 2001c). However, the sheer volume of agreements may be impossible to negotiate if each sector and each technology requires a separate effort – and without this level of effort, the remaining policies might prove inadequate. One way to remove this hurdle would be to focus on some priority sectors, for instance, those sectors faced with international competition, for which other measures are more difficult to adopt and implement

Another concern is that of cost-effectiveness as well as of institutional "lock in." As they are inherently less comprehensive than quantity-based or market-based instruments and likely to lead to large differences in abatement costs, technology agreements would almost certainly be costlier for the same environmental results. As an example, Edmonds and Wise (1999) believe that their proposal could cost 30% more than an emissions trading scheme for similar results. Further, starting with sub-optimal (inefficient) institutions like technological agreements, could lead to a lock-in that policy-makers may find difficult to change in the future (Woerdman 2002).

However, beyond efficiency, political feasibility is another metric against which to judge technology agreements: if they can pass political muster, they may have enormous advantages over theoretically more attractive options that cannot. Also, such technology agreements may usefully complement other forms of international agreements, by helping key technologies to move more quickly through the market over a specific time frame through accelerated research, development, demonstration and dissemination.

3.2.3 Carbon taxes

Carbon taxes have been suggested as possible alternatives to the Kyoto framework. Under a commonly assessed form (e.g. Nordhaus, 2002), domestic carbon taxes could be harmonised at international level. In this case, carbon taxes would equalise the marginal cost of abatement globally and thus share with emissions trading based on quantified objectives the important feature of cost-effectiveness. As climate change is a long-term issue, cost-effectiveness also matters from an environmental perspective since, in adopting new commitments, countries will consider what costs they incurred in the former steps.

Carbon taxes offer another advantage: that of adjusting spontaneously the amount of abatement to the reality of abatement costs. While they would provide no guarantee on emission levels, they would control marginal costs – and it might be argued that, given the long term nature of climate change, this better deals with cost uncertainties (see "fixed targets" above).

Carbon taxes, however, have been politically unacceptable to some developed countries in an international context – even less so than quantified objectives. Furthermore, it seems clear that developing countries would be unwilling to adopt such an instrument. Even if revenue recycling could partially offset the costs of action, developing countries are unlikely to accept this option. If harmonised at the international level, taxes also raise concerns about sovereignty. However, taxes also meet opposition at domestic levels from various vested interests in virtually all countries.

3.2.4 Sectoral targets

Sectoral targets would be quantitative instruments of a limited scope; they focus on specific sectors, not entire countries. Sectoral targets might be a pragmatic first step towards more comprehensive action in developing countries. They could also serve to address sectors in which it is expected that national targets would not necessarily take effect – for example where there are too many economic agents to devolve obligations, such as in the transport sector.

Sectoral targets might be preferred for various reasons. A developing country, for example, might wish to complement the Clean Development Mechanism by targets in sectors not readily addressed with project activities, such as household and transport. Alternatively, sectoral targets might be adopted for industry sector(s), while leaving emissions more directly linked to consumption unregulated for various reasons (e.g. lack of monitoring, or perception of fairness). Sectoral targets might be fixed or dynamic, binding or non-binding. They may also be established in such a way as to allow emissions trading.

One key issue that has been raised as an objection to sectoral targets – as with other non-universal targets of all types – is that of leakage. Concerns have been posed both with respect to inter-country leakage (where competitors in different countries would see different policy constraints), as well as competitive consequence between sectors within the same country.

The implications of the extent of the leakage are governed by the relative stringency of the targets in the countries, as well as the forms of the targets. Thus, if a developed country undertakes a binding target, and a developing country adopts only a single-sector target, the extent of the leakage in that sector will be reduced by the level of the stringency of the sectoral target.

Unlike country-level dynamic targets (discussed above), sectoral dynamic targets for industries offer little protection against leakage. The protection provided by country-level dynamic targets is essentially based on the fact that leakage would take place for energy-intensive industries that have a higher carbon intensity than the country's economy as a whole. The increase of economic output of these industries would presumably not be sufficient to make the country-level target ineffective. This may not be true with a sectoral dynamic target, where the pertinent criteria may be the carbon intensity of the sector, not that of the whole country.

Sectoral targets could also be a natural outgrowth of the evolution of the Clean Development Mechanism (Baumert et al., 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. Effects of specific policy actions would be judged against a reference scenario – and if they could be determined to generate reductions below what would happen without the policy, and those reductions could be quantified, they could be credited. However, as with other CDM projects, there would be no obligation to act. The project developer (i.e. the country) would bear the entire onus for its programme. In essence, this builds on the "unilateral scheme" for CDM; it is also akin to a no-regrets policy, or even a non-binding target, to which it could offer a smooth transition. One advantage of such a system is that it would provide incentives for financial assistance. Countries undertaking policy action could sell a share of the reduction they yield for hard currency under an international trading regime. However, such a regime also has clear drawbacks. Accounting for emission reductions that are specifically linked to a policy action would be difficult (as can be seen in the problem of determining the effects of policies currently being taken within OECD countries).

3.3 Allocation

A number of options for the form of future commitments have been set out in the preceding discussions. It is clear that they offer fundamentally different visions of how to proceed to mitigate climate change. Options including quantitative commitments beg the question: if global levels are ascertained, how is the overall "pie" divided? While final decisions will be the outcome of a political process, one pathway to a solution may involve an agreement on principles or guidelines for assigning amounts.

While this discussion is usually designated as a "burden-sharing" exercise, there are in fact a number of different ways to frame it. Most common are approaches that prioritise either cost or resources as the primary consideration. Ultimately, costs and resources are intimately connected; any allocation of resources implies a cost, and any allocation of cost implies resource constraints.

For those supporting the resource sharing view, the atmosphere is considered to be a global common good. Assigning amounts to countries would thus be sharing the atmosphere's ability to receive limited amounts of greenhouse gases without triggering climate change. Under this "resource" view, a frequently made proposal is that equal property rights be assigned to all individuals, with a country's assigned amounts assigned proportionally to population (see, e.g., Baer et al., 2000). However, the equal per capita distribution of emission rights that might arise from a "resource-sharing" perspective could entail relatively large costs to industrialised countries depending upon how such an approach is implemented. These costs may not be limited to the direct costs of GHG emission abatement. Since any tonne emitted above the stabilisation level would need to be bought on the international market through emissions trading, such a system also implies significant resource transfers to developing countries, with only the wealthiest of developing countries taking action toward limiting emissions. In effect, such an approach could enable countries with relatively low per capita emissions to delay taking action for long periods of time – even where technologies are highly inefficient.

The "cost-sharing" view begins with the presumption that any action will entail costs – and the issue is how these costs are to be shared. Most developing countries have been historically reluctant to accept that they should "share the costs" of mitigating climate change with industrialised countries – as they argue that the latter have been responsible for the bulk of the growth in greenhouse gas concentrations. Conversely, as the highest growth rates in future emissions, and some of the largest sources of emissions are expected to come from developing countries, it has been argued that an equitable distribution should allocate obligations to all major emitters including developing countries. One approach to this problem could be to assign costs as a function of energy or GHG intensity – GHG/GDP or energy/GDP. A similar approach (using energy intensity per volume of production) with respect to energy-intensive industries was incorporated as one of the elements of the "triptych sectoral approach" that served as a basis for the EU burden-sharing agreement (Phylipsen et al., 1998).

Many proposals try to find a compromise between cost-sharing and burden sharing approaches. They combine timing and stringency in differentiating commitments for various groups of countries – often going beyond the simple distinction between "Annex-I" and "non-Annex-I" countries (see, e.g., Jacoby et al., 1999; Bartsch & Müller, 2000; Berk & den Elsen, 2001; Blanchard et al., 2001; Sijm et al., 2001. For recent reviews, see SEPA, 2002; Höhne et al., 2003). While most of these analyses only consider the option of fixed targets, they offer a number of useful ideas for shaping allocation, in particular in articulating how countries could progressively move, in the course of their economic development, to more comprehensive forms of commitments.

An alternative to either of these could be a "no-harm" rule (Edmonds et al., 1995). Under this approach, if objectives are set on the uncontrolled emission baselines for most developing countries, after "win-win" actions have been realised, additional actions would be financed by industrialised countries through international emissions trading (Philibert & Pershing, 2001). Such a rule offers one way to differentiate obligations of developed and developing nations (in the spirit of the UNFCCC), while allowing for effective action in both the developed and the developing world. This kind of solution may not be very different from the CDM policy option described above.

However, it may ultimately emerge that no allocation regime is needed at all – even if a quantitative target approach is adopted. Instead, countries may seek to develop the next iteration of their targets with respect to their individual capacities and domestic priorities – and the outcome of a negotiated agreement. In this kind of regime, the total amount would be a matter of simple mathematical calculation, constructed from the bottom up. The collective reduction would emerge as it has under Kyoto, by adding up the individual amounts pledged.

This kind of approach has several advantages. It removes the need to negotiate any allocation rule or criteria. It avoids assigning “rights” to the atmosphere or to emissions (a concern repeatedly voiced by India and others during the negotiations), and it builds from reality instead of hypothetical quantities. Further, it does not in any way limit the possibility that cost-effective emissions trading solutions could be applied.

However, this approach also has several disadvantages. Unlike a regime in which a total global quantity target drives the apportionment of allowable emissions among Parties, there is no *a priori* incentive to meet a safe level. If the aggregate sum is inadequate, negotiations – likely to have already been quite painful – will merely need to restart and will not necessarily lead to a successful outcome. Moreover, in the absence of any agreed principle to guide differentiation, Parties have an incentive to progressively adjust their level of effort to correspond to those with the lowest willingness-to-pay and move even further from what are probably “safe” emission pathways. Nevertheless, in the absence of international consensus on differentiation principles and “safe” emission pathways or boundaries, such an approach may garner broader international support than specific allocation approaches.

As the IPCC has suggested, there is not likely to be a single “equity” rule that will gain universal acceptance. By extension, this suggests that a single burden sharing or allocation rule will also be extremely difficult to develop. However, ultimately, progress in mitigating climate change will require action well beyond the level currently being undertaken – suggesting that a process of iteration and negotiation will be required to develop and agree on solutions to this currently intractable problem.

4. Summary Discussion

This paper considers the challenges facing climate change policy makers from different perspectives. In so doing, it reviews some of the decision criteria that might guide policy decisions, as well as practical options on the form that different mitigation commitments might take. Taking a broad, longer-term view of the climate problem provides insights on what criteria might be used to eventually shape decisions about future commitments. The paper draws from previous IEA and OECD papers, from information presented and discussions in previous Annex I Expert Group meetings and from other sources in the open literature.

The evaluation of possible mitigation commitments may be undertaken using tools from the natural and social science and economics disciplines. These incorporate perspectives on what stimulates technological and institutional change, and how they are modified over time. These perspectives provide clues for decision criteria and offer insights on how GHG mitigation efforts in different parts of the world could emerge over the longer term. While the natural sciences, economics and technology perspectives are addressed in the IPCC TAR (and in the wider literature), the institutional and social change perspectives have so far received less attention.

From nearly all perspectives there are clear grounds for taking early, cost-effective action – to extend participation, to reduce costs over the long term, and to achieve deeper emission reductions in the next round of mitigation commitments. Such action is necessary to keep open the option of achieving stringent or lower levels of atmospheric concentrations. How we achieve such reductions matters. To be cost-effective, action should be iterative, building on improved information on damage, adaptation and mitigation costs.

A variety of actions may be taken to address the problem. One, possibly new element, could focus on technology actions. The aim of such an approach would be to create new markets for climate friendly technologies, and to provide incentives to substitute investments in no- or low-carbon energy sources or technologies for current investments in GHG intensive alternatives. For example, it may be desirable to establish explicit technology decision criteria, e.g., through indicative benchmarks for desirable rates or types of technology change, such as rates or absolute objectives for the carbon intensity of energy use at a global or regional level. Such a specific focus on technology would provide governments (and more importantly the private sector) with clearer signals to drive change.

Viewed through the lens of institutional dynamics, it is clear that there will be a need to allow time for change: societies adapt only very slowly, and time is required to develop expertise and gain experience. To be effective, policies need to target different levels of society to influence the daily lives of people and individual investment decisions.

An approach to designing the structure (including the form and stringency) of any future commitments that takes account of these multiple perspectives will inherently be more robust. This paper suggests some lessons that might be applied:

- The risk of irreversible climate change argues for near term action to keep the options for lower atmospheric concentrations open. While the use of indicative mid-term emission ceilings may be used to guide the design of next steps in the global climate regime, such upper bounds on global emissions are likely to be difficult to set.

- The global scope of climate emissions and the need to keep open the options for lower atmospheric concentrations implies the need for broad participation in mitigation efforts over coming decades with emission reduction efforts being required from all major emitting countries. Partial participation is likely to lead to concentration levels that may be felt to be unacceptably high.

- Uncertainty regarding the impacts of climate change – including in the stringency and timing of mitigation, as well as on the costs and benefits of action and inaction – imply the need to adjust the level of action at regular intervals, following an iterative approach incorporating the best new information on both costs and benefits of action.

- Alternatives to fixed national targets, combined with emission trading in one form or another, provide one potentially cost-effective way to design mitigation commitments. While these options would lower the "certainty" offered by fixed targets on future emission levels, they may paradoxically increase the environmental efficacy of the agreement. If they manage to effectively "shave" the expected costs of compliance, they may help countries to adopt more ambitious targets, making it possible, for the same expected costs, to take on more stringent commitments. Alternatives to national targets may be adopted as complementary approaches. For instance, technology agreements may be invaluable in bringing new technologies to the market throughout the world – and may be politically more palatable than price based mechanisms.

- The inadequacy of institutions and/or the lack of political will to take on and enforce national targets is a main reason to propose more pragmatic approaches. This suggests that alternatives to national targets may be more likely to meet with success in negotiations for some countries, particularly if they are less constraining in terms of economic growth. Thus, successful alternatives may be win-win policy reforms or sectoral targets, especially if they are combined with market instruments (like the CDM) to provide a source of revenue to assist with financing of action.

This paper does not aim to comprehensively evaluate and choose between the options presented. Indeed, it could be argued that many of these options are complementary, rather than exclusive. It may well be that a menu of these options could be simultaneously implemented, with different countries selecting different policies according to their national circumstances. This would acknowledge a main lesson from the Kyoto process -- the fact that countries around the world differ widely and may need different forms of commitments. It may also emerge that some of these options are most useful as a transitional stage to more comprehensive forms of agreements.

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