

Taking Action Against Climate Change: the Kyoto Protocol

1. Introduction and summary

Meteorological evidence points to a rise in the average global temperature over the past century. The trend towards warming is consistent with predictions from global climate models, that higher concentrations of so-called greenhouse gases trap increasing amounts of heat in the earth's atmosphere. Increased concentrations of greenhouse gases result to a large extent from emissions arising from human activity – in particular the burning of fossil fuel. Against the background of increasing scientific consensus that man-made greenhouse gas emissions add to global warming, international efforts to reduce these emissions have thus far culminated in the Kyoto Protocol, agreed in December 1997.

The purpose of the current publication is fourfold, corresponding to its four main chapters. Chapter 2 describes some main aspects of the Kyoto Protocol and discusses some areas where choices in its implementation may have an impact on its success. The subsequent chapter quantifies the economic costs of implementing the Protocol under a variety of assumptions about how this will take place. Chapter 4 considers how, over the longer term, a credible effort towards stabilising concentrations of greenhouse gases can be made which includes participation by developing countries. The final chapter considers what kind of climate change is expected to occur over the next 50 to 100 years, which is largely independent of whether or not the Kyoto Protocol is successfully implemented, and discusses some aspects of the problems of adapting to such changes.

The Protocol contains targets for greenhouse gas emissions over the period 2008-12 for each so-called Annex 1 country; the countries involved include all OECD countries except Korea, Mexico and Turkey, and a number of economies in transition, most notably Russia. The targets are fairly ambitious in the sense that OECD emissions in 2008-12 will need to be some 20-40 per cent below the level they might be expected to reach without policy action. If countries were to respect their individual targets through domestic abatement measures, the cost to OECD countries may be a loss in annual real incomes of the order of magnitude of ¼-1 per cent provided that adjustment to higher energy prices is smooth. Given the size of

energy price increases, this assumption cannot be taken for granted. The marginal abatement costs can be thought of in terms of a carbon tax that would typically correspond to a doubling or tripling of the international oil price from its 1995 level. Such large price changes will require substantial reallocation of resources, especially labour, between individual sectors of the economies. They will also lead to real wage losses which may be resisted with the end-result of higher unemployment. Preliminary analysis shows that in the latter case, costs of implementing the Kyoto targets could be substantially higher than the above estimates. The low estimated cost for OECD countries not only reflects the assumed flexible adjustment, but also that part of the cost will be borne by some non-OECD countries, as a result of the terms-of-trade changes induced by the lower demand for fossil fuel. When assessing the economic cost it has to be taken into account, however, that the model simulations do not include the “ancillary benefits” of emission reductions, such as reduced local pollution levels, which may also be significant. Finally, it is important to keep in mind that this assessment is based on econometric models which neglect the non-CO₂ GHGs and, therefore, tend to overestimate the economic costs of meeting the Kyoto targets.

The Protocol includes a number of mechanisms to reduce the cost of meeting the emission targets – and therefore increase the likelihood that the Protocol will be ratified and the targets met. The details of the Kyoto mechanisms, which include emission trading and the so-called Clean Development Mechanism, are not yet fully specified. It is important that the timetable, requiring agreement on details of the mechanisms by the end of year 2000, be met. The longer the delay, the later abatement measures are likely to be taken and, as illustrated by model simulations in Chapter 3, the higher the cost of meeting the emission targets is likely to be.

The costs of reaching the Kyoto targets can be significantly reduced by use of the flexibility mechanisms. Emission trading allows the marginal abatement costs in different Annex 1 countries to be equalised by trading emission permits so that emission reductions in one country, where they can be done relatively cheaply, may be counted against the target for another, where emission reductions are more costly. In the process, both countries can benefit. If trading succeeded in fully equalising marginal abatement costs across Annex 1 countries, the overall cost of meeting the targets could be cut by a third for OECD countries and become almost insignificant for all Annex 1 countries taken together, according to simulations with the OECD’s GREEN model. Again, however, the strong assumptions behind and the uncertain nature of the model results should be borne in mind.

Emission trading raises a number of issues which need to be resolved for trade to deliver such efficiency gains. Some of these issues have a somewhat technical nature and relate to topics such as monitoring, verifying and enforcing compliance. The uncertainties in these areas have sometimes led to calls for restrictions on emission trading. Such restrictions, and the increased domestic action they imply,

have also been justified with reference to the need for industrialised countries to show a good example which would induce developing countries to accept quantified emission limits too, as well as with reference to ancillary benefits of reduced domestic emissions (such as lower local pollution levels). The price of these restrictions would, however, be an increase in the costs of achieving the Kyoto targets. If, instead of general restrictions on trading, a subset of Annex 1 countries were to impose unilateral restrictions on emission trading, their costs could go up while those of other Annex 1 countries might fall.

Two specific implications of the participation by transition economies in full emission trading are worth mentioning. First, part of the apparent gains from trading would come from higher overall emissions: emissions in Russia and Ukraine are likely to be considerably lower than the Kyoto target even in the absence of any abatement measures; by allowing emissions by OECD countries to rise by that amount, trading reduces the latter's costs. Restricting trading in this so-called "hot air" might reduce the gains from trade by about a fifth, based on the amount of hot air present in the baseline scenario with the GREEN model. Such restrictions would, however, be politically difficult and also ineffective in reducing atmospheric concentrations of greenhouse gases over the longer term, because another provision ("banking") of the Protocol allows unused emission quotas to be carried forward for use (or trading) later. Second, with Russia and Ukraine potentially the dominant suppliers in the market for emission permits, there is a risk that the market may be imperfectly competitive; if collusion allowed Russia and Ukraine to keep permit prices significantly above the competitive level, the gains from trade could be reduced.

In addition to emission trading, the Kyoto Protocol contains two mechanisms for project-based emission transfers between countries. While so-called Joint Implementation among Annex 1 countries resembles emission trading in that it leads to transfers of emission rights, the Clean Development Mechanism allows Annex 1 countries to gain emission rights from investments to cut emissions by developing countries. The latter do not have emission targets and the transfers of emission rights therefore have to be made with reference to agreed, project-specific, baselines for emissions. This makes it hard to assess how important the Clean Development Mechanism will be. Preliminary analysis has assumed that only a fraction of the potential for low-cost abatement in developing countries will be exploited and suggests that the gains from the mechanism will therefore be modest if it is introduced in conjunction with full emission trading among all Annex 1 countries.

In the context of attempts to reduce global warming appreciably, the Kyoto Protocol is best seen as a starting point for a long-term effort towards a significant reduction in global greenhouse gas emissions, and eventually stabilisation or reduction of atmospheric concentrations. Chapter 4 shows that, although the science is far from sufficiently well-developed to give definitive answers, action by

Annex 1 countries alone will have only a marginal impact on concentrations, if emissions by non-Annex 1 countries grow as they are expected to without any constraint.

Inducing non-Annex 1 countries to accept such constraints is difficult, as evidenced by both the third and the fourth Conference of the Parties to the UN Framework Convention on Climate Change. This is not just because countries will be affected differently by climate change – some developing countries are likely to be more severely affected by it than most OECD countries – or because they have different valuations of these effects. Analysis in Chapter 4 suggests that the likelihood of a large number of countries voluntarily agreeing to cut emissions may be small in the absence of side payments. Furthermore, equity concerns may over the next half-century or so call for much larger cuts in emissions by Annex 1 countries than by developing countries, whose *per capita* emission levels are many times smaller. This, on the other hand, would conflict with concerns for global cost-minimisation, unless the flexibility mechanisms are sufficiently developed and implemented globally.

Chapter 4 considers a number of global emission scenarios which will move the world towards a stable concentration of greenhouse gases in the atmosphere. The scenarios differ both with respect to their ambition in terms of cutting global emissions and with respect to the distribution of the adjustment burden across countries. In particular, scenarios are constructed where emissions rights are distributed so as to reflect the economic disparities (thus taking into account the “ability to pay” of each country) or where countries will have to converge at the same, fairly low, level of emissions *per capita*. Under these two burden-sharing rules and given widely different abatement costs across countries, permit trading becomes a crucial instrument for keeping down costs. Depending on the degree of ambition with respect to emission paths, and assuming permit trading, annual costs at the world level could be of the order of ¼-1 per cent of GDP. However, revenues from permit selling may not provide sufficient incentives for all developing countries to participate in a global agreement, and Chapter 4 also considers the possibility that Annex 1 countries provide financial transfers to encourage participation. In this case, annual costs to Annex 1 countries could be sizeable if an ambitious emission reduction strategy is aimed for – the estimates range between 1½ and 2 per cent of Annex 1 GDP depending on the degree of ambition.

Despite the efforts being made in the context of the Kyoto Protocol and any likely follow-up agreement, some considerable further increase in atmospheric concentrations of greenhouse gases cannot be avoided. Chapter 5 notes that the resulting climate change is difficult to predict in the current state of knowledge, especially as regards precipitation patterns which, in many areas, will play a more critical role in determining the costs of climate change than changes in average temperatures. Few conclusions can therefore be drawn about the costs of climate change or about appropriate adaptation strategies in particular countries or for particular activities or sectors. Such studies of costs as have been undertaken appear

to show relatively low costs over the next 50 to 100 years for most OECD countries. However, longer time horizons obviously matter – as do concerns for non-OECD countries, many of whom seem likely to bear much higher costs. Moreover, what is of interest is not just the mean expected outcome but also the variation around it – there may be a risk that beyond some concentration of greenhouse gases in the atmosphere, the associated climate change could be dramatic, with a substantial influence on the economy and society.

Whatever the change in climate may be, it is important that adaptation to it be as smooth as possible. To some extent, countries can learn from each other, given the wide differences that currently exist in climates. A number of countries also have some experience with adaptation, most prominently perhaps in the case of sea-level rise. In that area, because of externalities and perhaps also owing to economies of scale in information gathering, the public sector is typically involved in the necessary long-term planning and in resolving potential conflicts between different users of land. However, in many cases less rather than more public sector involvement will be necessary to achieve smooth adaptation – agricultural policy may be an example of this. At this stage it may be premature to draw very firm conclusions as to what type of policy change will be required to ensure smooth adaptation to climate change. Indeed, a general conclusion in the area of climate change is that there is a need for further knowledge. In particular, consideration of the accuracy of climate change forecasts, of the role of uncertainty and how fear of catastrophe should be valued (and indeed how a number of other aspects of climate change, such as species loss and other irreversible changes, should be valued) is required if the benefits of the Kyoto Protocol and its successors are to be usefully compared with their costs.

2. The Kyoto Protocol and the process of climate change

2.1. Climate change

Since the last substantial analytical work on climate change was presented to WP1 (summarised in OECD, 1995), the issue has lost none of its importance. Meteorological evidence from the 1990s has reinforced the view that some global warming is already under way. Scientific research finds that this tendency increasingly corroborates predictions from global climate models which incorporate the greenhouse mechanism, whereby certain gases produced by human activity – from industry, from households, from transport and from agriculture – trap increasing amounts of heat in the earth's atmosphere and add to the “natural” greenhouse effect.

Despite the considerable attention being paid to this problem over the past ten years and the declarations arising from the 1992 UN Framework Convention on