

Chapter 4

PROSPECTS FOR AN EFFECTIVE GLOBAL RESPONSE

What has the world community done so far to counter the threat of climate change? What would be an appropriate global strategy? What approach should the UK adopt in international negotiations? What are the implications for its own future emissions of greenhouse gases?

4.1 Human-induced climate change appears to have begun (2.4), it will continue (2.25) and, once in train, it can only be reversed after centuries have elapsed. Unless an effective response is mounted to this challenge, there will be serious, and possibly catastrophic, damage to people and ecosystems (2.27-2.35). In order to reduce both the extent of climate change and the rate at which it will happen (2.39-2.40), the crucial contribution must come from reductions in global emissions of carbon dioxide from the burning of fossil fuels, as chapter 3 showed. It will also be necessary to protect natural sinks by controlling land use changes.

4.2 We now consider the adequacy of the response by the world community to date (4.3-4.9) and what further response is required at global level now and in the coming decades (4.10-4.20). In particular, we consider the role of economic appraisal in determining the optimum level of response (4.21-4.28), what concentration of carbon dioxide ought not to be exceeded (4.29-4.34), the timing of measures to reduce emissions (4.35-4.39) and how the effort should be shared between different nations (4.40-4.54). Finally we discuss the implications for the UK (4.55-4.70), thus paving the way for Part II of this report.

A DECADE OF CLIMATE DIPLOMACY

4.3 There has now been more than a decade of climate diplomacy involving nearly all the world's nations. The two major achievements have been the United Nations Framework Convention on Climate Change (UNFCCC), signed by the overwhelming majority of world leaders at the 1992 Earth Summit in Rio de Janeiro, and the Kyoto Protocol, signed at the Third Conference of the Parties to UNFCCC in Japan in 1997.

4.4 These international agreements took a great deal of time and effort to negotiate, involving the highest levels of governments. Yet they are modest achievements when considered against the scale of the task that appears to lie ahead.

4.5 UNFCCC sets out a legal framework for controlling emissions of greenhouse gases. In article 2 the contracting parties pledge themselves

to achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.

Article 3.3 states that

Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing [precautionary] measures, taking into account that policies and measures to deal with climate change should be cost effective so as to ensure global benefits at the lowest possible cost.

4.6 There is already therefore a commitment in international law to the principle of co-operating to slow and eventually halt the rise in concentrations of greenhouse gases. It is binding on the UK and over 180 other nations, containing more than 98% of the world's population, which have ratified UNFCCC. But there is not as yet any agreement on what the maximum tolerable concentrations might be, nor on how the effort required to prevent them being exceeded should be distributed amongst nations.

4.7 UNFCCC also placed an obligation on developed nations to aim to reduce their annual emissions of greenhouse gases to the 1990 level by 2000. Very few of them are expected to achieve that goal. The UK will have done so; but, as we show later (5.48-5.50), this is largely fortuitous, rather than the consequence of policies devised with that objective in mind.

4.8 Developed nations took matters further at Kyoto. They agreed that by 2008 to 2012 they would reduce their annual emissions of a basket of six greenhouse gases (see box 2C) by amounts that in aggregate represent a reduction of 5.2% from the 1990 level. The European Union (EU) undertook to reduce its emissions by 8%, and the Council of Ministers subsequently agreed what contribution each Member State should make to that. The Kyoto Protocol however will not enter into force until at least 55 parties to UNFCCC have ratified it, including nations which contributed at least 55% of the total greenhouse gas emissions by developed nations in 1990. At the time of finalising this report no developed nations had ratified the protocol. There is strong political resistance to doing so in some countries, notably the USA. Keeping the developed nations to what they agreed at Kyoto depends on the completion of further complex and difficult negotiations. These largely concern mechanisms, such as trading, which would allow reductions in one nation's greenhouse gas emissions, over and above its legal obligations, to be credited and/or sold to another nation (box 4A).

4.9 The direct benefit from the Kyoto Protocol will be modest. It sets emission limits only for the developed nations. The reductions they are pledged to make are expected to be outweighed by the increase in developing nations' emissions between 1990 and 2012, and global emissions will therefore continue to rise. The protocol's effect in reducing the carbon dioxide concentration in the atmosphere below what it would otherwise have been is calculated to be only 10 parts per million by volume (ppmv) in the middle of the 21st century (equivalent to 5% of the increase that has already occurred, 2.7) and 20 ppmv at the end of the century.² Much more needs to be done.

THE NEED FOR INTERNATIONAL AGREEMENT TO LIMIT CLIMATE CHANGE

4.10 Each nation will make its own assessment of how much damage various degrees of climate change would impose on it in terms of harmful impacts and costly adaptations. A few may even anticipate an overall benefit from climate change, for example through increases in crop yields and opportunities to grow new crops. Given the current uncertainties about the regional impacts of climate change (2.32), and the possibility that shifts in climate may be more abrupt than currently envisaged (2.34), it would be foolish for any government to count on such a benefit.

BOX 4A

FLEXIBILITY UNDER THE KYOTO PROTOCOL

The Kyoto Protocol allows the industrialised nations of the Organization for Economic Co-operation and Development (OECD) and the former Warsaw Pact to meet some of their emission limitation commitments by actions outside their own borders. There are three ways in which this can be done:

Emissions Trading enables a nation to purchase the credit for greenhouse gas emissions reductions made in another nation and count them as its own. A nation which sells emissions reductions it has made at home cannot then count them as a contribution towards meeting its own commitment. This direct trading in emissions, or rather in *assigned amounts* of greenhouse gas quota, is only allowed between developed nations. It is envisaged that nations which find it relatively easy to meet their Kyoto commitment, particularly the Russian Federation, will sell quota at a negotiated price to those which find it more difficult, such as the USA.

Joint Implementation, which also involves only developed nations, is based on specific projects which reduce emissions, the idea being that nations work jointly to meet commitments under the protocol. One nation funds a project in another country, such as a non-fossil fuel power station which substitutes for fossil fuel electricity generation. The donor state then claims the credit for the resulting reductions in emissions. Joint implementation could facilitate investment by OECD nations in major energy efficiency improvements in the former Soviet bloc nations. It can apply not only to reductions in emissions but to enhancement of carbon dioxide sinks.

The **Clean Development Mechanism (CDM)** is similar to joint implementation, but involves emission reduction projects in a developing country financed by a developed nation. The latter will receive *certified emission reductions* which it can count towards its Kyoto commitment. Thus to receive the credit for the reduction the donor nation will have to demonstrate that the project will lead to the recipient's emissions being lower than they would otherwise have been, a difficult concept at a time when developing nations' emissions are rising and are not subject to any limitations. The protocol calls for organisations to be established, including an executive board for the CDM, to ensure genuine reductions are achieved, and audited and verified. An unspecified proportion of the funds flowing from developed to developing nations under the mechanism will be used to cover administrative expenses and 'to assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation' (article 12).

The main purpose of these three 'flexibility mechanisms' is to reduce the overall costs of curbing emissions by concentrating reductions in sectors and regions where they can be made most cheaply. The protocol stipulates that emission reductions which developed nations make outside their borders should be regarded as supplementary to those they make at home. However, no specific limits have been set on the proportion of reductions that they can achieve through the flexibility mechanisms, and that remains the subject of international debate. Projects and trading can be carried out by companies and other organisations. But it is nation states and their governments which must take ultimate responsibility for ensuring they meet their national commitments.

The detailed and potentially complex rules required for these three mechanisms to begin operating have yet to be drawn up. However, several nations have already pioneered joint implementation-type projects. Some have made it clear that they will rely heavily on these flexibility mechanisms to meet a substantial part of their commitments under the protocol. The government of the Netherlands, for instance, has said it will make half its 6% cut in greenhouse gas emissions in this way.¹

4.11 While any country or community can make its own attempts to adapt to climate change, there is little scope for any nation to act alone to reduce the accumulation of greenhouse gases. The UK's emissions are about 2% of the global total; whatever the UK does to limit its own emissions will have a minute impact on its own future climate and those of other countries. Nations must act together, even though there will be intense and prolonged debate over how the burden should be shared among them.

4.12 The appropriate mix of measures to reduce carbon dioxide emissions, and their costs, will vary from country to country according to stage of development, the availability of particular energy sources and the scope for management of terrestrial ecosystems. Some countries, including the UK, are potentially rich in renewable energy sources such as wind, wave and tidal power. In others solar energy is abundant. A few may be able to offset emissions from burning fossil fuels by planting large areas of fast growing forests (3.21). Still others, such as the oil-rich nations of the Middle East, are anxious to sell fossil fuels from the abundant reserves that are the mainstay of their economies. Some developing nations, notably India and China, have immense coal reserves which they may wish to use as a cheap, indigenous fuel source.

FRAMING A RESPONSE

4.13 The analysis in chapter 2 showed what the aim of stabilising greenhouse gas concentrations implies in terms of reducing emissions from burning fossil fuels. Because reductions on that scale will necessitate very substantial changes in the way energy is obtained and used, some consumers or industries or nations will resist change, fearing it will seriously harm their interests. This has been seen already in the demands of some major oil-exporting nations to be compensated for any large reductions in fossil fuel use, in the extensive advertising and lobbying against the Kyoto Protocol organised by some US industries, and in the UK in the strong resistance to the road fuel duty escalator (6.117).

4.14 However, important benefits may flow from the reduced dependence on fossil fuels that will accompany substantial reductions in carbon dioxide emissions. The most obvious is an improvement in public health due to reductions in the air pollution associated with burning fossil fuels. There will be other important gains: emissions from fossil fuels are the major contributor to acid deposition and photochemical smogs which damage buildings and ecosystems and can reduce crop growth.

4.15 Policies aimed at reducing carbon dioxide emissions from transport can be integrated with policies for reducing the congestion, noise and environmental degradation associated with increasing road traffic. This was the subject of the Commission's 18th and 20th reports. A shift away from largely oil-based economies would reduce the risks of oil spills such as those which gravely damaged wildlife and fisheries along the coasts of south-west Wales in 1996 and Brittany earlier this year.

4.16 Policies for enhancing natural carbon sinks could reduce the rate of deforestation in tropical countries and increase the UK's forested area. These outcomes could bring benefits additional to climate change abatement, such as conserving biodiversity, preventing soil erosion and landslides, and increasing people's enjoyment of the countryside.

4.17 While there may be coincidental benefits from reducing carbon dioxide emissions, any attempt to make radical changes in current energy systems is bound to face resistance. The complaints of those who are certain they will be harmed by a change of direction tend to drown out the approval of those who believe they might gain. Given such resistance, the global debate about the appropriate response to climate change becomes chiefly one about equity between generations. How much effort is the current generation prepared to undertake, how much change will it contemplate, in order to reduce the impacts and risks of climate change through this century and the next?

4.18 There is a moral imperative to act now. If this generation took no measures to curb rising emissions, it would be condemning our children, grandchildren and generations beyond them to considerable dangers (2.27-2.35). In the light of where the harshest impacts are likely to fall,

that would perpetrate an enormous global injustice. The developed nations are responsible for by far the largest part of the current enhancement in the greenhouse effect, even though they contain only a fifth of the world's population.³ Yet most studies have concluded that the developing nations in the tropics and sub-tropics will suffer more harm from climate change than the developed countries in higher latitudes.

4.19 This is partly because of what are likely to be major regional differences in the effects of climate change (2.29, 2.35), but also because many developing nations lack the income and capacity to mount an adequate adaptive response to significant shifts in temperature and rainfall and rising sea levels. Their populations may include large numbers of nomads or subsistence farmers and fishermen whose livelihoods will be particularly threatened by climate change. An adaptation such as raising the height of flood defences on coasts and river banks which might cost the UK a very small proportion of its gross domestic product would impose a very much heavier strain on a country such as Bangladesh. The wide gap in incomes, educational attainment and life expectancies between the richest and poorest nations is likely to be widened still further by climate change. Rising sea levels may eventually cause some of the world's small island nations to disappear entirely.

4.20 While there could be seen to be a moral duty for all nations, especially developed nations, to act now in order to reduce the dangers of climate change, action should not of itself cause even greater injustices. In responding, nations should not burden the weakest and most vulnerable among their own citizens. The response to the threat should not be disproportionate. If society were to take excessively costly action in order to reduce emissions, that would harm the prospects both of this generation and of future generations that will build on its achievements. Resources which might have been devoted to healthcare, food production, clean water and sanitation would be diverted into reducing emissions to an unjustifiable extent, given the benefit in reduced risks.

ECONOMIC APPRAISAL

4.21 We have considered the extent to which economic appraisal might help in deciding the level of an appropriate response. Climate change will impose costs on future generations, either directly or through adaptations they have to make. But reducing emissions in order to limit climate change becomes increasingly costly, the greater the desired impact. Somewhere between a policy of no action and the allocation of a significant proportion of the total available resources is a range of policies consistent with the attempt to find a level of preventive action at which the overall costs to the global economy of climate change and its limitation are minimised.

4.22 One leading economist seeking an acceptable response to climate change has summarised the problems in estimating the likely costs of unabated climate change thus:

It must be emphasised that attempts to estimate the impacts of climate change continue to be highly speculative. Outside of agriculture and sea-level rise for a small number of countries, the number of scholarly studies of the economic impacts of climate change remains vanishingly small. Estimates of the regional climatic impacts of global warming are still inconsistent across different climate models, and economic studies have made little progress in estimating impacts, particularly in the low-income countries.⁴

4.23 Identifying and assessing the global costs of reducing emissions of greenhouse gases may be somewhat easier than assessing the costs imposed by climate change, because more of the former involve resources that are traded in markets. Even so, there are currently no reliable

estimates even for the costs of reducing greenhouse gas emissions to any given percentage of their 1990 level by a given year in the future. The long time-lags which underlie climate change mean that preventive measures have to be carried out several decades, and even centuries, before the harm they seek to avert. Economic analysis of such a process involves discounting future events. Other things being equal, the discounting would be at a positive rate, so that events taking place today are given more weight in decision-taking than those expected to take place in the future. The discount rate used should take into account the combination of a rising standard of living and the declining value of a marginal addition to income as people become richer, or the increasing pain attaching to marginal cuts in income should people become poorer – perhaps as a result of severe climate change. If an acceptable policy for responding to the threat of climate change has a substantial effect on economic growth, that will impinge on the discount rate appropriate for use in the economic analysis.

4.24 It has been suggested that changing discount rates should be used, applying a conventional rate for the short term, and then a very low or zero rate after that, or possibly even a negative discount rate if climate change threatened to make continuing positive growth of material consumption unlikely or unsustainable.^{5,6} These risks, too, should be taken into account. If there is the possibility of a major disruption to society, such as would arise from extreme shifts in climate, then this should be incorporated into the analysis.

4.25 In addition, the analysis should take account of expected changes in people's relative willingness to pay for environmental benefits. If the climate does not change so fast as to threaten the growth in material consumption, that growth is likely to reduce the acceptability of any associated environmental degradation.

4.26 Several studies have set out to explore the implications of a range of possible responses to the threat of climate change using computer models that integrate the global economy, emissions, the carbon cycle and the climate system. Most conclude that some measures to reduce emissions from burning fossil fuels or enhance sinks are now justified, usually in the shape of an internationally agreed carbon tax (which penalises the burning of fossil fuels according to how much carbon dioxide is emitted) or international trading in permits to emit specified quantities of greenhouse gases.

4.27 Some of these studies have concluded that the Kyoto Protocol cannot be justified on economic or social grounds, because the costs which will fall on the developed nations in the next decade as they reduce their emissions are not justified by the effects of the resulting, very small reductions in climate change.⁷ They advocate rather low corrective carbon taxes. However, other studies using similar integrated models have concluded that a stronger response and much higher taxes are justified. The gap is largely explained by differences in the discount rates employed, the projected price of replacement energy sources and the size of the ancillary benefits which flow from reducing fossil fuel consumption.

4.28 We have argued that there is a moral imperative to act now (4.18-4.20). That argument and economic appraisal both point towards similar actions for the short to medium term – reductions in greenhouse gas emissions from their current rising trend, led by the developed nations, and adaptation where impacts are already inevitable.

A PRAGMATIC APPROACH

4.29 We are concerned about the longer term. The principle that concentrations of greenhouse gases should be prevented from rising to a dangerously high level is enshrined in international law (4.5). Deciding on an appropriate long-term response to the threat of climate

change involves making judgements about what such a level would be, and about the level at which actions should be designed to stabilise concentrations. We focus here on the concentration of carbon dioxide, for reasons explained previously (2.38).

4.30 The likely extent of climate change resulting from any given concentration of greenhouse gases, and the scale of impacts, can be predicted using models (2.19, 2.26), but only fairly approximately, especially at regional level (2.32). Assessments must also be made of the risk that there might be a much greater shift in climate or an abrupt change, for example in the transport of heat by the North Atlantic ocean (2.34). To show what scale of effort is required to achieve a broadly stable position, calculations can be made of the paths that emissions would have to follow. In chapter 2 we discussed, on the one hand, scenarios the Intergovernmental Panel on Climate Change (IPCC) included in its 1995 assessment to show how stabilisation of the carbon dioxide concentration in the atmosphere might be achieved at 450 ppmv, 550 ppmv or 750 ppmv (2.21 and figure 2-VI) and, on the other hand, the results of more recent modelling which incorporates projections for emissions both of carbon dioxide and of a range of other greenhouse gases (2.22 and figure 2-VII). Of the four scenarios we have derived from the more recent modelling, the 'earlier adjustment' scenario, which results by 2300 in a carbon dioxide concentration nearly constant at about 600 ppmv accompanied by specified concentrations of other greenhouse gases, would have broadly similar effects to the earlier scenario for stabilising the concentration of carbon dioxide alone at 750 ppmv (2.37).

4.31 Analyses of the effects of climate change based on the 1995 scenarios have shown that, while limiting the carbon dioxide concentration to 750 ppmv would bring benefits, there would be much greater benefits if it is limited to 550 ppmv, more especially in reducing the rate of change (2.39). A concentration of 550 ppmv represents approximately double the concentration of carbon dioxide in the atmosphere prior to industrialisation (2.7). Some environmental groups (including the Global Commons Institute, see 4.52) regard 550 ppmv as a dangerously high concentration which is incompatible with the aim of sustainable development.⁸ A few groups have argued for a maximum higher than 550 ppmv.⁹ The EU Council of Environment Ministers has proposed that stabilisation below 550 ppmv should guide global limitation and reduction efforts.¹⁰

4.32 On the basis of current scientific knowledge about human impact on climate, we support the proposal that an atmospheric concentration of 550 ppmv of carbon dioxide should be regarded as an upper limit that should not be exceeded.

4.33 To keep below that level, global carbon dioxide emissions will have to fall dramatically. According to IPCC's findings they will have to be reduced eventually by about 70%. There are different paths emissions could follow in order to achieve that result. Figure 2-VI showed two sets of paths, and the effects they would have on the concentration of carbon dioxide in the atmosphere: the solid lines assumed that the previous rising trend in emissions would be significantly modified from the mid-1990s onwards, the broken lines assumed that the previous trend would continue beyond 2000 and emissions would subsequently fall more sharply, at an average rate of about 1% a year over the next two centuries in the case of a 550 ppmv upper limit.

4.34 The choice of 550 ppmv as the upper limit will need to be kept under review. Expectations about the future trends in emissions of other greenhouse gases are clearly an important factor, and IPCC's Third Assessment (2.1) may reduce the uncertainties on that score. Advances in scientific understanding may eventually make possible a more informed judgement about what is the maximum tolerable concentration of carbon dioxide in the

atmosphere. These factors may result in a figure lower or higher than 550 ppmv. But, given the possible consequences of uncontrolled climate change, it would be imprudent to take a higher concentration as the basis for policy at this stage.

TIMING OF MEASURES TO REDUCE EMISSIONS

4.35 Because carbon dioxide remains in the atmosphere for 50 to 200 years (2.18), and exerts its effects gradually over a long period, the eventual consequences of different time-paths for global emissions are broadly similar, provided a similar quantity of carbon dioxide is emitted in total over a given period. Although they differ in the date at which global emissions diverge from the previous trend, all the scenarios discussed in chapter 2 show them continuing to rise for a period before they start to fall (2.21). This type of profile enables emissions from developing countries to continue rising for several decades as their populations grow and they industrialise (4.43), even while emissions from developed countries are being reduced.

4.36 If the principle of a 'rising and then falling' profile is accepted, there can still be debate about the point in time at which global emissions should start to fall. One path to achieving stabilisation at a carbon dioxide concentration below 550 ppmv might involve emissions reaching their peak, say, 20 years from now; but a similar outcome might be obtained if global emissions continued to rise for, say, 40 years but then fell much more sharply.

4.37 It has been contended that there would be benefits in a gradual phasing in of measures, with global emissions continuing their current rate of increase for several decades. Several reasons have been advanced for delaying reductions in emissions and for phasing them in gradually.¹¹ First, there is generally a positive return on capital in the long term; capital growth means that, if a given set of measures were deferred, fewer resources would need be put aside today to fund them. Second, capital stock for energy supply is often long-lived; if expensive plant such as coal-fired power stations is replaced with alternative energy sources before it reaches the end of its life, assets will be left stranded. Third, the availability of alternative energy sources is expected to improve with time and their costs are expected to fall.

4.38 While there may be benefits in delaying some measures to reduce carbon dioxide emissions, and while there may be no case for closing fossil fuel plants immediately, achieving very large long-term reductions in emissions is dependent on adopting an appropriate strategy now. It is not only the climate system which has great inertia; so does the global economy's dependence on fossil fuels. Around the globe, investment decisions are already being made about carbon-intensive plant and products which will not go into operation for several years and will then emit carbon dioxide for decades. The process can be compared to turning a supertanker away from a collision course. There may appear to be little change of direction for some time after the helm is turned, but the change is still supremely necessary.

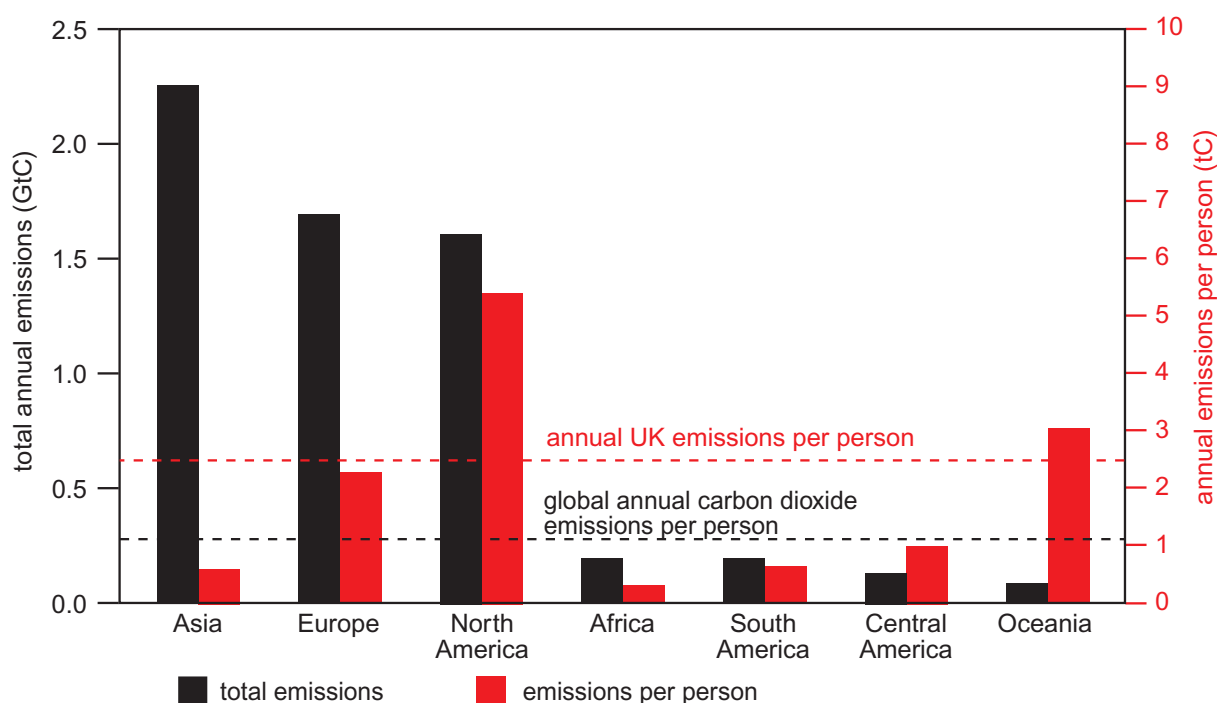
4.39 Even keeping the concentration below 750 ppmv would require a very large fall in global emissions from their current fast rising trajectory, beginning within the next few decades. But to ensure that the concentration of carbon dioxide in the atmosphere does not exceed 550 ppmv, major changes have to be made almost at once in plans and policies.

THE SHAPE OF A FUTURE INTERNATIONAL AGREEMENT

4.40 Given that a long-term strategy to deliver reductions in emissions requires global agreement, and that there is an urgent need for such a strategy, what form might such an agreement take? The Kyoto Protocol represented a reasonable first attempt at addressing the threat of climate change, but cannot have more than a modest direct effect (4.9).

4.41 The principle that developed nations should act first is enshrined in article 3.1 of UNFCCC, which states that: ‘In accordance with their common but differentiated responsibilities and respective capabilities the developed country Parties must take the lead in combating climate change and the adverse effects thereof.’ In the case of carbon dioxide the justification for initially requiring reductions only from developed nations is that they have contributed a high proportion of the additional amount now in the atmosphere, and their emissions per head from burning fossil fuels are still much higher than those from developing countries (figure 4-I).

Figure 4-I
Carbon dioxide emissions from fossil fuels by continent (1995)



4.42 It is crucial that the developed nations fulfil their existing commitments under the Kyoto Protocol (4.8). That should not result in significant overall damage to their economies. The limits set were the outcome of a bidding process which culminated in several days of intense negotiations at political level. Although somewhat arbitrary, their broad effect is to minimise each nation’s costs and share the pain equally. Nations which argued they would find cuts relatively costly because of their economic circumstances face smaller cuts (indeed, a few are allowed to increase their emissions). The Kyoto Protocol also makes provision for a range of mechanisms (see box 4A) which allow nations to import reductions by procuring, or purchasing the right to take advantage of, reductions in the emissions from other countries, rather than taking actions within their own borders. These mechanisms will bring down the costs of compliance.

4.43 If global emissions of greenhouse gases are to be substantially curbed, there will have to be both a willingness by developed nations to make further reductions and a willingness by developing nations to limit their emissions. Developing nations are now contributing some two-fifths of current greenhouse gas emissions. Their emissions have been growing by 5% a

year; while some decline in this rapid growth rate has been predicted, it is expected to remain above 3%.^{12, 13} Thus, global emissions are expected to continue rising, even though the Kyoto Protocol should result in a cut in developed country emissions. There is a strong argument that developing nations should be able to continue to increase their use of fossil fuels for several decades as their populations and economies grow.¹⁴ But there will have to be a rapid deployment of alternative energy sources in the developing world if there is to be an effective response by the world community to the threat of climate change.

4.44 The next step after effective implementation of the Kyoto Protocol must be negotiation of a new protocol which creates a transparent, rational and just means of ensuring greenhouse gas concentrations are kept below an agreed maximum, in accordance with article 2 of UNFCCC. Under any such agreement, each nation would be granted the right to emit up to a certain limit of greenhouse gases over a given period covering several years or decades. The combined total of global emissions would follow the rising and then falling pathway discussed above (4.33).

4.45 There has been extensive debate over the basis on which such emission quotas should be allocated. The Kyoto Protocol was based on negotiated reductions from each developed nation's level of emissions in 1990. This approach gives those nations which have produced the most greenhouse gases to date an unfair advantage, in the shape of 'grandfather rights' to continue making the largest emissions. That does not seem a fair basis on which to proceed in the long term, nor one likely to win widespread support in the developing world.

4.46 Alternative bases for national allocations have been proposed, with particular attention given to the need to secure the commitment of developing nations. For instance, allocations could be inversely related to past emissions, so that nations which have made the greatest historic contributions to climate change would have to make the largest reductions in future emissions (the UK would be among the leaders). It has been proposed that allocations to developing nations should be linked to their economic growth; as a nation's economy grew it would be allowed higher emissions, but only if the carbon intensity of the economy (5.10) declined at an agreed rate.¹⁵ Another suggestion is that developing nations should be exempted from any limitation on their emissions for a specified period of several decades.¹⁶ A similar approach was adopted, albeit over a much shorter time-span, in negotiating and amending the Montreal Protocol to the Vienna Convention, the UN treaty to phase out chemicals which deplete stratospheric ozone (4.57). This last suggestion has been strongly opposed in the USA, partly because of fears that investment in carbon-intensive industries would as a result be diverted to industrialising nations.

A *PER CAPITA* BASIS FOR EMISSION QUOTAS

4.47 Continued, vigorous debate is needed, within and between nations, on the best basis for an agreement to follow the Kyoto Protocol. **Our view is that an effective, enduring and equitable climate protocol will eventually require emission quotas to be allocated to nations on a simple and equal *per capita* basis. There will have to be a comprehensive system of monitoring emissions to ensure the quotas are complied with.** Adjustment factors could be used to compensate for differences in nations' basic energy needs. Those countries which regularly experience very low or high temperatures might, for instance, be entitled to an extra allocation *per capita* for space heating or cooling.

4.48 A system of *per capita* quotas could not be expected to enter into force immediately. At the same time as entitling developing nations to use substantially more fossil fuels than at present (which they might not be able to afford), it would require developed nations to make drastic and immediate cuts in their use of fossil fuels, causing serious damage to their economies.

4.49 A combination of two approaches could avoid this politically and diplomatically unacceptable situation, while enabling a *per capita* basis to be adhered to. The first approach is to require nations' emission quotas to follow a *contraction and convergence* trajectory. Over the coming decades each nation's allocation would gradually shift from its current level of emissions towards a level set on a uniform *per capita* basis. By this means 'grandfather rights' would gradually be removed: the quotas of developed nations would fall, year by year, while those of the poorest developing nations would rise, until all nations had an entitlement to emit an equal quantity of greenhouse gases per head (*convergence*). From then on, the quotas of all nations would decline together at the same rate (*contraction*). The combined global total of emissions would follow a profile through the 21st and 22nd centuries which kept the atmospheric concentration of greenhouse gases below a specified limit.

4.50 The upper limit on the concentration of greenhouse gases would be determined by international negotiations, as would the date by which all nations would converge on a uniform *per capita* basis for their emission quotas, and the intermediate steps towards that. It would probably also be necessary to set a cut-off date for national populations: beyond that date, further changes in the size of a country's population would not lead to any increase or decrease in its emission quota.

4.51 In table 4.1¹⁷ we have applied the contraction and convergence approach to carbon dioxide emissions, and calculated what the UK's emissions quotas would be in 2050 and 2100 for four alternative upper limits on atmospheric concentration. We have assumed for this purpose that 2050 would be both the date by which nations would converge on a uniform *per capita* emissions figure and the cut-off date for national populations.¹⁸ If 550 ppmv is selected as the upper limit, UK carbon dioxide emissions would have to be reduced by almost 60% from their current level by mid-century, and by almost 80% by 2100. Even stabilisation at a very high level of 1,000 ppmv would require the UK to cut emissions by some 40% by 2050.

Table 4.1

Contraction and convergence: implications for UK carbon dioxide emissions

maximum atmospheric concentration ppmv	permissible UK emissions in 2050 % of 1997 level	permissible UK emissions in 2100 % of 1997 level
450	21	11
550	42	23
750	56	47
1,000	58	61

4.52 The UK-based Global Commons Institute has taken the lead in promoting contraction and convergence, and has developed a computer model which specifies emission allocations under a range of scenarios.¹⁹ The concept has been supported by several national governments

and legislators. Some developed nations are very wary of it because it implies drastic reductions in their emissions, but at least one minister in a European government has supported it.²⁰ Commentators on climate diplomacy have identified contraction and convergence as a leading contender among the various proposals for allocating emission quotas to nations in the long term.²¹

4.53 The other ingredient which would make an agreement based on *per capita* allocations of quotas more feasible is flexibility of the kind already provided in outline in the Kyoto Protocol (4.42 and box 4A). Nations most anxious to emit greenhouse gases in excess of their allocation over a given period will be able and willing to purchase unused quota at prices which incline other countries to emit less than their quota, to the benefit of both parties. The clean development mechanism, which allows developed nations to claim emission reductions by sponsoring projects which reduce emissions in developing nations to levels lower than they would otherwise have been, can also be seen as a form of trading.

4.54 In the longer term trading by companies in emission permits, drawn from national emission quotas determined on the basis of a contraction and convergence agreement, could make a valuable contribution to reducing the global costs of stabilising greenhouse gas concentrations while transferring resources from wealthy nations to poorer ones. Trading needs to be transparent, monitored and regulated, and backed by penalties on nations which emit more than they are entitled to. If it became merely a means of enabling wealthy nations to buy up the emission entitlements of poor countries on the cheap, thereby evading taking any action at home, trading would not serve the cause of climate protection. Nor would it if developing countries which had sold quota heavily went on to emit in excess of their revised entitlements.

UK POLICY IN A GLOBAL CONTEXT

4.55 It will take several years, possibly decades, before agreement is reached on a climate change protocol which commits the majority of nations, developed and developing, to quantified limits on their emissions of greenhouse gases. Meanwhile there remains a great deal of negotiating to be done on the detailed mechanisms of the Kyoto Protocol. There is a risk that the number of ratifications needed to bring it into force (4.8) will not be reached in time to affect emissions in 2008-2012 (or, if it has not been ratified, that too few binding commitments will have been made voluntarily). If the USA, the world's largest emitter of greenhouse gases, were neither to ratify nor make the agreed reductions voluntarily, that would be likely to nullify the protocol. We conclude this chapter by considering what stance the UK should take amid this continued diplomatic uncertainty.

4.56 There is a dismal but real possibility of very limited progress in climate negotiations over the next decade, with the Kyoto reductions not being delivered and further commitments being modest or non-existent. Climate change would then continue unabated. It would become a case of *sauve qui peut*, with the peoples of some of the world's poorest nations suffering most. Alternatively, the Kyoto reductions may prove to be but a first step in progress towards concerted and effective global action. Over the next 50 years greenhouse gas reduction targets would then become progressively more demanding in order to prevent prudent maximum atmospheric concentrations from being exceeded.

4.57 The 1985 Vienna Convention on the Protection of the Ozone Layer offers a reasonably encouraging precedent. Over the decade following its adoption, as the severity of the threat to the Earth's protective ozone layer grew, and as the threat became better understood, a series of agreements were reached, commencing with the 1987 Montreal Protocol, which accelerated the

phasing out of ozone-depleting chemicals. Reducing emissions of greenhouse gases will, however, require vastly greater effort.

4.58 There are three reasons why the UK should strive, at home and abroad, to ensure that an effective international response to the threat of climate change is mounted, beginning now and extending far into the future. First, there is the moral imperative outlined above (4.18-4.19) which requires developed nations to take the lead in addressing the threat (as does UNFCCC, which the UK has ratified). Second, the more nations there are which hesitate, the less chance there is of concerted global action. Even if only a minority of nations adopt a 'wait and see' stance, this could jeopardise progress in future negotiations. Third, the UK is very likely to be harmed by climate change. Although the direct impacts of climate change within the UK are generally difficult to predict (see box 2D), adaptation to them is likely to be costly, and would become more costly if climate change is allowed to proceed further and faster. Adding the burden of climate change and necessary adaptation to the already complex set of parameters involved in development planning in this country will intensify the existing problems of delivering acceptable levels of environmental quality and protection. The UK would not, furthermore, be able to shut itself off from the economic, social and political disruption that climate change might cause elsewhere in the world, leading to mass migrations and international conflicts over scarce resources.

4.59 We have considered what the UK could do to help bring about international agreement on further effective action. To date it has been a leader in advocating early action to reduce the threat of climate change. Compared to other developed nations it is already obliged to make relatively large reductions in greenhouse gas emissions between 1990 and 2012; only four other nations, all EU Member States, are obliged to make larger reductions under the Kyoto Protocol. The government has set the further goal of reducing carbon dioxide emissions in 2010 to 20% below the 1990 level. In its evidence to us the Foreign and Commonwealth Office said:

The most effective role the UK can play [in influencing the development of international climate policies] is practical leadership. Many countries will be watching to see how the UK achieves its proposed 20% reduction in carbon dioxide emissions. Measures we use to help meet that aim will be the strongest influence we can provide to influence the policies of others.

The government's draft programme for achieving the 20% goal is discussed in the next chapter (5.46-5.60).

4.60 The question the UK now has to confront is what further action to take in advance of commitments by other countries and what further reductions it should be planning for the years after 2012. Our view is that nations which advocate strong preventive action should demonstrate their good intentions and commitment by taking measures which not only meet current obligations but also put them on a path to achieve the much more demanding targets which will be necessary if the threat of climate change is to be adequately addressed. They will then carry more weight in international negotiations on a future climate change agreement, especially if there are more than a small number of such nations and they include major economies. If the UK is to be effective in urging long-term, global action it must have, as well as some like-minded allies, a credible policy for reducing its own emissions over several decades, in particular emissions of carbon dioxide.

4.61 If, as we hope, there emerges a sustained global drive to reduce greenhouse gas emissions, to improve existing non-carbon energy sources and develop new ones, and to raise the energy efficiency of manufacturing and commerce substantially, there may be an economic advantage for nations whose industries take a lead in developing and deploying the necessary new

technologies. Irrespective of the threat of climate change, there is an expectation that the global market for non-fossil fuel energy sources will expand rapidly through this century in order to meet the growing demand for energy as conventional oil and, later, conventional gas reserves come under pressure. But while there are examples of 'first mover' status bringing economic success to some national industries, such as Denmark's wind turbine industry, that has not always been the case.

4.62 The issue for the UK however is, not so much whether to be a first mover as whether to catch up. While it has taken a lead in promoting international agreement on climate change, and has made early reductions in emissions, the UK trails several other European states in its development of renewable energy sources, the energy efficiency of its housing stock and the willingness of equipment and appliance manufacturers to improve energy efficiency. It will face real difficulties in maintaining emission reductions after 2012; we discuss this in the next chapter. High risks of losing existing markets, and failing to enter new ones, arise from being a laggard when energy production and energy efficiency technologies are changing rapidly in the UK's major competitors.

4.63 The privatisation of energy industries and the liberalisation of energy markets which the UK has pioneered (5.14) could create a good basis for encouraging new technologies if these changes bring a culture of innovation. We discuss in general terms in the next chapter (5.18-5.28), and in more specific contexts in later chapters, what forms of intervention can best be used to encourage energy companies operating in liberalised markets to move in directions that are environmentally desirable.

4.64 The development of an international market for trading greenhouse gas emission permits will help reductions to be made cost-effectively and could enable some nations to buy time to allow the technological options to be deployed. There is considerable interest in the UK in such trading, as shown by the work of the UK Emissions Trading Group and the encouragement the government has given.²² Two major energy corporations, BP Amoco and Royal Dutch Shell, have set up internal trading schemes. **We urge government to facilitate and encourage the creation of a national trading scheme, to help position the City of London – which has the necessary skills and capacity – as the world centre for international trading in emission permits when that emerges from the negotiations on implementing the Kyoto Protocol.**

4.65 The UK has already had some success as a broker of global deals on climate change, working on its own and as a member of the EU. Its commitment to make substantial early reductions in emissions has contributed to this success, even if its ability to do so has been largely fortuitous (5.48-5.49). The EU has proved to be a formidable force in climate negotiations, because of its importance to global trade and its demands for substantial emission reductions on the part of the developed nations.

4.66 We believe the UK, working within the EU, can strengthen its position as a broker of climate agreements if it develops a long-term strategy for reducing greenhouse gas emissions. Its EU and Commonwealth memberships and its links to the USA all favour this role. The UK will not be alone in urging action; several other European nations also appear willing to adopt this stance.

4.67 As the impacts of climate change become clearer, large developing nations which are major greenhouse gas emitters, such as China and India, may begin to change their current position of holding back from commitments to specific emission limitations. They may look to make common cause with the UK, the EU and others in putting pressure on nations with very

high *per capita* emission levels which currently seem prepared to do little to abate climate change. If, as seems possible, this issue comes to dominate international relations in the first quarter of the 21st century the political and diplomatic advantages to the UK of a leading position on climate change could be considerable.

4.68 We recommend that the UK should continue to play a forceful leading role in international negotiations to combat climate change, both in its own right and through the European Union. The government should press for further reductions in the greenhouse gas emissions of developed nations after 2012, and controls on the emissions of developing nations.

4.69 The government should press for a future global climate agreement based on the contraction and convergence approach (4.47-4.50), combined with international trading in emission permits (4.53-4.54). Together, these offer the best long-term prospect of securing equity, economy and international consensus.

4.70 To demonstrate its willingness to accept and implement an agreement based on the contraction and convergence approach, the UK needs to adopt a strategy now for making major reductions in greenhouse gas emissions in the period after 2012. In doing this, it will not only be anticipating the global climate agreement that will probably be concluded during the next two decades, but will also be improving the chances that negotiations will be able to bring about the large reductions that are needed in global emissions. The core of the strategy will have to be very large reductions in carbon dioxide emissions from the burning of fossil fuels. In part II of this report we consider UK energy policies in that perspective, in order to determine what the nature and content of a long-term strategy for carbon dioxide emissions should be.

Given current knowledge about humanity's impact on climate and IPCC's findings, we support 550 ppmv as an upper limit on the carbon dioxide concentration in the atmosphere. Major reductions in global emissions are necessary to prevent that limit being exceeded. The UK should be prepared to accept the contraction and convergence principle as the basis for international agreement on reducing greenhouse gas emissions, and should adopt a long-term strategy for reducing its own emissions