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Climate change: From science to global policies

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7.1 Introduction

It has become evident over the past few decades that human activities are significantly altering the atmosphere's composition and its radiative properties. This has resulted in global environmental problems such as climate change and ozone depletion, which have potentially far-reaching effects on society. The focus in this chapter is on global climate change and the process that eventually led to the United Nations Framework Convention on Climate Change (FCCC).

Before the Convention was signed at the United Nations Conference on Environment and Development (UNCED) in Rio in June 1992, various scientific trends and political mechanisms could be discerned interacting in an evolutionary process which is still far from being concluded today. Scientific progress is gradually improving our understanding of the impact of the atmospheric changes. At the same time, international consultation mechanisms have come into being which have facilitated the development of a global climate policy. Climate change affects the private sector, governments, non-governmental organisations, the scientific community and many other societal actors. It can probably be considered as the most complex public policy issue ever to have confronted the international community. The formulation and adoption of the Climate Change Convention has been a major exercise in conciliating an immense diversity of conflicting interests. By providing an overview of the numerous scientific and political dimensions of the climate change issue, this chapter seeks to explore how divergent interests were reconciled in the policy-making process.

Several developments will be discussed separately. First, section 7.2 elaborates on the causes of climate change and the related scientific and policy issues. Section 7.3 gives a historical discussion of how climate change came to be a topic of debate in the international scientific and political community and how it resulted in the Framework Convention on Climate Change. The development of a global treaty involving so many different parties has been a highly complex process. This is clearly understood if one concentrates on the differing and often conflicting starting points and interests of the major countries. In section 7.4 the contrasts between the major world regions in developing and implementing climate policies will be emphasised. Finally, section 7.5 draws some conclusions.

7.2 Science and policies

Any examination of the political process surrounding global warming must begin by looking at the scientific aspects of climate change. In turn, we shall look at physical causes, effects and the scientific uncertainties regarding climate change. Then we shall analyse climate policies, revisiting the causes, the impacts and the uncertainties of climate change.

Science: causes of climate change

The greenhouse effect is a natural phenomenon that keeps the Earth warmer than it would otherwise be. It is caused by so-called greenhouse gases. One distinguishes natural greenhouse gases, the main ones being water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3), and human made greenhouse gases such as chlorofluorocarbons (CFCs) and variants. Because of their physical properties, greenhouse gases permit short-wave radiation emitted by the Sun to pass through them, but absorb the long-wave infra-red radiation that is in turn emitted by the Earth. The Earth would be 33°C colder without this naturally occurring greenhouse effect (Watson *et al.*, 1990). Tropospheric water vapour (H_2O) is the single most important greenhouse gas yet its atmospheric concentration is not directly influenced by anthropogenic emissions (emissions originating from human activities). Instead it is influenced indirectly by temperature. Similarly, ozone (O_3) formation and degradation is not a direct but an indirect result of anthropogenic emissions. For this reason, H_2O and O_3 are not usually included in an analysis of climate change.

As is evidenced by Table 7.1, the chemical composition of the Earth's atmosphere is changing. This is mainly due to human activities. Since the Industrial Revolution,

Atmospheric concentrations[1]	CO_2	CH_4	N_2O	CFC-11	CFC-12
Units[2]	ppmv	ppmv	ppbv	pptv	pptv
Pre-industrial (1750–1800)	280	0.8	288	0	0
Present day (1990)[3]	353	1.72	310	280	484
Current rate of change per year	1.8 (0.5%)	0.015 (0.9%)	0.8 (0.25%)	9.5 (4%)	17 (4%)
Atmospheric lifetime (years)[4]	50–100	10	150	65	130

Explanation of notes: 1. Ozone has not been included in the table because of a lack of precise data.
2. ppmv = parts per million by volume; ppbv = parts per billion by volume; pptv = parts per trillion by volume.
3. The current (1990) concentrations have been estimated by an extrapolation of measurements reported for earlier years, assuming that the recent trends remain more or less constant. 4. For each gas in the table except CO_2, the 'lifetime' is defined here as the ratio of the atmospheric content to the total rate of removal. This time-scale also characterises the rate of adjustment of the atmospheric concentrations if the emission rates are changed abruptly. CO_2 is a special case since it has no real sinks but is merely circulated between various reservoirs (the atmosphere, ocean and biota). The 'lifetime' of CO_2 given in the table is a rough indication of the time it would take for CO_2 concentrations to adjust to changes in the emissions.

Table 7.1 Summary of key greenhouse gases influenced by human activities (Source: Watson *et al.*, 1990.)

atmospheric CO_2 concentrations have risen by 25%, from 280 to over 350 parts per million. This anthropogenic influence has increased in significance during the period since 1960. The sources of greenhouse gases are very diverse. The anthropogenic increase in CO_2 is principally the result of the burning of fossil fuels such as coal, oil and gas and changes in land use (e.g. deforestation). CH_4 originates from cattle, sheep, landfills and wet rice production. N_2O is emitted primarily by chemical processes in the soil and water surface as a result of, for instance, fertiliser use. Finally, CFCs and HCFCs are industrially manufactured gases, used in refrigerators, foam blowing and solvents. An examination of Table 7.1 demonstrates that the anthropogenic influence on the radiative balance, and thus on the climate system, is already significant and, as stated by the Intergovernmental Panel on Climate Change (IPCC), will ultimately lead to perceptible climate changes (see also section 7.3).

Science: impacts of climate change

If the emissions of greenhouse gases in the atmosphere are not reduced (the *business as usual* emission scenario), the IPCC forecasts that the mean global temperature will rise over the next 100 years at a rate of approximately 0.3°C per decade (with an uncertainty range of 0.2°C to 0.5°C per decade) (Houghton *et al.*, 1990; see also section 7.3).

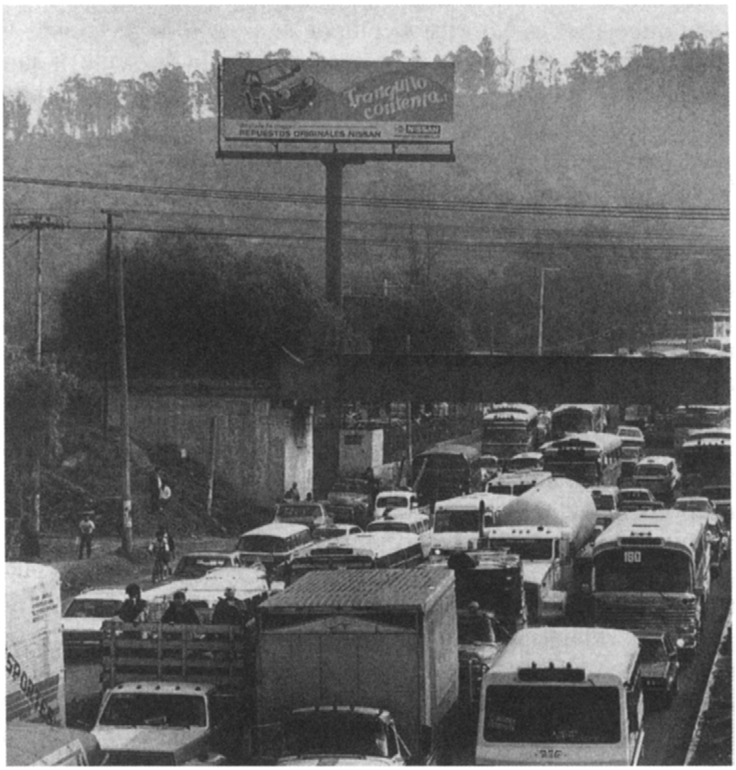

Plate 7.1 Smog hanging over Mexico City due to extensive traffic. Photo: Ron Giling/Lineair

The impacts of climate change vary significantly from region to region and from season to season. The degree of warming is predicted to be 50–100% above the global mean in high Northern latitudes in winter. Land surfaces will warm up more rapidly than the ocean. Precipitation is expected to increase in middle and high latitudes, especially in winter. Increased precipitation is also expected in the tropics (Mitchell *et al.*, 1990). Consequently, global warming will initiate a shift in climate zones. Estimates show that a temperature increase of 1° would cause the climatic boundaries of agriculture in the Northern hemisphere to shift to the north by 200–300 kilometres (Izrael, 1991). Adaptation (probably through trial and error due to the inevitable uncertainties) to the new conditions will be required, creating considerable ecological and economic costs.

The impact on society may well be felt particularly keenly in the form of a rise in the sea level, caused by the thermal expansion of the water as well as the more rapid melting of glaciers and polar ice sheets. Warrick and Oerlemans (1990) estimate that the predicted increase in temperature will lead to a rise of 3–10 centimetres per decade. Even if action is taken to reduce global emissions, the sea level is still likely to rise significantly during the next century on account of the greenhouse gases which are already present in the atmosphere. Low-lying coastal areas, where both population and agriculture are often concentrated, are directly threatened and the long-term existence of the small island states is at stake (Gilbert and Vellinga, 1990).

A costly impact of climate change on society is the change in the patterns, frequencies and intensities of extreme weather events. Although science is not able to explain this phenomenon adequately, the recent increase in the scale of damage caused by extreme weather events may be an indication of the predicted relation between temperature rises and more severe weather. A northward shift in the pattern of gales and hurricanes, exposing unprepared and more vulnerable areas, would have a particularly severe social impact. In addition, other types of climate extremes such as high-temperature events (over 35°C) are expected to occur more often, causing increased droughts. At the same time, cold waves will be less frequent and less intense. Such effects could be damaging to agricultural productivity. Milder winters will increase crop damage caused by insects and pests during the summer. Also, certain trees need a period of frost in order to bear fruit. The IPCC (1990) also predicts a shift from gradual precipitation to heavy local rainfall. Consequently, there will be a greater risk of river flooding.

The climate change, however, will also have a positive impact on agriculture in the form of the so-called *fertiliser effect* exerted on plant growth by a higher atmospheric CO_2 concentration. So far, however, experiments have not been able to give conclusive proof of the nature of the overall effect of climate change on agricultural productivity. If anything, research suggests that an increased CO_2 concentration may indirectly limit, rather than enhance, plant growth. The mineral nutrient uptake by microflora supposedly becomes enhanced, resulting in a lack of nutrients for plants (Diaz, 1991). Also, climatic change will have effects besides CO_2 fertilisation, such as temperature changes, extreme weather events, soil moisture changes, changes in precipitation, pests, etc., all of which will have an impact on agriculture. Regional computer models which attempt to take account of the full range of these impacts point to a decrease of 10–15% in agricultural output in Africa, Latin America and certain parts of India and South-east Asia (Fischer *et al.*, 1993).

Global warming is also projected to have far-reaching effects on health. Although winters will be less severe and consequently cause less illness and fewer deaths, the negative impact of milder winters is likely to overshadow these benefits. Temperature rises and precipitation changes will affect vector (disease-transmitting) species such as mosquitoes, as well as the quality of the water and air and stress conditions. Morbidity and mortality will probably increase as a result of an increased incidence of respiratory, vector-borne and water-related diseases. In addition, heat waves will occur more often, causing increased stress, especially in urban areas. At the same time, local food shortages should be expected as a result of poor harvests (Rouviere *et al.*, 1990). The less resilient members of the population will be most vulnerable and will consequently suffer most.

In addition to a gradual change in the climate system, sudden instabilities cannot be ruled out. Palaeo-records indicate that some 10,000 years ago the temperature probably increased by 7°C over a period of only 50 years. During that period, the sea level rose at a rate of several metres per century. A sudden change in ocean currents from one quasi-equilibrium pattern to another equilibrium pattern is the most plausible explanation. Model experiments have confirmed that such a type of shift may also be triggered by increasing greenhouse gas concentrations in the atmosphere. A most intriguing aspect of such 'flip-flop' climate changes is that they seem to be irreversible.

Yet another threat posed by human-induced climate change is the so-called *runaway greenhouse effect*. Global warming may lead to the release of additional greenhouse gases by vegetation, the ocean and the soil. In this way, the greenhouse effect would be a self-accelerating phenomenon fed by positive feedbacks. This could happen, for instance, if large quantities of methane were released as a result of the thawing of tundra soils, which would in turn exacerbate the greenhouse effect. Similarly, the Earth may respond by absorbing more greenhouse gases through ocean current shifts and/or plant growth. Such effects are still highly uncertain. Current observations, however, suggest that positive feedbacks may dominate (Houghton *et al.*, 1992).

Scientific uncertainties

A major constraint restricting the action which can be taken to curb climate change is the various uncertainties we are faced with. At present, uncertainties exist with regard to almost every aspect of the greenhouse effect: the sensitivity of the average global temperature and mean sea level to the increase in greenhouse gases, the timing of the expected climate change, the natural variations in the climate, and the regional climatic impacts. This may well produce a state of paralysis among stakeholders, who may hence postpone decisions or the implementation of emission-reducing measures (De Freitas, 1991). Substantial scientific progress would need to be made in order to overcome these uncertainties. However, there is only a slight chance of such uncertainties being resolved quickly. It is indeed likely that the effects of climate change will actually be felt before any full scientific consensus is achieved on the subject. Given the largely irreversible nature of climate change and its long-term nature, postponing action in the hope that new information will resolve or at least reduce present uncertainties is a dangerous strategy.

How should scientific uncertainties be dealt with? Current options include the development of new production and consumption technologies in order to limit the costs of reduction and the accomplishment of immediate reductions in emissions with the aim of curbing the global warming process. Each of these options is essential for a timely response (Manne & Richels, 1991).

Above all, one must be aware of the relationship between uncertainty about the consequences of accelerated climate change and the effectiveness of response options, especially as to how this relationship changes over time. Figure 7.1 illustrates the trade-off between effectiveness and certainty. Measures to reduce emissions taken today will have a lasting and immediate effect on the future emission level of greenhouse gases. Similar limitation measures taken in 2050 (rather than now) will obviously be insufficient to obtain the same emission reductions which could have been achieved by then if action had been taken now. The present effectiveness of emission limitation is therefore high. At the same time, the present degree of certainty with regard to the greenhouse effect is low. Certainty is likely to increase in the future as a result of scientific research and monitoring; then policy makers will be more confident about the measures to take. However, as has already been argued, these measures will be less effective (Vellinga & Swart, 1991).

There are basically two types of policy which can be used as a means of responding to the possible impacts of climate change. First, *emission reduction measures* or *carbon sequestration* can be initiated in order to minimise the causes of global warming. This response is called a *limitation policy*. Second, one can focus on the effects of climate change and apply *adaptation policies*, such as building higher dykes as protection against rises in the sea level. The two policies are closely related: the less one limits climate change, the greater the costs of adaptation are likely to be. Yet, even if the focus is entirely on limitation, adaptation measures will still be indispensable, since limitation measures can never fully eliminate climate change. The climate scenario studies published by

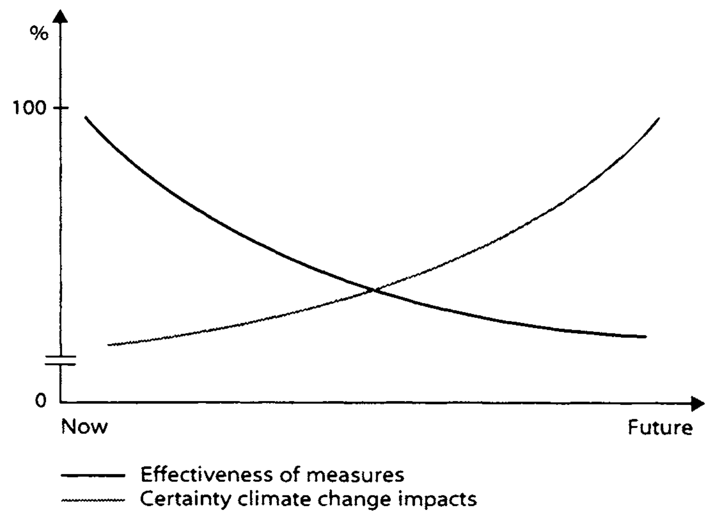

Fig. 7.1 The policy dilemma: the trade-off between the effectiveness of measures and scientific uncertainty. Source: Vellinga and Swart, 1991

Working Group I of the IPCC suggest that control policies on emissions can slow global warming, perhaps from 0.3°C/decade to 0.1°C/decade (IPCC-RSWG, 1990). An appropriate climate policy will therefore not focus on either one of these policy options, but will use a combination. In what follows we will discuss both limitation and adaptation strategies. However, both policies are constrained by the existence of scientific uncertainties. How to deal with them will conclude this section of the chapter.

Policies addressing causes

At present, most limitation policies focus on the reduction of greenhouse gas emissions and follow a 'gas by gas' approach (see Box 1). The reasoning behind this is that, as the exact *greenhouse warming equivalents* for all the various greenhouse gases are not yet known with any degree of certainty, it is more sensible to tackle the gases separately in the first phase of policy making. Once the exact global warming potentials are known, a 'comprehensive' gas policy can be applied, with trade-offs between gases. With such a comprehensive approach, a combination of the most effective measures is chosen irrespective of the greenhouse gas on which they are focused (Rijsberman *et al.*, 1993).

A policy designed to tackle the causes of climate change generates both short-term and long-term positive side effects. Such measures can be justified even in the face of scientific uncertainties because they make sense for reasons other than climate change. They may therefore be characterised as *no-regrets policies* (Bodansky, 1993). Limitation measures such as the improvement of energy efficiency will, for example, also enhance economic performance, reduce other pollutant emissions and increase energy security, besides reducing CO_2 emissions. Similar positive side effects can be realised with other limitation measures such as the use of cleaner energy sources and technologies, improved forest management and the expansion of forest areas, the phasing out of CFCs, improved livestock waste management and changes in fertiliser use.

Global warming potentials and equivalents

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By definition, each greenhouse gas is able to make a specific contribution to global warming. This potential contribution of a greenhouse gas is called its *global warming potential*. The global warming potential of a greenhouse gas depends on its capacity to absorb radiation and on its atmospheric concentration. The more it is able to absorb and the higher its concentration, the larger its contribution.

Suppose we know that gas A has an absorption capacity twice that of gas B. With identical amounts of A and B, A's contribution to global warming is twice B's. Conversely, for a given contribution, the allowable concentration of gas A is half that of gas B. One may thus exchange gas A for gas B, provided one keeps in mind that per unit A's contribution is twice B's. This is what is meant by the *greenhouse warming equivalents* of A and B, the extent to which A can be exchanged for B.

At present, although we know much about the concentrations of the various greenhouse gases, we know relatively little about their absorption capacities. Therefore, it is impossible to calculate greenhouse warming equivalents and one is forced to follow a gas by gas approach.

In the longer term, limitation policies will go hand in hand with the achievement of sustainable development. Sustainable development in this respect implies both increasing the efficiency of resource use and striving for renewable resources and thus lower greenhouse gas emissions. Long-term measures should be implemented at both national and international levels. Examples of long-term limitation measures are accelerated and co-ordinated research programmes, the development of new technologies (in particular renewable ones such as in relation to solar and biomass energy), review planning, the encouragement of beneficial behavioural and structural changes and the expansion of global observation and monitoring systems (IPCC-RSWG, 1990).

The international dimension of limitation policies is of great significance. Climate change is probably the most prominent cross-border environmental problem on Earth. The global weather and climate system has the effect of continuously mixing the greenhouse gases around the Earth. Emissions of greenhouse gases in one location will thus eventually cause damage on the other side of the planet; indeed, every nation will be affected by them one way or another. Emissions originate from all parts of the world so only a worldwide limitation strategy can be effective.

Limitation measures should be initiated by the developed or industrialised countries. Such an argument is legitimate for historical reasons, given the present emission situation and the current capacities of these countries to limit emissions. At present, the developed countries, which account for only 20% of the world's population, are responsible for approximately 75% of global CO_2 emissions. Projections suggest that business as usual conditions will lead to modest but constant growth in the level of emissions in the developed countries. The developed countries may therefore be expected to take the lead in addressing the climate change problem. It is very likely that emission reductions of 1–2% per year in these countries will be necessary to keep climate change within 'acceptable limits'. At the same time, CO_2 emissions from developing countries are growing fast, in keeping with their need to meet their development requirements. Over time, these are likely to represent an increasingly significant percentage of global emissions. Estimates show that CO_2 emissions in developing countries, which are currently growing by 4% per annum, will equal those in developed countries by the year 2030 and will exceed them thereafter (Vellinga and Swart, 1991).

A global strategy is required in order to achieve a situation in which the developed countries reduce greenhouse gas emissions and the developing countries simultaneously redirect their economic development into a low-emission growth track. Figure 7.2 depicts a conceivable scenario in which the developed countries take the lead in short-term emission reductions and the developing countries moderate the average growth in emissions (i.e. 2% annual growth instead of the present 4% per year) for the next 40 years, after which they actually succeed in reducing the level of emissions. The newly industrialised countries (Hong Kong, Singapore, South Korea, Taiwan), where CO_2 emission rates are currently growing at 4–6% per year, will need to follow the reduction rates of the already industrialised countries considerably earlier.

International political consensus on a global strategy is essential for such a development to take place. Unfortunately, there are several obstacles blocking such an agreement (Bodansky, 1993). First, because the causes of the greenhouse problem are deeply embedded in the world economy, stakes in the negotiations are very high. Many

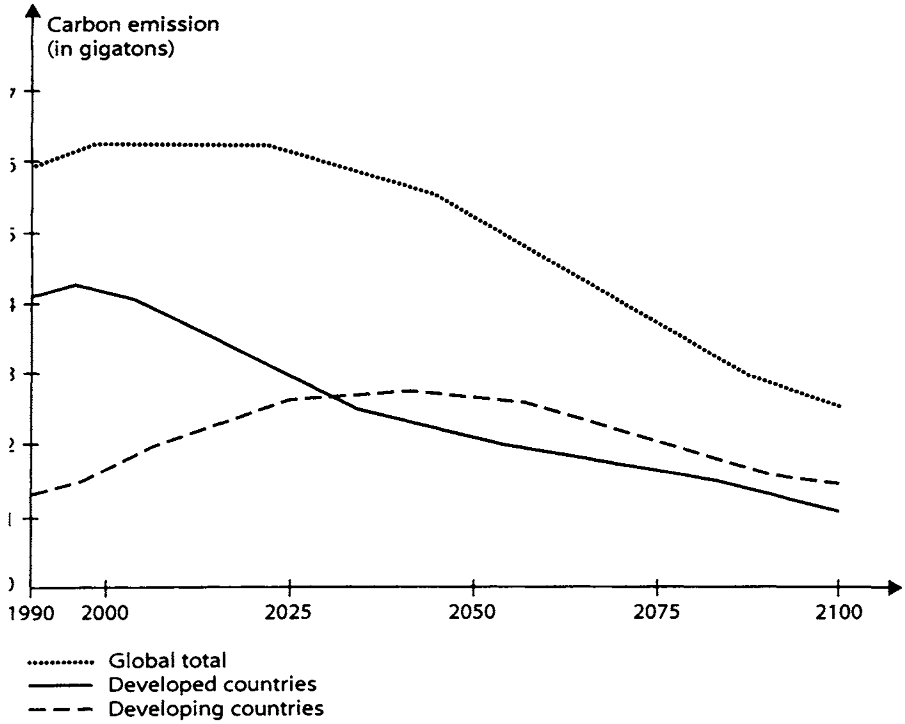

Fig. 7.2 A conceptual strategy for industrialised countries (developed and developing) for limiting and reducing global fossil fuel carbon emissions. Source:Vellinga and Swart, 1991

different sectors, such as transportation, industry, agriculture and forestry, are involved. Consequently, as a result of the diverse economic and social characteristics of the various countries, the interests involved are also highly divergent. For instance, as will be explained below, the stakes of the so-called small island states are completely unlike those of OPEC members. Another obstacle is the large number of parties participating in the political process. While there is a need for involving every nation in the world (more than 150 states participated in the UNCED Conference in Rio de Janeiro), this tends to slow down the negotiations. The process is further complicated by its multidimensional character. Not only do negotiations take place among the developed countries, the negotiations also redefine the North-South dialogue and the debate among developing countries. A final constraint, and one which has been continuously dominant during the climate negotiations, is the existence of scientific uncertainties with regard to almost every aspect of climate change. To this we will give attention after having discussed the second coping strategy – adapting.

Policies addressing impacts

Unlike limitation policies, *adaptation policies* do not focus on the causes of climate change. Rather, they concentrate on the impacts. For example, crop planning in the agricultural sector can be adjusted to changing climatic conditions. Adaptation policies are critically important for a number of reasons which are independent of limitation policies. Because it is believed that there is likely to be a time lag between emissions and subsequent climate change (owing to the greenhouse gases which have already accumulated), the global climate is already bound to change. Adaptation measures will therefore be inevitable, regardless of any limitation actions that are taken.

As is the case with limitation policies, adaptation policies may generate beneficial side effects. For instance, coastal vulnerability research helps to identify areas which are potentially at risk of suffering damage from a sea level rise or extreme weather events. At the same time, the findings of such research can lead to better protection against normal weather extremes and climate variability. Similarly, beneficial effects can be generated through adaptation strategies in the field of resource use and management, addressing the potential impacts of global climate change on food security, water availability, natural and managed ecosystems, land and biodiversity. In other words, adaptation policies also encompass numerous no regrets options.

The precise impact of climate change on natural resources and human activities is poorly understood, although our level of understanding is gradually improving. There are two basic types of adaptation strategy. On the one hand, specific measures can be aimed directly at specific effects on specific sectors. This *effect by effect* approach takes no account of the fact that one sectoral measure may affect other sectors. On the other hand, an *integrated approach* can be applied which includes the integration of programmes and plans for economic development and environmental quality management.

Policies addressing uncertainties

Scientific uncertainties can never be fully eliminated and will therefore continue to confront policy makers and other economic participants (Sloep and Van Dam, 1995). If an experiment does not confirm or disprove a certain theory or hypothesis, scientists can afford to continue and gather more information; but policy actors cannot afford to wait, they must choose a course of action. Many policy makers have adopted the *precautionary principle* as a means of dealing with uncertainties (see Box 2). This principle says that, rather than await certainty, governments should act in anticipation of environmental harm to prevent harm from occurring. Its essence is encapsulated in the old saying 'an ounce of prevention is worth a pound of cure' (Bodansky, 1991).

The precautionary principle

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The precautionary principle originates from marine pollution issues. It is mentioned in Article 3 of the Framework Convention on Climate Change. The article reads as follows:

> The parties should take precautionary measures to anticipate, prevent or minimise the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures ...

Carried over to the climate problem, this means that the risks associated with a rapid increase in the anthropogenic greenhouse gas concentration and its related influence on the global climate form adequate grounds for initiating greenhouse gas emission reduction measures; the uncertainties currently surrounding climate model simulations should not be used as an argument for not taking precautionary measures (Jansen *et al.*, 1993). The IPCC explains that an immediate emission reduction of over 60% would be required in order to stabilise atmospheric greenhouse gas concentrations at today's levels (Houghton *et al.*, 1990). The human race has only one planet at its disposal; 'experiments' such as accelerated climate change, with their potentially far-reaching consequences for future generations, have moral implications of an unprecedented nature.

However, although the precautionary principle is useful as a general goal, it is unsuitable as the ultimate solution to climate change. As it does not specify how much caution should be used, it is too vague to serve as a regulatory standard. In order to know how and when to apply the precautionary principle, one needs to know the risks and uncertainties associated with particular activities.

In order to get a better notion of the risks involved, decision models should be applied to understand, for instance, the consequences of an *act then learn* scenario versus a *learn then act* scenario. In fact, a *learn* and *act* scenario is often regarded as the optimum strategy (Manne & Richels, 1993). In addition, precautionary measures would have a sounder basis if scientists were more often prepared to quantify the extent of certainty or uncertainty in terms of probabilities (Tol & De Vos, 1993). Only then could decision makers comprehend the costs and benefits of taking, or not taking, a measure with regard to the complex climate problem. One way of avoiding the consideration of uncertainties is by limiting climate policy to no-regrets measures. Within this option, priority is given to instruments that serve a number of objectives (e.g. social, employment and environmental) and simultaneously result in a reduction in greenhouse gas emissions. In fact, such policy cannot be viewed as a true climate policy, since these measures already make sense for reasons other than climate change.

There are several halfway houses in between the two extremes of no-regrets and the measures that follow from the precautionary principle. Traditionally, uncertainties have been excluded by instituting insurance premiums to compensate for unforeseen events. The halfway house policies thus initiate no-regrets measures plus additional investments in emission limitation as an insurance premium. Such an insurance premium is paid in order to compensate partly for the damage which will be caused if climate change is found to be taking place, as well as to avoid having to implement drastic action at short notice.

Policy making to deal with climate change, then, must face two major problems. One is the fact that, in the face of uncertainty about the causes and impacts, there is relative uncertainty about the effectiveness of possible strategies. Related to this problem of uncertainty and compounding it is the fact that there are many conflicting interests both now and in the future. Each will have a particular perception of relative priorities of economic development and environmental protection which will influence the nature, timing and extent of the strategies adopted.

Whatever strategy is adopted by policy makers, there is no guarantee that serious environmental damage will be prevented. Many of today's most serious problems were not anticipated at the time when they arose and would probably not have been prevented even if the then decision makers had adopted the most cautious approach (Bodansky, 1991). Nevertheless, there is no justification for ignoring accelerated climate change while scientists point to the possible dangers. It is for this reason that the problem of climate change has been recognised by the international community and has evolved into probably one of the most complex public policy issues ever to confront decision makers, involving a wide range of participants varying from heads of state to local officials and multinational industries to environmental organisations throughout the world (Reinstein, 1993a).

7.3 Historical developments

The international negotiations on the Framework Convention on Climate Change took place between February 1991 and May 1992, under the auspices of the Intergovernmental Negotiating Committee (INC) created by the United Nations General Assembly in its Resolution 45/212 passed on 21 December 1990. Unofficially, the negotiations began earlier and, no doubt, will continue for many years to come. In this section, the historical development of the negotiations will be described from three different angles: the scientific, the national political, and the UN political in order to draw out the interests involved and the conflicts that had to be solved.

The scientific angle

Climate change was signalled in the 1970s. The first global debate on climate change was launched by the World Climate Conference in 1979, which was organised by the World Meteorological Organisation. There, Climate change was recognised as a serious problem. The Conference ended with the formulation of the following declaration:

> The Conference finds that it is now urgently necessary for the nations of the world: [...] to foresee and to prevent potential man-made changes in climate that might be adverse to the well-being of humanity.

Six years later, the World Meteorological Organisation organised a meeting with the United Nations Environment Programme (UNEP) and the International Council of Scientific Unions at Villach, Austria, with the aim of discussing the role played by greenhouse gases in causing climate variations. Scientists from both developed and developing countries concluded that:

> ... increasing concentrations of greenhouse gases are expected to cause a significant warming of the global climate in the next century.

In 1987 the report *Our Common Future*, commonly known as the Brundtland Report, was published by the World Commission on Environment and Development. It pays considerable attention to the risks associated with anthropogenic climate change:

> How much certainty should governments require before agreeing to take action? If they wait until significant climate change is demonstrated, it may be too late for any counter-measures to be effective against the inertia by then stored in this massive global system.

In response to the call for action by the World Commission, the government of Canada invited 300 world experts to the Toronto Conference on the Changing Atmosphere, held in 1988 in Toronto, Canada. For the first time, scientists and policy makers convened to discuss climate change. The Toronto Conference concluded with the recommendation that countries should '[...] reduce CO_2 emissions by approximately 20% of 1988 levels by the year 2005 as an initial global goal'. This historical target is referred to by the international community as the *Toronto Target* and has had a great impact on the debate on climate change. Its influence is now waning, however, as fewer and fewer countries regard its attainment as feasible.

Later in the same year, the Intergovernmental Panel on Climate Change, to which we already have referred, was established under the joint auspices of the World Meteorological Organisation and UNEP. This panel was charged with assessing the scientific information relating to the various components of the climate change issue and formulating realistic response strategies for the management of this problem. Three working groups were formed for this purpose to study the scientific aspects, the impacts and the response strategies, respectively. A special group was also set up in order to facilitate the participation of developing countries in the IPCC process.

Each working group took two years to complete a detailed review of the state of knowledge in its area of expertise. At its fourth Plenary Meeting in Sundsvall, Sweden, in August 1990, the IPCC approved this First Assessment Report. It concluded that, under a business as usual scenario, there would be an average increase of 0.3°C per decade in mean global temperatures, which would result in a rise of six centimetres per decade in the sea level, and that policy measures could be taken to limit this to 0.1°C per decade. The IPCC discussed various limitation and adaptation strategies such as improved energy efficiency, promoting the use of clean energy sources, improved forest management, phasing out the use of CFCs, improved waste management, developing emergency plans especially for risk-prone areas, etc. In addition, the IPCC recommended that countries should start to negotiate a convention (Rochon *et al.*, 1990).

In February 1992, the IPCC issued a supplement to its 1990 report, incorporating the work done in the intervening year and a half and essentially reaffirming the conclusions drawn in 1990. This supplement was intended to assist the INC negotiations, which were at that point approaching their final phase. The negotiations were motivated, however, almost entirely by political forces rather than by scientific analysis and as the IPCC supplement simply confirmed earlier scientific findings, it had little impact on the outcome of the negotiations. (This section is based mainly on Wolters *et al.*, 1991.)

The political angle

In the meantime, political momentum was building up. The year 1989 was one of great political debates on climate change. The first international political agreement dealing explicitly with the issue of climate change was a resolution adopted at the 43rd session of the UN General Assembly on 27 January 1989. This resolution was formulated as a direct response to a proposal put forward by the government of Malta and as an indirect response to the growing international consensus reflected in meetings beginning with the first World

Climate Conference in 1979, and including the conference held at Villach, Austria, in October 1985, to which we have already referred, and the Toronto Conference in 1988.

In March 1989, at the invitation of France, Norway and The Netherlands, representatives of 24 countries, including 17 heads of state or government, were invited to a summit meeting in The Hague to consider the issue. Here, they declared their commitment to addressing the problem of climate change (The Hague Declaration). The original goal of the meeting was to develop a new regime (along the lines of the UN Security Council) on global environmental issues. In the event, this goal proved to be beyond the reach of consensus. Nevertheless, the fact that heads of state were discussing climate change reflected the increasing importance of the issue.

Another political meeting was held in Dakar, Senegal, where the heads of French speaking countries met in May 1989 to endorse The Hague Declaration and to set an agenda for action. A number of other political initiatives were taken in that same year and these paved the way for a focused debate on various aspects of the issue of climate change in Noordwijk in The Netherlands. This led to the adoption of the Noordwijk Declaration on Climate Change by 67 countries in November 1989; the declaration proposed, *inter alia*, the following long-term target:

> Stabilising the atmospheric concentrations of greenhouse gases is an imperative goal. The IPCC will need to report the best scientific knowledge as to the options for containing climate change within tolerable limits. Some currently available estimates indicate that this could require a reduction of global anthropogenic greenhouse gas emissions by more than 50%.

Clearly, the trend of increasing emissions needed to be reversed in order to stabilise the atmospheric concentration of greenhouse gases. This is why the initial goal was to stabilise emissions in the short term. Simultaneously, it was agreed that sink management (i.e. forest preservation and replanting) should be improved. The following step was to be a reduction in greenhouse gas emissions. Consequently, the following short-term targets were formulated in Noordwijk:

> *CO_2 Target*: In the view of many industrialised nations, such stabilisation of CO_2 emissions [at 1990 levels] should be achieved as a first step at the latest by the year 2000.
> *Forestry Target*: Agrees to pursue a global balance between deforestation on the one hand and sound forest management and afforestation on the other. A world net forest growth of 12 million hectares a year at the beginning of the next century should be considered as a provisional aim.

This meeting had considerable political impact internationally and later that month the Maldives hosted the Small States Conference on Sea Level Rise (at Malé), where climate change was discussed for the first time by the vulnerable small island states. By the end of 1989, climate change was very high on the international agendas of both developing and industrialised countries.

In April 1990, the then US president George Bush invited policy makers from several countries to the White House Conference on Science and Economics Research related to Climate Change. The Conference strongly supported the need to integrate scientific and economic research on global change as an alternative to the more difficult measures of emission control. Later that year (in May), the ministers of the

Economic Commission of Europe (ECE), a United Nations regional grouping of Western Europe, Eastern Europe and North America, met in Bergen, Norway, in order to prepare for the forthcoming UNCED, scheduled for June 1992 in Rio de Janeiro, Brazil. The ministers formulated an explicit definition of the precautionary principle, which they felt should guide the action and policies which were required to address the problem of climate change. The first regional target on this issue was set when the European Council met in October 1990 to establish a CO_2 target for EU countries as a whole.

This was clearly a political signal intended for the Second World Climate Conference , which was due to be held the following month in Geneva (November 1990). This conference was attended by 137 countries and can perhaps be described as the biggest governmental meeting focusing on environmental issues prior to UNCED. Several questions which had arisen in the previous conferences were addressed. The precautionary principle was accepted as an integral part of any global strategy:

> In order to achieve sustainable development in all countries and to meet the needs of present and future generations, precautionary measures to meet the climate challenge must anticipate, prevent, attack, or minimise the causes of, and mitigate the adverse consequences of, environmental degradation that might result from climate change. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent such environmental degradation.

In determining who must take the initiative, the conference declaration furthermore stated:

> Recognising further that the principle of equity and the common but differentiated responsibility of countries should be the basis of any global response to climate change, developed countries must take the lead.

Prior to the Second World Climate Conference, the members of the EU had committed themselves to stabilising CO_2 emissions at 1990 levels by the year 2000. They were joined shortly before the conference by the members of the European Free Trade Association. Canada, Australia, and New Zealand independently adopted similar political commitments, in some cases including other greenhouse gases. Japan, which had been cautious to that point about commitments which could seriously affect its energy costs and hence its industrial competitiveness, also joined the EU and the OECD countries mentioned. Among developed countries, only the United States was without any kind of emissions target. In the end, the conference's ministerial declaration basically finessed the issue by calling on the developed countries to:

> ... establish targets and/or feasible national programmes or strategies which will have significant effects on limiting emissions of greenhouse gases not controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer.

Since most countries already had either a target or a national strategy, this appeal had little impact on those countries attending. Nevertheless, the conference was an important event because, for the first time, developing countries participated as equal partners in the discussions and made clear that North-South issues would play a prominent role in the coming negotiations. (This section is based mainly on Reinstein, 1993a.)

The UN policy development angle

For many years, the issue of the transfer of money and technology from the developed countries to developing countries has been the subject of considerable debate. The climate issue provided a new opportunity to revisit these old concerns.

Against this background, the UN General Assembly met in the autumn of 1990 and began a debate that resulted in Resolution 45/212. Two themes emerged during the discussions. One was the question of *form and process*, namely the relationship between the Intergovernmental Negotiating Committee (INC) established by the resolution and other UN bodies, including the General Assembly itself. The other was the *substantive nature of the commitments* which were to be negotiated: would there be separate protocols on CO_2 emissions by the energy sector, the forestry sector and so on and, in view of earlier resolutions passed by the General Assembly, to what transfer of money and technology would the developed countries be willing to commit themselves?

With regard to the first question, it was decided that no parallel negotiations outside the INC would be held on the protocol. The question of the financial and technological wishes of developing countries was more difficult to resolve and continued to be a major issue throughout the negotiations. In the end, Resolution 45/212 simply considered that the climate negotiations 'should be completed prior to the UNCED conference in June 1992 and opened for signature during the Conference'. The resolution also reaffirmed the concerns of all states about climate change and the specific needs of developing countries.

In the two years still left until the Rio conference, several meetings of the INC were held and various issues were discussed. The participating groups took divergent positions. Countries whose economies were in a state of transition (mostly in Central and Eastern Europe) had trouble reaching and adhering to the proposed targets, while developing countries wanted to discuss the provision of fresh financial support and the transfer of technology. As a first step, the negotiating process was distributed over two working groups, which were chaired by different countries providing the best possible representation of the many interests that would have to be reflected in the negotiations.

Once this had been done, various strategies for tackling the climate problem were discussed. From the outset, the United States argued for a *bottom-up* or no-regrets approach. Such an approach would start with taking actions that were already justified for reasons other than climate change. However, it could not be guaranteed to produce a specific result. Other countries were in favour of a *top-down* approach. This would involve laying down targets and timetables for greenhouse gas reductions. A compromise was introduced by Japan: the concept of *pledge and review*. Each country would 'pledge' either targets and timetables or a national programme or strategy (or both). Other countries could then formally 'review' or comment on these efforts and, as appropriate, make suggestions for improving them in the next 'pledge' cycle. Although formal agreement was far from being achieved, the deadlock was finally broken at the end of the fifth session of the Committee, when the US and the UK worked out the wording of the compromise deal that shows great similarity to Article 4(2) described below.

The last negotiating session before the Rio conference took place in New York in May 1992 (INC-5, second part). The final text was very carefully drafted so as to satisfy as many countries as possible, including all the developed countries. On the evening of 9 May 1992, the world's first truly global environmental agreement, providing a dynamic link between environmental protection and economic considerations, was finally signed by 155 States and the EU. 'It is a package which contains something for almost all of the negotiating States, but leaves none entirely satisfied' (Sands, 1992)

The relationship between scientific evidence and policy strategies was shaped by the conflicting interests of the different parties. At the international level it is possible to distinguish broad contrasts in the interests of the major world economic realms; that is, the industrialised North, the economies in transition in the former communist bloc and the developing countries of the South.

7.4 Climate change: regional aspects

During the course of the negotiations leading up to the Convention the diversity of conflicting interests both within and between the major world groupings became apparent. These interests manifested four dimensions.

Firstly, and most importantly, the interests were based on the *economic features* of certain countries. Broadly speaking, three economic clusters were formed: the developing countries, the countries with economies in transition and the developed countries. Secondly, *physical conditions* also played a significant role. A country such as Switzerland has less to fear from a sea level rise than Bangladesh. The *energy dependency* and CO_2 emission conditions of the various parties provided a third dimension. Table 7.2 depicts the differences in CO_2 emissions in the major countries. Finally, *political factors* influenced the final draft of the Convention. For instance, the differing power and impact of environmental lobbies in the political systems had a concomitant impact on the attitudes adopted in the climate negotiations. Several cases will now be described based on these dimensions.

Country	Total (1,000 ton)	Percentage of world total	Per capita (ton/inhabitant)	Per GDP (kg/$)
World	21,863,088	-	4.21	1.0
US	4,869,005	22.3	19.68	0.9
USSR	3,804,001	17.4	13.26	1.4
China/India	3,040,549	13.9	1.47	4.5
EC	2,562,318	11.7	9.17	0.5
Eastern Europe	1,193,167	5.5	8.82	3.1
Japan	1,040,554	4.8	8.46	0.4

Table 7.2 Total and per capita CO_2 emissions from industrial processes in 1989. Source: The World Resources Institute (1992)

The industrialised countries

The developed countries have been responsible for most of the global greenhouse gas emissions so far and will thus have to play the leading part in solving the issue of global warming. Besides the fact that developed countries are the largest emitters, they also have the best available technologies for reducing emissions. In spite of this, this group was far from united during the negotiations and their positions were extremely diverse. This is reflected in Article 4(2) (see previous page) of the Convention, which states that each industrialised country is required to take those actions it has identified as being appropriate and feasible in its national circumstances. The following discussion of the positions adopted by certain countries, focusing on the major parties (United States, the European Union and Japan), elucidates the way in which these individual parties interpreted their situations and the impacts which they had on the process.

Responsible for 22% of total global CO_2 emissions, the United States of America (US) is the world's largest greenhouse gas emitter. Its CO_2 emissions are also the world's highest on a per capita basis. These points are often cited by representatives of developing countries in order to emphasise the historical responsibilities of the US for global warming. The US approached the climate issue in a way very different from Europe, Japan and other OECD countries. On the one hand, its scientific awareness and knowledge of climate change was advanced due to high research budgets and well-established scientific institutes for climate science. On the other hand, the US was the most timid of all OECD countries in endorsing ambitious policies on climate. This was due in part to questions and concerns arising from a preliminary economic analysis conducted by US experts and in part to the conservative ideology of top White House officials. Because of its large size, its geographic separation by two oceans from Europe and Japan and its very different constitutional, legal and political system, the United States often has a tendency to see things differently and go its own way. The climate change issue was no exception.

The United States' rationale was based on the premise that, as long as there was still any scientific uncertainty about the impact of global warming, it would be premature to agree on targets and timetables. The US therefore stressed the scientific uncertainties and sought to go slow on responding to climate change, thereby protecting its domestic industrial sectors which were most closely tied to energy production and consumption (i.e. coal and oil production, the automotive industry, chemicals and primary metals). This strategy was opposed by the majority of other OECD countries, which had all adopted emission targets.

During the negotiating process, the US provided the only counterbalance offsetting the momentum of most OECD countries, whose desire was to move forward quickly. If the rest could be accused of an excess of idealism over pragmatism, the US was certainly guilty of an excess of pragmatism over idealism. At the same time, the difference between the US position and that adopted by the other OECD countries could also be described as a practical versus a political standpoint. The US was simply not convinced that a climate policy with targets and timetables could accomplish the projected emission reductions. The EU, on the other hand, believed that the strength of a climate policy would be adequate. In the end, the combination of American arguments and its enormous influence as the world's largest economy and emitter of greenhouse gases caused the rest of the world to agree to a compromise text in the climate treaty that balanced concerns on both sides.

After the US presidential elections in November 1992, the new US President, Bill Clinton, announced a new US policy on climate. On 19 October 1993, President Clinton unveiled what he called a 'detailed, realistic and achievable' plan to return national greenhouse gas emissions to their 1990 levels by the year 2000. The strategy emphasised measures that could be implemented rapidly and without congressional approval. The programme's success or failure fully depended on the response of US society in showing that it was capable of controlling its emissions through voluntary measures and a minimum of government intervention. The administration warned, however, that it would propose 'additional administrative, regulatory or legislative actions' if the 'voluntary' approach were to fail.

The European Union (or the European Community, EC, as it was then still called) played an important role as a collective actor in the international debate on climate change. The EU is responsible for about 12% of the world's total annual CO_2 emissions. Unlike the US, the EU took a very progressive stand during the climate negotiations and was prepared to endorse a convention that included specific targets and timetables aimed at stabilising CO_2 and other greenhouse gas emissions. One reason for this radical stance was the rapidly growing environmental awareness in all sectors of society in the EU. A second reason was the new challenge faced by the member states to build a European partnership. In October 1990, therefore, the EU agreed to stabilise total CO_2 emissions by the year 2000 at the 1990 level for the Union as a whole. In addition, EU members acknowledged the need to reduce the rate of deforestation and thereby achieve an increase in the sink capacity of the world's forest reserves.

The EU's decision to stabilise carbon dioxide emissions at a Union level created some flexibility among the member states. The more industrialised nations, such as Germany, The Netherlands and Denmark, would make a greater effort to cut emissions, creating the margin necessary for the less developed countries, such as Spain, Portugal, Greece and Ireland, to increase economic growth (and the emissions of CO_2 that are to some extent related to economic growth). Such a flexible approach, which is called *burden sharing*, was necessary to bring all EU parties into the game (Vellinga and Grubb, 1993). For example, total carbon dioxide emission per capita in Portugal is about 1 tonne at present, whereas this figure is more than three times higher in Germany.

The member states have consequently made different commitments with respect to the stabilisation target. Belgium, France, Luxembourg and Italy have unconditionally adopted the EU target. Spain, Portugal, Ireland and Greece have adopted the EU target on condition that their present CO_2 emissions are allowed to grow. Germany, Denmark and The Netherlands have committed themselves to targets which are more stringent than the overall EU target. The UK was the only member state which originally planned to set 1990–2005 instead of 1990–2000 as its target period. Eventually, however, even the UK joined the EU regime in October 1990 (Schepers, 1991).

The EU strategy is based on a combination of the principle of no regrets and the search for a minimal cost solution. In this regard, the Commission has suggested using a wide variety of instruments such as voluntary agreements, research and development efforts and, most important of all, an energy and carbon tax. However, as a strong

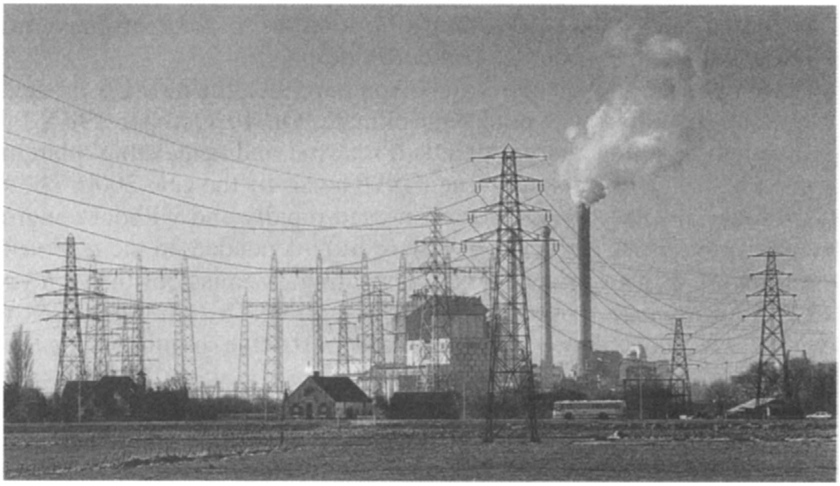

Plate 7.2 Coal-fired power plant at Nijmegen, The Netherlands. A source of greenhouse gases emissions. Photo: Ron Giling/Lineair

collective agreement has not yet been reached at EU level, the actual implementation of the measures has been left to individual member states. So far, this approach has not proved very successful (Vellinga and Grubb, 1993). In the environmental field, the complex constitutional structure of the EU is still evolving, as it is in other fields such as foreign policy. The establishment and implementation of EU greenhouse gas policies have hence been constrained by various political frictions, which both complicate the EU's role in international negotiations and hamper internal implementation. Attempts to adopt EU policies on global warming have coincided with the intensifying conflict over formal moves towards greater monetary and political union.

A good example of this friction (between environmental and economic interests on the one hand and between individual and community interests on the other) is the recent attempt to introduce a community-wide carbon tax. The UK opposed the proposal because it could see no reason why it should overachieve in order to compensate for the underachievement of others. At the same time, six other EU countries (Belgium, Denmark, Germany, Italy, Luxembourg and The Netherlands) said that the EU could not possibly meet its obligations unless the energy and carbon tax was adopted in due course throughout the Union. This incident emphasises the difficulty of imposing a common target on such a wide diversity of countries (Wynne, 1993).

Japan's share in the world's CO_2 emissions is less than 5%. However, beyond this relatively modest share lie the more significant, technological aspects of its global role. As far as the limitation of CO_2 emissions is concerned, Japan has achieved one of the highest levels of energy conservation among the developed countries. Despite the fact that the gross national product began to grow sharply in the 1970s, CO_2 emissions increased only slightly until the end of the 1980s. This tendency owes much to the technological progress achieved in relation to energy conservation (although the result is slightly distorted because a large number of primary energy-intensive manufacturing industries have moved to other countries in South-east Asia). Thus, Japan is ahead of the

EU and far ahead of the US (see again Table 7.2), especially on a CO_2 emission per capita basis. It is therefore not surprising that Japan has followed the EU in promoting targets and timetables (albeit on a per capita basis). Japan and the EU jointly opposed the more hesitant attitude taken by the US and the OPEC countries (Bodansky, 1993).

The high population densities on Japan's main islands and the spectacular growth of its industrial facilities in the 1950s and 1960s led to Japan being one of the first industrialised market economies to react to some of the acute effects of modern industrial pollution (Vernon, 1993). As a result of this relatively early initiation of an environmental policy in Japan, it is less easy to compare Japan's current environmental improvements with those of other countries. Japan is one of the countries which have achieved the most remarkable fuel switching results during the period since the first oil crisis. Due to its already high level of energy conservation, further limiting of CO_2 emissions by saving energy will be difficult. Technologically more advanced measures are needed. The costs of CO_2 limiting measures will therefore be higher in Japan than in any other country.

Japan (together with Germany) was at the forefront of those countries which also viewed the convention as an instrument for gaining longer-term competitive advantage by requiring the further development, production, use and dissemination of innovative new technologies. In addition, Japan has supported the idea of transferring some finance and technologies to other countries, especially developing countries.

In contrast with the US and Europe, Japanese policies tend to move forward rather like a supertanker at sea. It is highly unusual for any entity in the government structure to take an independent line and disregard or override an existing international agreement. Unlike the significant influence exerted by environmental and green NGOs in other OECD countries, informal forces in Japan have had relatively little impact on Japan's contribution to international environmental policy making (despite the domestic activism which has been seen in Japan in relation to a number of environmental matters). Programmes are shaped much more by expert opinion than by political pressure (Vernon, 1993). The crusading elements so evident in European and US environmental movements are scarce, though growing, in Japan's policy-making establishment.

With the Japanese economy continuing to grow, Japan's energy consumption has also expanded since 1987 at a much higher rate than had been predicted. This has made it harder for Japan to attain the CO_2 stabilisation targets. Over the two years from 1988 to 1990, the GNP grew at an average of 5.3% per annum and energy consumption increased by an average of 4.5% annually, pushing CO_2 emissions up to 7.2% of the world total in two years. At that time, the Japanese Ministry of International Trade and Industry (MITI) remarked that Japan might be urged to make drastic reviews (i.e. downward revisions) of its economic growth and energy policies if it faced international demands for short run stabilisation of CO_2 (Matsuo, 1992). MITI had actually planned a large-scale investment in nuclear energy to allow for higher electricity demand and to ensure, at the same time, that the CO_2 stabilisation target could be met. Public pressure has brought the proposed nuclear expansion into question. In MITI's view, without an increase in nuclear energy, drastic changes in the future shape and management of the Japanese energy economy will be required in order to reach the CO_2 target. On the other hand, Japan's Environment Agency takes a more optimistic view on these matters, stressing the opportunities for energy efficiency.

In the field of diplomacy and active international policy development, Japan, like Germany, has played a modest role since the Second World War. In the area of global policy making, Japan has often followed the US. The climate negotiations were one of the first occasions on which Japan took a position different from the US by following the EU. This should be attributed to a number of factors. Firstly, the EU was a rapidly growing economic and political factor in the late 1980s. Secondly, Japan was becoming more self-conscious *vis-à-vis* the US; it was keen to take a leading role in the global climate issue (perhaps to compensate for its environmentally unfriendly positions on other issues such as drift net fishing and whaling). Thirdly, Japan recognised the technological challenge of the climate change issue.

Countries with economies in transition

The problems faced by the former socialist countries of Central and Eastern Europe led to a novel distinction being drawn in the convention. In order to differentiate between the specific commitments relating to sources and sinks of CO_2, a distinction was made between developed countries and developed countries undergoing the process of transition to a market economy. The Central and Eastern European countries are showing falls in emissions due to the process of economic restructuring. So, while they were hesitant about committing themselves, they appeared to be more advanced than any other group of countries in terms of CO_2 emission reduction. On the other hand, as soon as the process of transition has been completed, emission trends may well increase again.

In *Eastern Europe*, a process of rationalising energy consumption has not yet taken place. While Western Europe dominated Eastern European countries in the 1950s in terms of CO_2 emissions, in the 1980s overall energy-related CO_2 emissions in Eastern Europe were almost twice as high as those observed in Western Europe. On a per capita basis, CO_2 emissions in Eastern European countries were also higher than in Western Europe. On the one hand, this contrast can be attributed to efficiency improvements in Western Europe. On the other hand, it also is a result of the inefficient utilisation of energy in Eastern Europe during the past 30 years.

In 1985, the average energy intensity of industry, in terms of quantities of energy per unit of GDP, was much higher in Eastern Europe than in Western Europe. This implies that, in a no-regrets scenario, Eastern Europe holds great potential for improvements in energy intensity. Limitation measures can reduce production costs, lower energy consumption and reduce CO_2 emissions both per unit of GDP and per capita. Theoretically, this means that Eastern European countries can continue to increase production without necessarily increasing CO_2 emissions. Its international energy dependency is another good reason for Eastern Europe to increase its energy efficiency.

As a result of the process of political transition, the Eastern European countries are now in an unusual position. Although the level of energy efficiency remains unchanged, total energy demand is decreasing. This decrease is, however, only temporary. The transitional process will eventually be completed and the economy will recover. Without efficiency measures, energy consumption will return to its previous level, leading to both adverse economic effects and environmental damage (see also Chapter 3).

Several measures have been proposed to ensure that the transition is accompanied by efficiency improvements. Price reforms could play a major role in this regard. In addition, and in conjunction with price reforms, best available technologies will be very effective in meeting these goals. In this context, technology transfer from the other developed countries, as mentioned in the convention, could play a significant role. In fact, many Western European energy utilities are extremely interested in initiating projects and joint ventures in order to receive emission reduction credits. Whether such an approach – known as *joint implementation* – will get off the ground, however, is something which remains to be seen (for a critical note, see Jones, 1993).

The Eastern European countries played a receptive and sometimes constructive role in the negotiations. During the preparations for the Second World Climate Conference and for UNCED, there were regular contacts between the EU and its member countries on the one hand and Eastern European countries on the other. The EU countries assisted the Eastern European countries with their CO_2 assessments and, in view of the political situation in Europe, it is not surprising that Eastern European countries such as Poland, the Czech Republic, Slovakia and Hungary have adopted (or agreed to) similar CO_2 targets as has the EU as a whole. The Eastern Europeans' position in the negotiations was dominated by a basic concern about climate change and by an eagerness to join the EU countries.

Russia's power and role changed considerably during the process of global policy development. Russian scientists were among the first to recognise the importance of the greenhouse effect and climate change. Much Russian scientific work has been based on an analysis of climate changes in the past (a discipline known as *palaeoclimatology*). Whilst Russian scientists recognised the potential for catastrophe, they also recognised the potential gains for Russia in a warmer climate. The Russian government has always stressed the benefits of climate change. During the negotiations, the Russian delegates took the position that it would be very premature to take any action to limit emissions. The degree of influence which the Russians exerted on the process decreased during the negotiations to almost nil as it was not even clear on some occasions how the Russian Federation was represented and what the mandate of the delegation was. In fact, because of its national and international policy priorities, Russia was left with no room for any strong role in the climate issue.

With respect to emissions of greenhouse gases, Russia is in a position very similar to that of the Eastern European countries. Following the dissolution of the former USSR, which was initiated by the transformation process of its centrally planned economy, there was a significant decline in the level of greenhouse gas emissions. However, this emission reduction is not the result of an improvement in energy efficiency and is likely to be eliminated as soon as the Russian economy recovers from its transitional situation (see Chapter 3). At present, by accounting for 17% of global CO_2 emissions, the former USSR – of which Russia is by far the biggest source – occupies the second place in the list of major CO_2 emitters in the world and consequently still plays an important role. However, besides being a large consumer of energy, Russia also plays a particularly significant international role as an energy producer. More than 20% of world oil production and almost 40% of world gas production originates from Russia (Makarov and Bashmakov, 1990).

At the same time as it consumed oil, gas and coal reserves, the former USSR also accumulated the highest energy conservation potential in the world. The returns of cost-cutting investments were invisible in a situation of inefficient planning. Consequently, in spite of the potential to save much money, only small investments were made in energy efficiency measures. Studies performed by the Moscow Centre for Energy Efficiency have indicated that, if local energy prices were to approach world market prices, a vast number of energy efficiency measures could be implemented without any cost.

Economic and social gains would not be the only benefits of such measures. Energy efficiency improvement would also be the cheapest and most effective way of stopping any further environmental degradation. For instance, a reduction in the amount of pollution caused by oil and gas production and transportation could lead to a reduction in the number of oil spills, methane leakages, gas flaring and pipeline breaks that are currently typical of Russian petrochemical and gas industries (Bashmakov, 1992). Assuming that measures for emission reduction are not allowed to increase energy development investment costs by more than 15%, calculations based on models show that emission growth can be halted in the period between 1995 and 2000. Emission growth can be reduced by 14% by 2005, with a steady decline of 25% by 2020 and 35% by 2035 (Makarov and Bashmakov, 1990).

Apart from its large energy conservation potential, Russia is also important because of its current natural resources. The Siberian region, for instance, with its extensive forests, has a key role to play in the absorption and storage of CO_2. There is a serious threat that these forests will be cleared in order to bolster future economic growth. That would imply extensive releases of CO_2 in the atmosphere. Something similar might occur in the tundra in Northern Russia. Global warming could cause bacteria that inhabit the soil to speed up their metabolism and grow faster. In doing so large amounts of methane would be produced. Once in the atmosphere, methane gets oxidised resulting in CO_2 releases. Indeed, things may even get worse. The CO_2 that is released further contributes to global warming, which in turn affects the soil in Siberia, because of which methane releases increase, etc. So the initial change triggers further changes, ever more warming up the atmosphere. This is known as the *runaway effect*. It is not unique to the Russian tundra. Similar processes are expected to occur in the extensive permafrost areas in the far north of Russia.

The developing countries

Although greenhouse gas emissions from developing countries are low and their financial and technical ability to reduce these emissions limited, their position is nevertheless of crucial importance to the climate negotiations and to the implementation of subsequent treaties. First of all, the developing countries are faced with a considerable growth in their populations, which will exacerbate future greenhouse gas emissions. Developing countries currently generate roughly 25% of global anthropogenic CO_2 emissions and about half the world's methane and NO_2. Even with substantial improvements in energy efficiency, developing countries will still need to expand their energy production and CO_2 emissions in order to meet the demands emanating from population and economic growth.

Secondly, the greater part of the current global sink capacity for greenhouse gas is located in developing countries, primarily in tropical forests. At the current rates of deforestation, this important sink will soon vanish. Finally, developing countries are not only leading contributors to future climate change; they are also likely to be its chief victims. Many developing countries are extremely vulnerable to the impact of climate change. A relatively high proportion of their income is derived from climate-sensitive activities such as agriculture or fisheries. Furthermore, climate change is likely to hit poor countries the hardest because they cannot afford to pay for adaptation measures and do not possess the infrastructure and technology which are needed to implement them (see also Chapter 4).

The developing countries were also divided during the negotiations because of their widely diverging interests. Three main groups emerged:

1 the powerful and self-conscious semi-industrialised developing countries, such as India and China, which emphasised development, sovereignty and equity issues;
2 the oil-producing states, which forcefully questioned the need for strong commitments by either developing or developed countries and called for compensation;
3 the Alliance of Small Island States (AOSIS), representing the states most immediately at risk from climate change.

In addition to these three groups, several less distinct parties emerged, such as a number of African states which stressed the issue of desertification and drought, and Malaysia and Brazil which argued that forests should not be singled out from other greenhouse gas sinks. Only the three main groups will be discussed.

More than half the world's identified coal reserves are located in just four developing countries: South Africa, North Korea, China and India. China and India alone account for over 50% of global coal production. As an additional factor, almost 40% of the world's population lives in China and India. According to projections made by the World Bank, the size of their combined populations (i.e. 2 billion) is likely to increase by 50% by the year 2025 (Global Environmental Change Report, 1993). The current levels of strong economic growth will also lead to an increase in the level of prosperity, which will in turn inevitably have a considerable impact on the total demand for energy. The International Energy Agency (IEA) estimates that global consumption will jump to 45% over the 1990 level by 2010. Consequently, China is expected to become the number two CO_2 emitter within the next ten years. At present, its rate of growth of CO_2 emissions surpasses that of any other major country.

Present annual and per capita emissions, however, are relatively low. Annual CO_2 emissions in India and China are in the order of 1.5 tonnes per capita as compared with nine and 19 tonnes per capita in the EU and the US respectively. Nevertheless, improvements in energy efficiency could still help significantly to curb the release of greenhouse gases. Japanese researchers have estimated that, if all the world's existing coal-fired power plants were converted to efficient, clean coal technologies, CO_2 emissions from coal-fired electricity generation would drop by 30% (Global Environmental Change Report, 1993). For this reason, India, China and many other developing countries attach great importance to the issue of technology transfer. In their view, the developed countries should transfer advanced technologies to developing countries under the most favourable conditions and provide technologies to promote the renovation of energy industries as well as to achieve the effect of reducing CO_2 emissions as early as possible. Unfortunately, the negotiations did not result in distinct agreement on technology transfer. As has already been stressed, the convention does not define the terms on which such transfers will occur.

Apart from being potentially large emitters of greenhouse gases, India and China face a substantial threat from climate change. Their large populations are fed on the basis of domestic rather than foreign sources and their agricultural sectors are both largely dependent on the weather. Impact assessment indicates that China's agricultural production potential would be reduced by at least 5%. A rise in the sea level could also seriously jeopardise China's 18,400 km coastline, along which a number of its main economic activities are located (Guang and Zhihong, 1993).

However, the prospect that the developing countries would probably be the main victims was not a subject that was raised with any force by the major developing countries. Their position was dominated by the fear that the OECD countries would set a global regime for CO_2 control that would take away their opportunities for development. Because of this overriding concern, the major developing countries did not really press for action to reduce CO_2 emissions by OECD countries as they feared that OECD commitments would in due course start a process which would end with the developing countries also being asked to make commitments to curb the growth in greenhouse gases. This 'instinctive' behaviour meant that they sided mainly with the US when targets and timetables were discussed.

When it came to technological co-operation, though, they sided with the EU. The EU countries were a little more willing to give way on this issue than the US. Most of the developing countries took the view that climate change provided a new impetus for the transfer of money and technology from the 'selfish' OECD countries to the 'needy'

Plate 7.3 Coal-fired electricity plant in China. Energy policy in China will play a significant role in the debate on climate change. Photo: Alain le Garsmeur/Lineair

developing countries. The idea that the major developing countries could take action themselves to limit climate change was disregarded as an immoral proposal, under the argument that existing development problems far outweighed the long-term climate problems. If the developed countries did not take the lead by adopting domestic measures and changing the lifestyle of their populations, there could be no real argument for developing countries to take any action.

The group of small island states, which is represented in the AOSIS, is a transregional group of nations in the Caribbean, the Indian Ocean, the South China Sea, the Mediterranean Sea, the Atlantic Ocean and the Pacific Ocean. Their contribution to the increase in atmospheric CO_2 concentrations is almost nil yet the impact of climate change on the rise of the sea level is of major concern to them and other low-lying areas. Over 50% of the world's population live within 50 kilometres of the sea and 100-200 million people live in very low-lying areas that are potentially subject to annual flooding. If the sea level rises, many of these people will lose their homes, their means of livelihood and perhaps their lives.

The major dilemma regarding the vulnerability of the small island states and other low-lying areas is the fact that the adaptation of local conditions would be more effective in terms of damage limitation than would be the option of emission reduction. For this reason, several developing countries (particularly the AOSIS) proposed, during the climate convention negotiations, that adaptation should be included as a fundable activity under the Global Environmental Facility (see Box 3). The fund's guidelines, as currently interpreted, would not permit this and, although it takes a flexible attitude towards these conditions, many OECD countries have made clear that they do not want to be involved in funding adaptation costs (Heileman, 1993).

Although the AOSIS had an important position in the negotiations, the actual impact of the organisation, not being region bound, is considerably lessened by the UN-established geographically based regional representation system. Even though small island states make up close to one-sixth of the votes in the UN system, their population is much less than 1%. Traditionally, the economically more important countries have tended to be selected as locations for offices and decision-making units. Nevertheless, the AOSIS ensured in the G-77 meetings that some of its concerns were incorporated in the negotiating position of the G-77. This indirectly increased the influence of the small island states and other low-lying areas.

The Organisation of Petroleum Exporting Countries (OPEC) has an obvious difficulty in supporting any sort of CO_2 limitation. Its members are afraid that emission restrictions could reduce both the size of their market and the price of oil and coal and

The Global Environmental Facility

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The Global Environmental Facility was established in November 1990 by the UN Development Programme, the UN Environmental Programme and the World Bank. It serves as an international facility that provides funding for schemes aimed at resolving global environmental problems.

that this would lower their national revenues. The oil-producing countries, led by Saudi Arabia, strongly opposed the incorporation of any substantive obligations in the convention and clearly would not have been unhappy to see the negotiations fail altogether. The OPEC countries were fairly successful in slowing down the process of reaching agreement on measures and policies to control CO_2 emissions. They were also very outspoken in their opposition to EU initiatives for introducing carbon and energy taxes.

7.5 Conclusion

Many governments and NGOs had set their sights too high at the early stages of the Climate Change Convention. Their expectation that it would go beyond existing international environmental agreements, for example by establishing a system of tradeable emission permits, and that it would create a basis for truly sustainable development proved unrealistic. 'Compared to these ambitious proposals, the FCCC is a modest achievement' (Bodansky, 1993). The Montreal Protocol, on emissions of substances that damage the ozone layer, for instance, is much more stringent, requiring the phasing out of most ozone-depleting substances within a decade. The FCCC does not even clearly require a stabilisation of greenhouse gas emissions in the industrialised world. However, the climate change problem is considerably more complex, both politically and from a scientific point of view. Thus, the current FCCC may be regarded as providing a good basis for further progress. It involves a variety of states, recognises the distinctive positions of the transitional economies and developing countries, strives for economic efficiency, preserves a certain degree of flexibility and lays a basis for future work such as national inventories and scientific research. The greatest disappointment, however, has been the absence of strict targets and timetables. The most important message of the convention is implicit, even in the absence of strict targets and timetables: business will not continue as usual.

The challenge of implementing the FCCC confronts society with much more than a climate problem. An effective climate policy requires changes in almost every sector of the economy: energy, transportation, industry, agriculture, etc. Increasingly, such remodelling will be conducted in an integrated manner, with trade-offs between the long-term benefits of environmental protection and the short-term concerns about international competitiveness (Reinstein, 1993a). The implementation of the FCCC will not be a sudden process, but is more likely to be incremental, as two contradictory tendencies can be observed in the international policy arena (Hisschemöller, 1993). On the one hand there is a tendency to wait for others to take an initiative. Disputed environmental problems such as climate change are particularly prone to such 'free-rider' behaviour. On the other hand there is a tendency towards the development of an environmental awareness that prompts people to act. Newly arising economic and technological opportunities serve to strengthen this tendency.

The product of these two tendencies is a fairly dynamic situation. As a result, there is likely to be an absence of clear leadership in the development of international climate policies. Until the Rio Conference, the EU had acted as a leading force, although this leadership was not irrefutable. The EU has never been completely united and most of all, the European Commission has neither the power nor the authority to implement a coherent programme. At present, the US and Japan are making better progress in designing and implementing their national climate action plans. Given the state of flux to which national politics are subject, the international policy debate on climate change will not be settled during the coming years.

Another reason for the implementation process to be incremental lies in the evolution of the scientific evidence on climate change. More signals will accumulate in the course of years. Uncertainties about the basic science will be removed only gradually and unexpected findings, which cannot always be explained conclusively, will frequently crop up. The key difference from other major environmental problems, such as acid rain and toxic pollution, is the absence of the fully visible signals of climate change that are capable of galvanising society into action. Although impacts are already occurring, these have not been fully associated with specific economic activities. Impacts such as extreme weather events have not yet been automatically related to anthropogenic climate change, though ever more proof is becoming available to corroborate this relation.

In other words, awareness of climate change and its impacts is a prerequisite for a climate policy to be successful. Efforts should be made to reduce scientific uncertainties and simultaneously to implement measures to reduce greenhouse gas emissions. At the same time, the dynamic international process of institutional structure building should continue in order to facilitate future developments. 'The UN Framework Convention on Climate Change makes a definite, albeit tentative, start along that road' (Bodansky, 1993).

In sum, the recent history of policy making attempting to deal with the problem of global climate change exhibits two fundamental features which are likely to impede progress. The first is the tentative state of scientific knowledge which presents ample opportunity for procrastination both over policy making and policy implementation on the part of those countries whose interests are threatened. The second is the inevitable clash between economic and environmental interests. Both the developed and developing countries are likely to give greater priority to the short-term demands for growth and development than to the longer-terms needs of the environment, no matter that these are, ultimately, interdependent. After all, governments must respond to economic interests if they are to survive. However, as awareness of the looming and inescapable problem of global warming deepens, governments will be able to act with assurance of support, even from hitherto opposed economic interests. When it is a question of survival, then erstwhile divergent interests will converge in the attempt to ward off the threat. The problem is that, by then, it may be too late.

Acknowledgements

The authors would like to express their appreciation to Joyeeta Gupta, Robert Reinstein, Roebijn Heintz and Joeri Bertels for their constructive criticism of the draft version of this chapter.