7
Emergent Conflict over Climate Change

Introduction

This chapter applies the theoretical considerations of the first part of this book to one of the most important environmental and security issues of the early twenty-first century. Ever since the industrial revolution fossil fuel burning and other human activities have increased the concentration of carbon dioxide and other greenhouse gases in the atmosphere. There is now a scientific consensus that anthropogenic emissions are contributing to global warming. The warming to date is already having a clear impact on human well-being and the survival of other species. It is also clear that the issue has opened conflicts of interests between different groups within states, between states, and across generations.

This is a conflict in which we are all involved, since we all contribute to greenhouse emissions and we are all affected by climate change. But some contribute more than others to the pollution and some are more vulnerable than others to its effects. The Saudi government, for example, relies on revenues from fossil fuels for its political survival. The Association of Small Island States (AOSIS) represents people in low-lying countries who face an existential threat from the rising sea. These groups have a clear conflict of interest. More generally, the North has historically contributed most to carbon emissions, while the South is most vulnerable to its effects. Constraining future emissions will place the development paths of North and South in conflict, if they remain on a fossil fuel-intensive development path. There are also diverging interests within the North and within the South. For example, EU member states are more dependent on imported energy and more willing to consider restriction based on agreed targets, while the United States and Australia are large fossil fuel producers who perceive the costs of switching to a

low fossil fuel economy as very high and currently reject agreed targets. Similarly the interests of fossil-fuel producing developing countries such as China and India differ from those of the non-oil producing countries of Africa which are vulnerable to changing rainfall and desertification. Producers and consumers, urban and rural dwellers, the rich and the poor all have differing interests. International co-operation is essential to develop an effective response but the differences of interest will make such co-operation difficult.

The impact of climate change

The first awareness of the possible impact of human activities on the climate dates back to the end of the nineteenth century when the Swedish scientist Svante Arrenhius calculated that doubling the concentration of carbon dioxide in the atmosphere would increase the average temperature of the earth by 5 to 6 °C. In the 1970s and 1980s a consensus developed in the scientific community that warming was taking place and that urgent international action was necessary. The Intergovernmental Panel on Climate Change (IPCC), which brought together the world's leading climatologists, reported in 1992 that 'emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases … These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface.' It would require 'immediate reductions in emissions from human activities of over 60 per cent to stabilize their concentrations at today's levels.'

By the year 2000 the level of CO_2 in the atmosphere had risen to over 370 ppm, a 30 per cent increase over the pre-industrial concentration of 280 ppm. The average surface temperature has increased by 0.6 °C over the same period. Predicting future trends is difficult because the future level of human activity, the carbon intensity of future economic development and the dynamics of the planetary climate are all very uncertain. In order to encompass a range of possibilities, the IPCC calculated a set of scenarios, ranging from worst cases in which the concentration of carbon dioxide rises by 220 per cent to 970 ppm and best cases in which it rises by 75 per cent to 540 ppm. This would imply rises in global temperature of between 1.4 °C and 5.8 °C by the year 2100.[1]

These changes in average temperature mask greater variations locally. Continental interiors would warm by 2.2 °C to 6.6 °C and the poles would warm more than lower latitudes. The warming in the Arctic would be from 3.6 °C to 11.4 °C.

The likely effects of these changes on sea levels, weather, rainfall patterns and plant and animal life have been widely canvassed. The British government report, 'Avoiding Dangerous Climate Change', suggested that a temperature rise of 2 °C might be a threshold (Schellnhuber 2006). Above this risks increase 'very substantially' with 'potentially large numbers of extinctions' and 'major increases in hunger and water shortage risks … particularly in developing countries.' There are fears that the higher temperature ranges could lead to 'tipping points' where positive feedbacks are engaged. For example, drying and burning of forests could transform them from a 'sink' to a 'source' of carbon, and melting of the permafrost could release large amounts of methane.

Implications for conflict

The consequences will be variable for different communities. Some will benefit over the short term, as the climate improves in cold areas. Others will suffer as crops are affected, water supplies are diminished and extreme weather and storm surges intensify. A study of the effects on agriculture in developing countries in 2050, drawing on two models of climate change, one from the UK Meteorology Office, the other from the Goddard Institute of Space Sciences, suggested that larger farmers in Asia and medium and large farmers in Latin America might benefit, as a result of rising prices, while poor farmers and all farmers in Africa would suffer. Urban dwellers would also suffer with poorer people standing to lose more than the urban rich (Winters et al. 1999).

There is also likely to be conflict of interest over the response because of the uneven pattern of existing emissions, the unknown paths of countries' economic development in the future and the implications these have for agreeing on restraints. A clear line divides the developed countries, which have much higher CO_2 emissions per capita, from the developing countries, which have much larger populations. In 2000 a little over one-fifth of world population in the developed countries and the east European 'economies in transition' (USA, Japan, western and eastern Europe, Russia, Canada, Australia and New Zealand) emitted 65 per cent of world CO_2, while almost four-fifths of the world's population living in the developing countries emitted the remaining 35 per cent (Grubb 2003). The developed countries have been responsible for most of the carbon emissions to date, while the developing countries are more vulnerable to their effects.

If the South follows the North's historical pattern of development and goes through a fossil-fuel intensive phase of industrialization, as major developing countries such as India and China are starting to do, the carbon

emissions of the developing countries will overtake those of the North. This is expected to occur by 2030 on current trends.

Because CO_2 remains in the atmosphere for a long time, global temperature will be raised for a long time as a result of higher emissions. What is the maximum level that is 'safe'? Although any increase may have undesirable effects, a case can be made for 450 ppm as a maximum 'safe' level of carbon dioxide in the atmosphere (Athanasiou and Baer 2002). This would increase global mean surface temperature by about 2 °C above the pre-industrial level. If this is to be achieved, sharp reductions by both the North and the South are necessary. The annual carbon emissions required to achieve an atmospheric concentration of CO_2 of 450 ppm fall steadily by about 60 per cent from 2000 to 2100, while the annual CO_2 emissions of North and South under the IPCC's A1 'balanced' scenario rise until 2050, reaching levels almost double their 2000 value in 2050 before falling back (Athanasiou and Baer 2002: 61). If the South industrializes along the same lines that the North took, even if the North's carbon emissions are stabilized, the resulting global emissions will continue to rise, taking atmospheric CO_2 well above the 450 ppm level. If carbon limits are accepted, they define a bargaining space within which the North and South are constrained. If either the North or the South takes up more than its limits within this constraint, it does so at the expense of the other. If they fail to observe the constraints, the climate damage will be at the expense of all. This makes it clear that the parties have at least a potential conflict of interest. For some, indeed, it is already existential conflict of interest.

Whether this conflict of interest has the potential for violence in the future has been a subject of popular debate. There is a widespread perception in policy circles that it could have. Sir Nicholas Stern, for example, who advises the British government on the economics of climate change, noted that climate change 'will create the potential for conflict and population movement, which will put pressure on the developed as well as the developing world'. Homer-Dixon (1991; Homer-Dixon 1994, 2001), Brauch (2002), Baechler (1999) and others have argued that climate change is likely to lead to violent conflict. Homer-Dixon (1991: 134) offers a three-phase model of the possible causal pathways in which environmental pressures and violent conflict are mediated by social and political structures. Others are sceptical of causal associations. Environmental scarcity frequently does not lead to violent conflict and in recent decades, indicators of environmental scarcity are poorly correlated with the incidence of armed conflict (Gleditsch 2001). Efforts to investigate whether environmental issues are directly and causally linked with violence may be misplaced since, as Peluso and Watts argue (2001), it is the social and political

response to environmental change (and in some cases the political creation of environmental scarcities) rather than environmental change in itself that is the source of potential violent conflict – a point with which few of these authors would disagree. There have been many disputes over rivers and water resources, for example, but relatively few have been violent. Usually states have been able to reach agreements to share them (Lonergan 2001) – sometimes on rather unequal terms. Of course this does not rule out the possibility of wars over water in the future.

The argument being made here is not that climate change represents an immediate source of armed conflict. Rather, it is that this is a major environmental change that is already putting the interests of different groups into conflict. How this conflict of interests will develop remains to be seen. It clearly has the capacity to add to uneven development, exclusion and marginalization. It could potentially contribute to polarization between groups of countries with conflicting interests, and possibly to violence within and between them, in association with other sources of conflict. Alternatively it could be transformed through negotiations and co-operative action. This chapter aims to explore both the forms this emergent conflict could take and the conditions for co-operative action to transform it.

The North–South conflict

As a first step towards characterizing the conflicts of interest involved, I shall take two deliberately artificial and simplified representations of the conflict.

First, consider the conflict of interest between OPEC and the Association of Small Island States (AOSIS). This is a one-sided conflict where the viability of one of the actors depends on a variable under the control of the other (see Figure 7.1). Assume that we can quantify the utility of the actors under different levels of carbon emissions. Here carbon emissions (which rise with time) are measured along the horizontal axis, and the parties' utility along the vertical axis. As oil consumption and carbon emissions rise, the payoffs to the oil exporters increase, but a point is reached where the island states find conditions more and more difficult as the rising sea level takes effect. At every point OPEC prefers the business-as-usual option of expanding output over the alternative of restraint. At every point AOSIS prefers restraint. Since by assumption OPEC acts in its own self-interest and AOSIS has no power of decision, the situation is steadily driven to a less and less favourable outcome for AOSIS, and finally to its extinction.

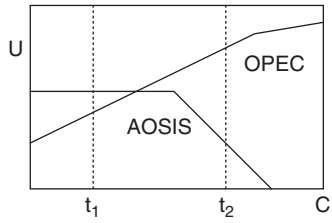

Figure 7.1 Global warming: the one-sided conflict

Now let us consider a two-sided conflict, in which the North and the South both control their own level of carbon emissions, and both affect each other in doing so. It is unrealistic, of course, to portray the North and the South as actors or even as groups having homogeneous interests. Nevertheless we can gain some insights by making a first analysis as though this were simply a North–South conflict. Figure 7.2 shows schematic cost–benefit curves associated with the level of carbon emissions from North and South. At first both parties benefit from the economic activities associated with carbon emissions. As large-scale industrialization takes place first in the North, the North obtains most of the benefits and imposes most of the costs of climate change on the South. However, as the South begins its own industrialization, it also experiences benefits while imposing increasing costs on the North. At some point the environmental disbenefits grow so large that both North and South suffer from further carbon emissions. Now, both parties have a choice between 'business-as-usual' strategies and restraint. At what point, if any, will the parties limit their emissions in order to avoid the pollution disbenefits? Assuming that each party acts in its own self-interest, it will only introduce restraint when its own perceived marginal costs from pollution exceed its marginal benefits from the activities generating carbon emissions. So the parties adopt restraint only when their own cost–benefit curves start to turn downwards. However, if they co-ordinate their actions, seeking to maximize joint benefits and minimize joint costs, restraint is adopted much earlier. The logic is the same as the example of the two firms imposing externalities on each other, considered in the appendix to Chapter 3.

This demonstrates that, in this simple model, a co-operative approach is collectively rational. But is it also individually rational for each actor? If the two agree to make side-payments, then there will be some distribution of side-payments which is also individually rational. However, it may not be easy to arrive at an agreement to split the benefits (and

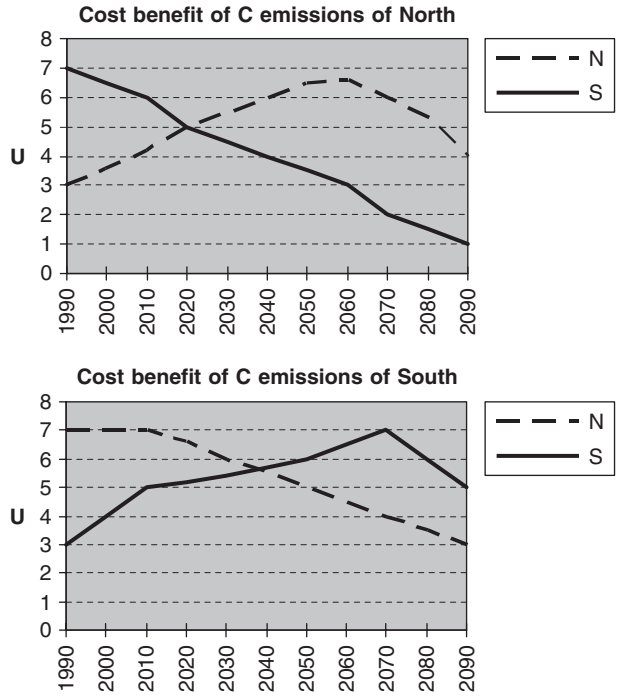

Figure 7.2 Global warming: the two-sided conflict

disbenefits) of co-operation. This depends on the course of bargaining and negotiations.

Let us now consider a slightly more realistic model, still based on the developing conflict of interest between North and South. The previous model assumed that actors would get signals from the environment as to the payoffs from their actions as they made them. In the case of climate change one of the difficulties is that the payoffs for present actions will only be known a long time in the future. We can therefore imagine North and South making bargaining offers to each other about possible restraint measures, and weighing up the value of these offers in relation to their expectation of the total emissions and their costs. The parties have to decide between 'business-as-usual' and proposals for restraint associated with proposed divisions of the resulting carbon emissions between them before the true costs are known.

How does this bargaining work? The characteristic of bargaining situations is that both sides have something to gain from a bargain, but

there is a 'threat point' at which no bargain is agreed. Nash offered a solution to the bargaining problem that identifies a collectively rational, unique, Pareto-optimal outcome, but this depends on knowledge of both parties' preferences over the range of possible outcomes and, as Bowles (2004: 178) points out, never results in a bargaining breakdown. Zeuthen (1930) and Rubinstein (1982) proposed theories based on alternating offers by the bargainers, which come closer to the actual process, but again their proposals are designed to reach a solution and never break down. A more plausible model may be based on the evolutionary game theory approach. Here the parties propose offers for restraint which allocate different endowments of allowed carbon emissions to each party. Each party weighs the offers on the table, on the basis of their own preferences (which need not be revealed) and attaches a weight, or a payoff, to the offer.[2] This is done on the basis of rules of the form: if the total carbon limit is not greater than x, and our endowment of permitted carbon emissions is not lower than y, then accept the offer. Both parties make a number of offers and vary the rules, rewarding rules that are successful and eliminating rules that fail to reach agreement. After a number of rounds the bargaining ends. If the parties' rules have converged on the same offer then they make an agreement. Otherwise, the bargaining fails.

This model goes beyond the 'blind' behaviour of the parties reacting to each other's moves to include a teleological element. It also allows for a change of goals over time, in the light of changing circumstances.[3] The rules are analogous to goals the parties test out and the bargaining process offers a means of ascribing payoffs to alternatives before the final outcomes are known. In principle the method can be extended to multiple parties and to more complex combinations of rules.

Complex rules can also represent principles, or norms, which often play an important part in negotiation theory, but are poorly represented in bargaining theory. The UN Framework Convention on Climate Change was successful because it set out key principles that proved acceptable to all. The first principle, which said that the developed countries must lead the way, encapsulated the framework. 'Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.' Such principles later have to be translated into commitments that can be implemented and monitored, but the choice between principles such as 'equal per capita limits' and 'equal proportional cuts' is crucial for framing the detail of the bargaining.

Conflict analysis of the climate negotiations

Turning from models to analysis of the negotiations to date, and prospects for the coming years, a more nuanced approach of the cross-cutting conflicts of interest between numerous parties is clearly required. There is a strong element of conflict of interest between the North and South but intra-North and intra-South conflicts are of equal importance.[4]

The climate negotiations opened in 1991 with a number of preparatory meetings leading to the Framework Convention on Climate Change. It was already clear in the preparatory meetings that participants were deeply divided. The US and OPEC resisted calls for binding reductions in carbon emissions, whereas other developed countries, especially the Europeans, wanted quantified targets included in the Convention. The developing countries resisted emissions targets for themselves but demanded new financial aid and technology transfer from the developed countries, which the latter resisted. In the end the Convention was limited to a framework of principles, leaving the details to later implementation meetings. It was adopted at Rio in 1992 and came into force in 1994. 185 governments and the EU signed it over the following ten years. This almost universal endorsement raised hopes that an effective regime might be formed. Government representatives subsequently met in annual Conferences of Parties (COP) to discuss the implementation of the Convention. The first stage was the effort to agree binding commitments among the industrialized countries.

The AOSIS countries had proposed that the industrialized countries should make reductions in their emissions of greenhouse gases of 20 per cent by 2005. This gained support from Germany, and although the G77 initially opposed the proposal, because of the objections of OPEC members, India led a breakaway group that endorsed the proposal. OPEC then swung around to support the proposal to avoid losing its position in the G77. With this coalition of European and G77 support, the US administration under President Clinton decided to accept the plans. Clinton, however, faced strong opposition in the US Congress. In 1997 the Senate unanimously passed the Byrd–Hagel Resolution, which said that the US should not be a signatory to any protocol that exempted the developing countries from mandatory emissions reductions, or that seriously harmed the US economy. Tied in this way Clinton sought to gain developing country participation. Argentina and Kazakhstan declared that they were willing to accept voluntary limits on carbon emissions, but the G77 countries objected to breaching the principle in the Framework Convention. Thus, although Vice-President Gore signed the

Kyoto Protocol on behalf of the administration, President Clinton was unable to secure its ratification by the Senate.

The Protocol, which was negotiated in December 1977, committed the Annex A developed countries to 5.2 per cent reductions in their 1990 emissions of greenhouse gases, to be achieved by 2012. The Protocol was based on hard bargaining between the developed countries and did not require cuts from all of them. The EU agreed to make a collective cut of 8 per cent, but some countries, such as the UK and Germany, accepted larger cuts and others were allowed increases. This led other OECD countries to claim they needed to increase their emissions too. The Protocol's mechanisms for trading of carbon emissions between states that had accepted emissions reduction targets, which had been inserted at the last moment, were also a source of disagreements. The developing countries saw emissions trading as a means for developed countries to evade their commitments and feared that they would be left out of the financial benefits of a trading regime. The Clean Development Mechanism, which provided for developed countries to claim credits from emissions saved through energy efficiency, renewables or forestry projects in developing countries was expected to raise much less money. The developing countries expected that emissions trading would 'turn greenhouse gases into commodities, locking in existing North–South inequities in the use of the atmosphere and natural resources and opening up many new and harmful profit-making opportunities for TNCs' (Gupta 2001: 72).

By 2000 it was unclear whether there would be sufficient international support to ratify the Kyoto Protocol. It needed 55 countries, representing 55 per cent of the 1990 carbon emissions, to come into force. The EU and the US bargained further over conditions for US entry, with the US demanding recognition of its 'managed lands' as carbon sinks, which would substantially ease the pressure of the Kyoto targets. Japan, Canada and Australia backed this proposal. The EU resisted at first, but its unity broke as several members with large forest resources saw the benefits of accepting 'sinks' in the regime. Nevertheless, despite the EU compromise at Marrakech on carbon sinks, President Bush decided in 2001 that the US would withdraw from Kyoto. Russia prevaricated for a long time, finally deciding to ratify Kyoto in 2005, after the EU supported its bid for membership of the WTO.

US withdrawal, though not unexpected, was a body blow to the Kyoto regime. It put in question the value of the developed countries' reductions since, even if the Kyoto targets were met, the reductions in carbon emissions would now make only a limited dent in the world's growth of carbon emissions. Moreover, the US withdrawal threatened to undermine

the carbon emissions trading system, since there was now a considerable supply of excess carbon credits (mainly in eastern Europe and Russia) but much less demand for them than had been expected. US withdrawal also undermined commitment among other industrialized countries. Australia followed the US in refusing to ratify the Kyoto Protocol, and Canada, which was failing to meet its Kyoto targets, elected a government opposed to Kyoto in 2006. Japan ratified the Treaty in 2002, but its business sector regards the energy efficiency of the Japanese economy as already high, and the marginal costs of further abatement higher in Japan than elsewhere. Especially in the light of the lower energy efficiency of the US economy and US non-participation, this has weakened Japanese support for the regime. Only the EU retains its original commitment to and support for Kyoto, which has given it a leadership role. The EU still hopes that it will be possible to bring the US back into the regime. Yet the EU, too, is struggling to meet its Kyoto targets.

So the North has been seriously divided over its responses and remains so. In July 2005 the US set up an Asia Pacific Partnership for Clean Development and Climate, which also includes China, Australia, Japan, India, South Korea. Its aim is to reduce greenhouse emissions through voluntary partnerships and technology transfers.

The South, too, became more divided in the course of the negotiations. The AOSIS countries retain their demands for urgent action and for support for adaptation, but, as the G77 has become more divided they have lost influence. Africa and Least Developed Countries (LDCs) retain their demands for financial help, but this is not yet forthcoming on any significant scale. China still has a leading position in the group, but its rapid development and size make it distinctive. Chinese policymakers believe that China deserves credit for its population policies and its success in cutting energy consumption per unit of GDP by 50 per cent since 1980. The Chinese government therefore believes it is already making strenuous contributions towards the problem and it is not obliged to take on mandatory emissions reductions until it has become a rich country. Similarly India is developing its own renewable energy sector and seeking to improve energy efficiency, but objects to several aspects of the Kyoto regime. The Advanced Developing Countries (ADCs), which are now middle-income countries, take the line that they will only consider participating if all developed countries are committed to reductions, and if these reductions are being accomplished. The OPEC countries retain their concern that strong abatement measures would damage their main source of revenue, lowering both demand for oil and the oil price. However, the shift to higher oil prices may moderate this concern.

The group is also vulnerable and concerned by the prospect of climate change. They see prospects in carbon sequestration, cleaner fossil fuel use technologies, and conversion of fossil fuels to hydrogen. OPEC countries are concerned that Western governments, rather than OPEC, derive many of the benefits of oil consumption in taxation. OPEC still takes a leading role in speaking for the G77 in climate negotiations.

As is clear from this account a complex pattern of groupings has emerged in the course of climate change negotiations, with clear lines of difference appearing between different states and communities. These differences are affected by whether they are industrial or developing economies, whether they are large fossil-fuel producers or energy importers, and by their degree of vulnerability to the effects of climate change. It is not only states, of course, but energy companies, other industrial groups, agricultural interests, financial interests, the scientific community, non-governmental organizations and many others who are involved.

The energy question

The role of the energy industries and of energy policy in general is fundamental. In the major fossil-fuel producing and exporting countries, oil, coal and gas companies have become major sectors of the national economy. They enjoy close connections with government leaders and have an important influence on government planning over energy decisions. This is a reciprocal relationship. The central role of energy in modern industrial societies makes governments dependent on energy companies for advice and planning. The energy companies also need to work closely with government to establish a stable framework for their planning decisions. In the United States, for example, the oil companies have been traditionally close to the administration, particularly during the Bush presidencies. But coal too is politically influential, especially in 'swing' states such as West Virginia, from where Senator Byrd has been a vocal opponent of the Kyoto Protocol. In Russia, the giant Gazprom, previously a state industry, remains close to national decision-making. The influence of these companies and state energy planning organs over long-term investments in the energy sector is crucial. Other industries such as the car industry, aviation and energy-intensive sectors like iron and steel similarly shape future demand through their present decisions.

The climate change issue cannot be divorced from questions of energy policy. The arrival of 'peak oil' sets the context for both national and international decisions. Whether we have already passed or are about to pass the time when demand for oil exceeds the supply from low-cost,

readily available sources, the tightening world oil market has major implications. On the one hand, the higher price of oil, which drives up other energy prices, should encourage energy efficiency, renewables and non-carbon-intensive means of providing energy-based services. On the other, the greater concern for energy security is prompting an international scramble for control of oil reserves. Falling domestic production in the US and Europe combines with increased projected demand for oil, so that US and EU dependence on imported oil is growing rapidly. The same is true of China as its demand for energy soars to keep pace with the country's modernization; it became the world's second largest oil importer in 2005. The US responded by seeking to bolster its domestic production, including in areas of wilderness such as Alaska, intensifying its hold over Gulf oil supplies, reinforcing its alliance with Saudi Arabia and the other Gulf sheikdoms, encouraging them to expand their production capacity, developing new pipelines to the Caspian oil fields, and seeking to diversify supplies by increasing production in Latin America, Africa and elsewhere (Klare 2005). Strong US support for the Saudi ruling family has been a pivotal part of this policy, and this gives weight to the views of the oil companies and the Saudi government on carbon abatement policy. While the climate talks are discussing means to reduce carbon output, the burden of US energy policy in recent years has been to find means to secure energy supplies, and to expand access to oil and other forms of energy in order to fuel the economy's growth.

The growing conflict of interests between states over the security of their oil and other energy supplies is a much more immediate security concern than the long-term conflicts of interest over climate change. 'By any estimation, Middle East oil production will remain central to world oil security', stated Vice President Dick Cheney's *National Energy Report* in 2001. 'The Gulf will be a primary focus of US international energy policy.' It has also become a primary focus of US security policy and a base for US Central Command. Besides the US, the EU, Japan and China are all dependent on increasing oil imports. The developing competition over access to oil and gas in the Gulf, the Caspian, the Caucasus and other parts of the world is setting the stage for a new landscape in international affairs, and shapes the prospects for co-operation in climate change policy. The political instability in most of the regions that are sources of oil is leading most of the consumer countries to consider investing in new and more diverse sources of supply. This seems likely to have a negative impact on climate policy. Meanwhile the international interest in these oil supply regions is tending to make them even more politically unstable.

The energy situation is not the only contextual factor affecting the conflict of interest over climate change. Other questions high on the international agenda shape the prospects too. For example, the development of the world trading system and trends in the world economy (whether towards further globalization, or greater regionalization) will also affect the prospects for co-operation.

The post-Kyoto negotiations

The purpose of the Kyoto Protocol was not to arrive at a comprehensive response to climate change, but to take the first step by setting up an international regime operating within the UN Framework Convention. The next round of negotiations will be more challenging as it will have to secure deeper cuts and wider participation.

One natural approach to framing the problem is to identify a target level of maximum permissible carbon emissions, taking into account the very long time (approximately 100 years) that additional carbon remains in the atmosphere. The resulting emissions are then allocated between different groups of countries on the basis of agreed targets, which would be negotiated in the post-Kyoto talks.

For many environmentalists, a level of zero additional carbon emissions is the desired target, and people have begun to build zero-emissions houses and to experiment with zero-emissions lifestyles. In the near-term, however, reduction rather than elimination is the practical target. The extent of reductions is a trade-off between environmental impact and the political and economic effort societies are willing to make. The IPCC's Third Assessment Report projected the relationship between emissions of carbon dioxide and other greenhouse gases and global temperature changes within a range of 'climate sensitivity', which is uncertain. This means that there is a band of possible values for global temperature around a given pathway of carbon emissions.

Athanasiou and Baer (2002) argue for 450 ppm as a maximum limit, compared with 370 ppm now and 275 ppm in pre-industrial times, with a view to keeping the increase in global temperature within 2 °C. Hare and Meinshausen (2004) take the same view. 'Current estimates of the climate sensitivity suggest that only by stabilizing anthropogenic radiative forcing at levels below CO_2 equivalent concentrations of 450 ppm, the risk of overshooting the 2 °C target can be termed "unlikely".'

The EU has adopted a target of a maximum temperature increase over the pre-industrial average of 2 °C, but the EU view is that this allows for 550 ppm of carbon dioxide. Scenarios prepared for the EU also explore a

higher limit of 650 ppm. Were there to be no restraint, the level of CO_2 in the atmosphere could rise to 900 ppm by 2100, which would result in an increase of global temperatures of more than 5 °C. These levels of temperature increase can be translated into likely levels of damage, using the IPCC's Third Assessment Report and more recent assessments. These suggest a higher risk from large-scale discontinuities, a large increase in extreme climate events, risks to many unique and threatened ecosystems, and negative aggregate impacts in most regions.

In making decisions about the appropriate pathway, decision-makers will be advised by economists, who attempt to weigh up the costs of the damage likely to be suffered by their country (and the world in general) against the perceived costs (in economic and political terms) of abatement actions. These calculations are difficult because of the long time scales involved and the high level of uncertainty.

Efforts to use cost–benefit analysis to work out appropriate global actions run into the problem of what discount rates to apply. Economists have engaged in a vigorous debate over whether to apply normal project discounting, on the grounds that capital invested in carbon abatement could be invested elsewhere in the economy and so should be discounted in the same way as any other investment, or lower or zero discount rates because of the long time periods involved. High discount rates tend to minimize the weight of long-term damage and inflate the short-term costs of mitigation actions. Zero discount rates are kinder to future generations. There are also arguments about how and whether to prioritize measures to abate the uncertain risks of climate change in the light of the existing needs of poverty, disease and stunted development.[5] In practice, decisions will not be taken at the global level. Governments will take different approaches to the discounting decisions and to the analysis of costs and benefits.[6]

There are considerable uncertainties and disagreements too over the costs of carbon abatement. These vary across individual end-uses of energy, economic sectors and countries. Opportunities for reducing carbon intensity are likely to be cheaper in developing countries than in developed countries. For example, cited costs of carbon abatement in the US economy vary across a five-fold range in different models. If economic activity has to be forgone in order to achieve carbon reduction, the costs can be massive. If carbon emissions are reduced by energy efficiency improvements that pay for themselves over a short period, the costs may be negative. These uncertainties add to the contentiousness of policy-making since it is easy to find either very high or very low abatement costs to support different cases.

Table 7.1 Estimates for global damage arising from climate change

Concentration of carbon dioxide in the atmosphere (ppm)	*Total emissions of carbon dioxide (GtC)*	*T (average global temperature increase in °C)*	*Damage (as % of Gross World Product)*
450	365–735	1.7371	0.274436
550	590–1135	2.460867	1.012163
650	735–1370	3.063387	1.905995
750	820–1500	3.579514	2.873741
1000	905–1620	4.617108	5.383492

As a basis for discussion I shall take the figures for carbon damage given in Table 7.1. The temperature figures are calculated from a formula linking temperature, radiative forcing, climate sensitivity and carbon dioxide concentration (Hare and Meinshausen 2004: 12). The damage figures are derived from a formula given by Nordhaus and Boyer (2000) for damage as a percentage of Gross World Product.[7] The regional distribution of damage is much more difficult to calculate, since it depends both on regional projections in the global climate models and the vulnerability of different societies is variable.

I take a conservative estimate of the abatement costs derived from the report by Criqui et al. (2003) for the EU.[8] This calculates the costs of achieving stabilization at 550 ppm and 650 ppm in terms of the percentage of GDP different regions would be investing in abatement by 2025 to meet these targets under a range of different scenarios for the post-Kyoto regime. Some of these scenarios involve 'per capita convergence', with all countries participating and converging to equal per capita emissions, either by the year 2050 or 2100. Others involve 'multi-stage' abatements, with an increasing participation of countries in accordance with their development. The multi-stage scenarios, which the EU currently favours, build on the Kyoto framework by excluding the poorer countries from commitments but expecting developing countries to take on reduction targets as they pass thresholds of economic development and carbon emissions per capita.[9] There are three stages for the non-Annex 1 countries: a first stage in which they are not required to meet carbon abatement targets; a second stage, when they are required to meet carbon intensity targets; and a third stage where they are required to meet absolute carbon reduction targets. Table 7.2 gives the costs as a percentage of GDP in 2025 for two scenarios and for concentrations of atmospheric CO_2, 550 ppm and 650 ppm. Costs are not presented for 450 ppm, but these would be higher than the 550 ppm figures. The costs include

Table 7.2 Efforts to meet carbon abatement targets by region in 2025, expressed as a percentage of GDP

	CO_2 concentration			
	550 ppm. PCC 2100*	*550 ppm. MS**	*650 ppm. PCC* 2100*	*650 ppm. MS**
EU	0.89	1.81	0.11	0.27
US	0.18	3.04	0.00	0.38
Canada	1.88	3.35	0.41	0.62
CIS & Eastern Europe	1.41	4.69	0.07	0.57
Australia, NZ	1.10	2.65	0.23	0.46
Japan	0.99	1.78	0.11	0.25
Latin America	1.54	0.72	0.14	0.06
Africa	1.58	−2.12	0.02	−0.30
Middle East	2.58	2.38	0.45	0.38
India	0.89	−0.49	0.10	−0.22
Other South Asia	−1.23	−1.36	−0.57	−0.16
China	0.8	−1.79	0.16	−0.13
Other East Asia	1.99	1.27	0.36	−0.02

Notes: PCC: Per Capita Convergence; MS: Multi-Stage.
Source: Criqui et al. 2003.

estimates of domestic abatement costs together with the costs of purchasing carbon emissions credits from others.

This enables us to get a rough idea of how different regions may look at the prospects of different scenarios. On the assumption that regions would favour abatement scenarios in which their costs were lower than the likely damage, it is clear from these figures that all regions would benefit from at least some scenarios of carbon abatement, but that lower levels of abatement would secure more widespread backing than higher levels, if conservative costings and national cost–benefit frameworks based on costs in the medium-term future (2025) were to prevail. For example, both the Per Capita Convergence and the Multi-Stage Abatement Scenarios are much less costly than the likely economic damage in the 650 ppm versions. In the 550 ppm versions, the Multi-Stage Scenario is relatively expensive for developed countries and also for the Middle East and other East Asian countries, but gives net benefits for many developing countries. The Per Capita Convergence scenario is less costly than the damage levels for the EU, US and Japan but more costly for Canada, the CIS countries and Australia and New Zealand. The costs for developing countries are also mixed, with some benefiting and others not.

If side-payments were allowed, these figures suggest that the Per Capita Convergence scenario could achieve 550 ppm stabilization without undue

strain on any region. In other words, if the regions co-ordinated their behaviour, as in the simple models discussed above, they would achieve stabilization of CO_2 at a lower level than if each optimized on a self-interested basis. However, if each region were to seek to negotiate a scenario in which its own interests would be best protected, it would be difficult to find any consensus. On these figures the Middle East would not accept the 550 ppm scenarios, without compensation. For the developing countries, the Multi-Stage Abatement Scenario is a better option than the Per Capita Convergence option, while for the developed countries, the opposite is the case.

The implications are that a successful negotiation should be possible, though there will be hard-fought bargaining. There are overarching common interests suggesting that, given collective rationality, an agreed stabilization path is feasible. But most scenarios will have winners and losers at the national level, and this conclusion is even starker if we investigate matters at the sub-national level where political lobbies are actually formed. The clearest illustration of the consequences for the energy industries comes from contrasting the expected energy mix in a 'business-as-usual' scenario with the mix in a scenario that stabilizes carbon emissions, such as the 550 ppm. The reduction in coal use relative to 'business-as-usual' would be 70 per cent by 2050, and the reductions in oil and natural gas would be 50 and 45 per cent (Criqui et al. 2003). This makes the difference between rapid growth and gradual decline for these huge industries.

It is clear that the future behaviour of the climate regime depends heavily on how political elites frame decisions about long-term factors that are inherently uncertain. Here a range of factors will enter decision-making besides the rational calculation of costs and benefits. For some, national economic interests will be paramount, but for some constituencies, vulnerability to climate change will be a crucial consideration and others will be motivated by the 'milieu goal' of sustaining the natural environment and avoiding damage to all human populations. Both international and domestic politics will shape the course of events.

We can anticipate several possible scenarios:

(1) *Kyoto abandoned.* In the first, the US retains its objection to targets, and other non-EU industrialized countries join it in promoting a voluntary approach to carbon mitigation. It is difficult to see how developing countries would be willing to come into a regime for agreed reductions in these circumstances, and the remaining members with Kyoto commitments would have a difficult choice to make between clinging to Kyoto, in the knowledge that the regime was likely to be partial and of limited effectiveness, or abandoning it. In this scenario policy-makers fail to signal that a serious switch of energy policy is imminent, and the

market in carbon credits fails to take off. The industrialized countries would remain aligned around the 'business-as-usual' scenario and might invest heavily domestically in adaptation to climate change. Conflicts over energy security might become serious, and this would be the most likely source of violent conflict. The poorer countries would be left to deal with its consequences using their own resources. There would be a deepening asymmetric conflict along North–South lines.

(2) *Kyoto maintained with US isolation*. In this scenario the Kyoto regime would survive and gradually gain members, with a developing carbon market and a thriving low-carbon energy sector developing under its protection. The US and some other non-EU industrialized countries would remain outside but would participate in aspects of the new trade in low-carbon technologies. In this scenario the interests of the Europeans and the US may diverge and the Europeans may develop more distinctive policies towards their main energy suppliers in Russia and the Middle East. This could be followed by US re-engagement, or it could be part of a drift towards regional blocs, in which disputes over trade, energy security, climate and other issues might come together. This scenario of regional fragmentation might also involve a danger of violent conflict between regions, possibly over energy issues, although the reduced demand may help to mitigate the risk.

(3) *Kyoto developed or replaced by a new regime*. A third scenario would see the US either returning to Kyoto or renegotiating a new regime with existing members, possibly with a different design.[10] This may be linked with assurances that major developing countries, including China, would enter the new regime, which may have thresholds and per capita elements, as in the Multi-Stage scenario, to meet the position of the developing countries. In this scenario a carbon market may take off and a sustained international effort to develop and promulgate low-carbon technologies and socio-economic systems may get under way. Developing country participation may be gradual, but this could be accommodated in a flexible regime. The major risk in this scenario would be that the commitments taken on would aim for comprehensiveness at the expense of vigorous cuts, so that climate damage could still be significant, especially if climate sensitivity turns out to be high. There would still be a risk of violent conflicts over energy security but these could be much reduced by lower demand for energy and a reorientation of the energy business towards low-carbon opportunities.

A conflict transformation approach

A proactive move towards the post-fossil fuel economy would help to transform the emergent conflicts over climate change and energy security.

Instead of resisting it, this approach would encourage the economic, social and technical innovations that can reduce the carbon intensity of economic development and of people's lifestyles. In outline the transformation required is for developed countries to radically reduce their carbon emissions, sharply reducing carbon intensity of all economic activities. This will involve an acceleration of the existing historical trends towards lower carbon intensity. Such a transition is likely to be self-sustaining when it is under way, as costs will fall rapidly and new systems (like mass transit systems using lightweight vehicles) will replace the inefficient ones we have inherited from the era of cheap oil. The scope for cost-effective improvements in energy efficiency remains very large; once innovations have been developed to enable economies to 'mine' this potential source of wealth, it is likely that both carbon emissions and costs will fall together.

It will also be necessary to enable the developing countries to jump from low-efficiency, low-emissions economies to high-efficiency, low-emissions economies without going through the 'dirty' high-emissions phase that has been experienced by industrializing economies to date. Given the scope for technical improvement in the new capital stock that will be deployed and the scope for technological transfer, this is eminently practical. But to place renewable sources of energy and energy efficient improvements on a level playing field with fossil fuels, lifetime costing will have to be adopted, and this will be difficult for economies with low supplies of capital. Innovations like carbon credits can help here, together with diversification into new energy businesses by existing energy companies.

The oil-exporting countries will retain their importance, since oil will remain vital as a fuel, lubricant and chemical feedstock for the foreseeable future. The key to its effective use is not to waste it in unnecessary applications, such as space heating, electricity generation and propulsion of heavy automobiles. There may be scope for the oil exporters to follow the example of the Californian utilities and become suppliers of energy services, providing an energy service rather than simply a fuel.

The basic viability of this approach is founded in its economic rationality. As fossil fuels become less expensive and more environmentally costly, alternative sources of supply are becoming more economic, and efficient use of energy is becoming even more economic than it already is. Efficient energy technologies and non-carbon-based sources of energy share the characteristic that they are relatively costly to install but cheaper to run than fossil-based sources over their lifetime. The institutional challenge is to find ways to reflect these 'lifetime economics' in the rules

that govern ordinary markets. Growing government support for energy efficiency and renewable sources of energy are signs that the case for investments in this direction is accepted.

Other forms of social innovation are developing besides direct investments in the energy sector and in energy efficient machines. Western economies as a whole are moving away from dependence on the more energy-intensive industries as new materials, miniaturization and the shift towards an information society change the basis of the economy. The example of China's modernization and its recent success in reducing its own carbon intensity shows that developing countries are also capable of moving rapidly in this direction.

Such a transformation would require changes of goal and changes of identity. The possible shift from oil companies to energy companies, and possibly to energy service companies, has been mentioned. Is it possible also to anticipate changes, for example, in the Saudi goal tree? At present this would perhaps prioritize the maintenance of the regime and development of the economy, supported by maximizing government revenue, maintaining a high flow of revenue from oil, pumping sufficient cheap oil to meet world demand, relying on security guarantees from the US and maintaining access to US decision-makers at the highest level. However, the regime faces threats to its survival, linked to its close association with the US. Could the Saudi government shift towards a policy emphasizing economic development built on support for other energy services besides oil, including 'clean coal' and energy-efficient oil-conversion technologies? Is a triangular trade possible between the oil-consuming countries, the oil-exporting countries and the developing countries, with oil flowing in one direction, carbon credits in another and low-carbon investments in a third?

Conclusion

The world's growing demand for energy is reaching a limit. Like the expansion of American states into the West in the nineteenth century, this limit creates conflicts of interest. Whether the complex conflicts of interest surrounding carbon emissions are likely directly to fuel violence is unclear. The post-Kyoto negotiations are a critical point. If the opportunity is lost to make a concerted effort to overcome the world's dependence on fossil fuels, the consequences both for the climate and for energy security are grim. We have seen that, as in other conflicts of interest, the links between issues are crucial. Climate change on its own may not be the most likely source of violence, but competition for oil and gas are

already a factor in armed conflicts. The two are linked by the policies being taken to invest in the future energy supply and demand. Ignoring climate change and investing heavily in new sources of energy supply will lead into a world of greater energy insecurity, stronger conflicts of interest between regions, and potential conflict. A proactive response to climate change, through accelerating the transition away from fossil fuels, offers a means to transform this conflict.