

# CLIMATE CHANGE: SCIENTIFIC PERSPECTIVE AND ITS IMPLICATIONS

## Contribution to

Committee for Interdisciplinary Environmental Studies (CIES)

Allied Domecq lecture

Cambridge, April 2002

**Professor Michael Grubb:** Thank you very much and thanks also to Michael for an overview. What I have to say does follow on very well in a number of ways from Mike Hulme's excellent overview of a very complex terrain indeed. I'm going to, as he indicated, say a fair amount about the international response as it has developed and as it relates to some of the kinds of points that Mike Hulme was making.

I thought I would add some comments about how we look at the seriousness of climate change as a policy issue, to say a little bit about the pressures on emissions and the opportunities for reducing emissions, and then move onto the international response as it has developed. I will finish with some brief thoughts on ways forward, and ask does the international system match up or can it indeed?

So the first point, without going into any of the details of potential impacts that Mike covered, is really just to reinforce his comments and his doubts about this being a benefit - cost kind of problem, as Bjorn Lomborg said and complained about the Kyoto protocol not being a cost benefit appraisal. Well not only are there still important uncertainties in the scientific aspects which are further multiplied when one tries to establish the actual physical impacts of climate change, but there are whole categories of things which we actually need to specify and be clearer about, even if we were sure of some of those things. Michael emphasised risk, so the question is; what is our risk aversion? Not just, lets just stack up some probabilities here but how averse are we to the risks of greater

impacts than the central scenarios, the central estimates? We can't just take an average estimate and necessarily assume that that's what we have to work with.

**Impacts of climate change (1)**  
The seriousness of climate change is a matter of judgement ....

- Risk                      Risk aversion given acknowledged ranges
- Dynamics                Most impacts associated with dynamics and extremes, not equilibrium or smooth changes
- Planetary Surprise      High risk low probability dilemmas; Meade's observations on the 'disutility of doom'

The second point is that a lot of the modelling studies still, although this is better than it was, but many are really focused on what would the world look like if, for example, we reached a concentration of 550 parts per million? Now that frankly is almost an irrelevant question. The policy relevant question is, what would be the impact associated with a changing climate system, particularly in relation to the dynamics of how things change, and the uncertainties. If some regions are more susceptible to drought, can you predict to what extent, when, and what are the extremes? This is neither equilibrium system nor indeed is it likely to be smooth changes. And that makes it very difficult to do a cost benefit kind of approach. Then we have the more dramatic side of the planetary surprise. Digging through the literature a few years ago there was a beautiful essay on the disutility of doom; it was written in the context of nuclear power, but some of the points made will still apply to low probability, very high consequence events. In a sense it wasn't clear to me that this economics researcher managed to get further than saying

“well just because its low probability, you shouldn’t ignore it if the danger is big enough”. So there’s a whole set of issues there.

**Impacts of climate change (2)**  
... and of ethics

*Aggregate impact by the rich on the poor or the absent*

What valuation for statistical life & other non-market	Willingness to pay, willingness to accept compensation, or other?
Whose valuation?	‘Aggressor’ or ‘victim’ valuation and payments?
Future generations	Avoiding the ‘dictatorship of the present’

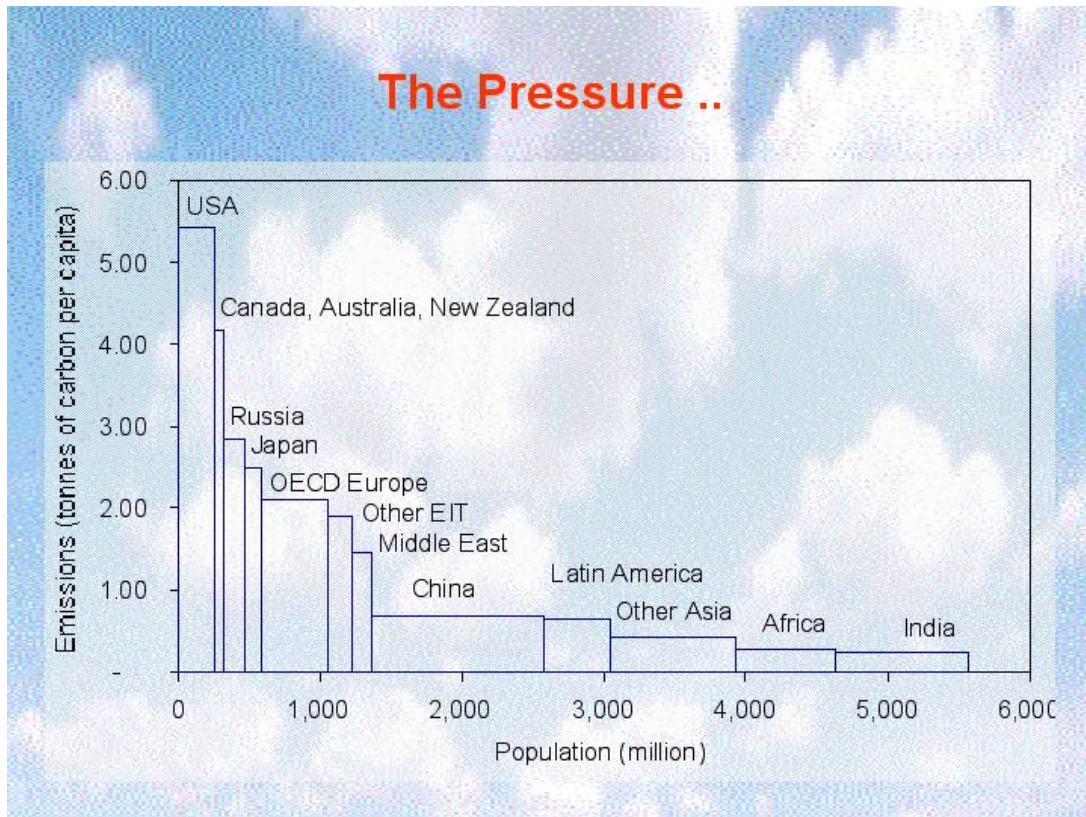
But the other aspect, which I think Mike didn’t lay such stress on is that fundamentally this is also a matter of ethics, because there’s a whole set of issues surrounding who is impacted when and how do you value that. In the second assessment of the IPCC report, which came out in the mid 1990s, there was an absolutely blazing row, diplomatic feud, over what is the appropriate value of statistical life. In other words, if you think people are going to be killed, how important should that rate in your overall cost benefit analysis? Well, like it or not economists use this criteria very regularly, it’s standard in road systems analysis, etc, to do with how much is a society willing to pay to reduce the risk of death of its citizens. The answer is not infinite, it cannot be infinite. The problem is when you move from a national context where you essentially have a domestic set of regulations, debates, values, etc imbedded, and move to an international system you then ask “well who’s valuation of life are you going to use?” and by and large the statistical value of life in India, in the economic sense of the word technically, is a lot lower than in

America. Obviously, America has got far, far more money to spend on its health system and it wouldn't make sense for India to invest in the same kind of high tech things. But if you apply that as an international aggregator, you very quickly get the reaction that the Indian government had, which is how dare anyone imply that American lives should be valued at fifteen times the level of Indian lives. That is the most, if you like, stark indication of the general problem of who's valuation are you using, and how do you aggregate them when you're dealing with citizens in very different national contexts for a transboundary global issue? Is it essentially the value system of the emitter, the aggressor if you want to be aggressive about your descriptions, is it their willingness to pay, or is it the willingness of the victim to pay to avoid impacts, or is it how much you want to compensate them for their culture being obliterated, or some other measure? So actually there are very deep questions there, all to do with really who's doing what valuation on whose behalf. And that's just in the thinking about current generations. Of course, by and large the victims are going to be future generations, who are not actually sitting in this room or any decision-making committee trying to establish how much they care about what might be inflicted. So the deeper you dig into a cost benefit kind of approach the more problems you turn up.

Of course there's always the question of what's the alternative. One other implication of all I've said is that it's more than one just needs a risk appraisal approach. There are two other key elements to it. One is it's sequential, there is no unique risk assessment to be done now that will determine policy for the next century. All we need to know about is what's the next step and do we have a structure that will enable us to improve our response as we learn more? The other thing is that you should not expect there to be a unique best step now, you should expect that only to be reached through a process of negotiation of the different kinds of interest that I've sketched. There was actually a lot of discussion at one point in the Kyoto negotiations as to why developing countries were in the room, if this is about commitments from industrialised countries, the answer of course was because they were intimately affected by the decisions. I think economist Richard Toll, after bashing his head against the valuation of life issue for a while, finally came to the realisation that there is no unique answer because there is no unique decision-maker; there is no global decision-maker for whom we are trying to perform this

calculation. So you would expect different countries to bring different values to bear and basically try and slug it out in negotiations.

This next overhead turns us to the question of the pressures on emissions and their implications for degrees and approaches to control of emissions.



Apologies for those of you who were here last year when I also gave a lecture in this series. I think I probably used this as well, but I find it such a revealing diagram, I hope you'll bear the repetition. What it shows on the vertical axis is per capita emissions, emissions of CO<sub>2</sub> per person in the different regions indicated. The width of each block and the horizontal axis is the population. Now there are several things that one can draw from this. The first is obviously a big disparity in per capita emissions, in fact not just two fold but perhaps three fold in a way between the new world, particularly the Americas and Australia; the old world industrialised countries of Europe, Japan, Russia to some extent; and the developing countries, where you can see very stark differences and patterns of per capita emissions at the moment. The other thing of course is that if you

look at the area of those blocks, per capita emissions times population that tells you the absolute emissions from those different regions. You can see that although global emissions are dominated by the industrialised countries at present, the scope for global increase from the developing countries, if and as they aspire towards anything like the per capita levels of the industrialised world, and even before in fact one factors in population growth, the scope and the potential pressures for global emissions growth is enormous. Given how intrinsic CO<sub>2</sub> is to economic systems it's kind of a bit of a marvel that people are talking about how to stabilise and then bring down global emissions at all when you look at it in the context of these potential pressures for growth.

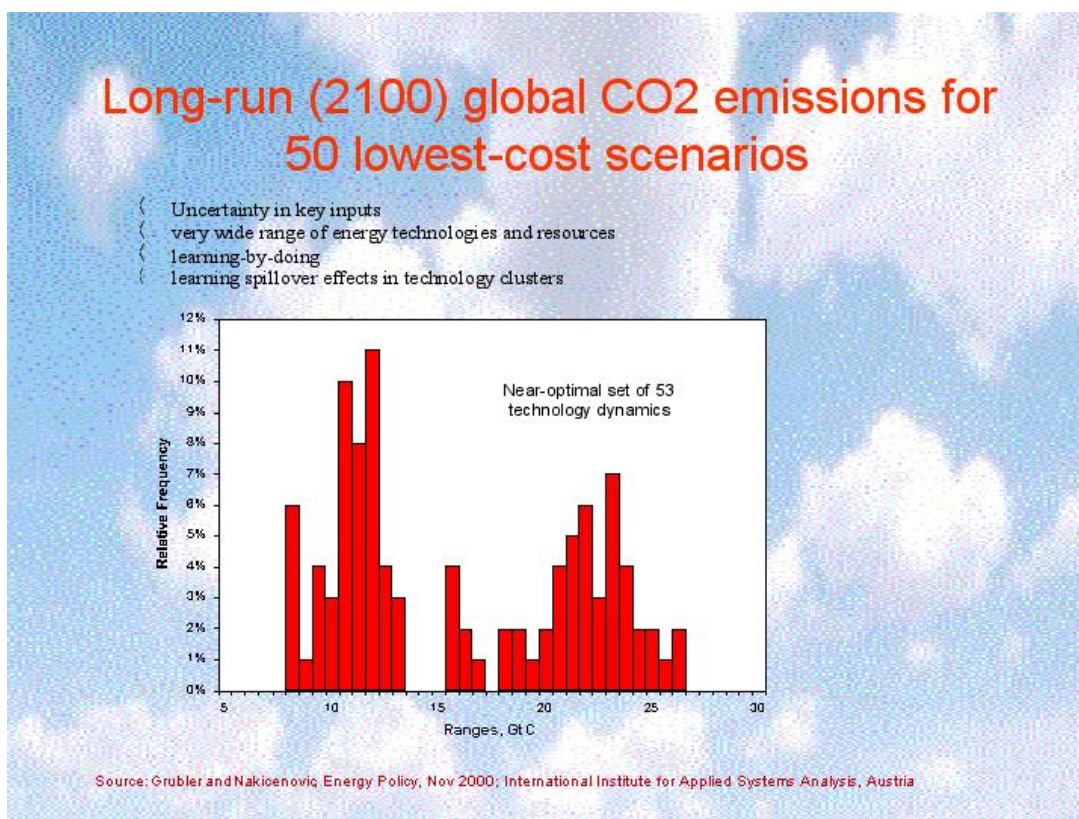
However, the IPCC in its third assessment, the most recent assessment was relatively optimistic in this.

**Mitigation & the IPCC Assessment, 3:  
solutions exist but require greater effort**

- *Significant technical progress.. faster than anticipated. Advances are taking place in a wide range of technologies at different stages of development, e.g., the market introduction of wind turbines ..*
- *Depending on the emissions scenario this could allow global emissions to be reduced below 2000 levels in 2010-2020 .. half of these potential emissions reductions may be achieved by 2020 with direct benefits (energy saved) exceeding direct costs.. and the other half at a net direct cost of up to US\$100tCeq (at 1998 prices) ....*
- *.. known technological options could achieve a broad range of atmospheric CO<sub>2</sub> stabilization levels, such as 550ppmv, 450 ppmv or below over the next 100 years or more, but implementation would require associated socio-economic and institutional changes ...*

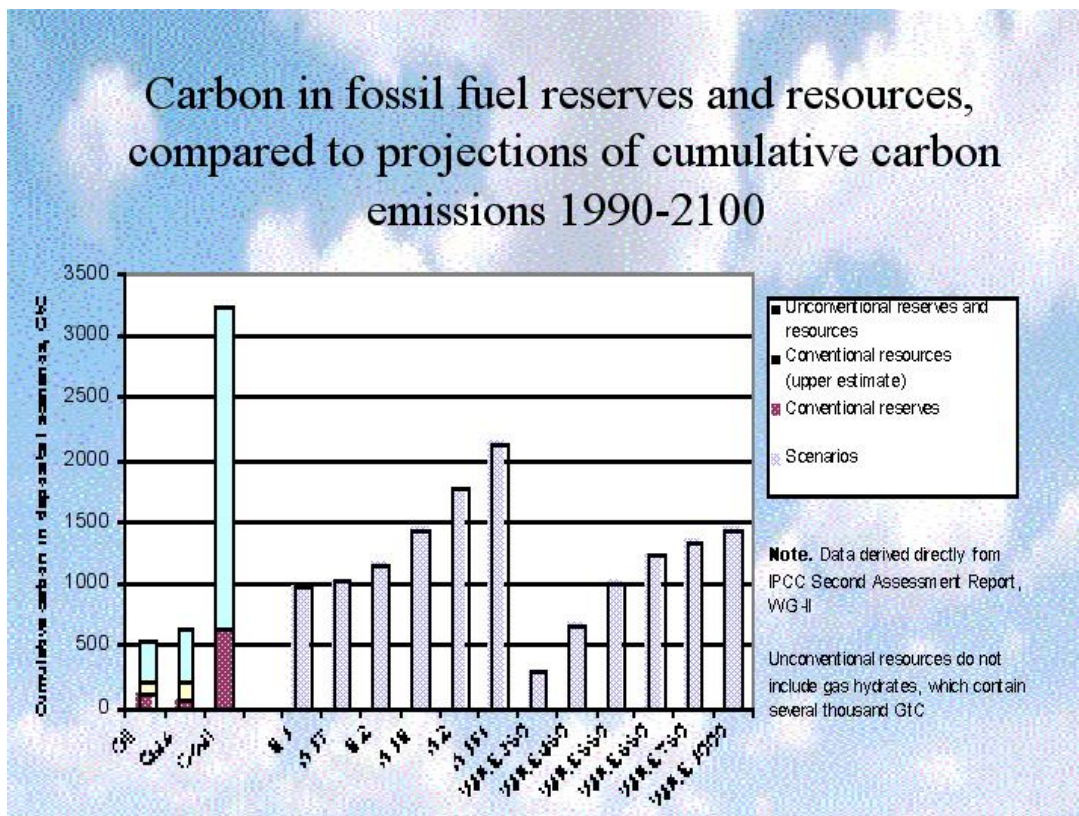
It concluded that technologies for reducing CO<sub>2</sub> emissions have developed, and have developed faster than anticipated in the previous five year assessment, across a wide range of technologies. They gave some indications of what might be expected from those

technologies over the next couple of decades that are certain, probably relatively moderate costs, they could succeed in stabilising global emissions, not concentrations. But beyond that, known technological options could achieve a range of CO<sub>2</sub> stabilisation levels such as 550, 450 or even lower. In that context, I would say that when people talk about 550 parts per million, as Mike did, sometimes people are very unclear about whether they're talking about CO<sub>2</sub> or about the basket of greenhouse gases, because CO<sub>2</sub> is not the only one of course, there is methane, nitrous oxide etc. In fact from the scientific side, insofar as there was any reaching 550 they were talking about a basket of gases, which implies something closer to 450 in terms of CO<sub>2</sub> alone. I submit that, it's the range of CO<sub>2</sub> concentrations between 450 and 550 that is the really interesting range, and I'll say a little more about that in a moment.



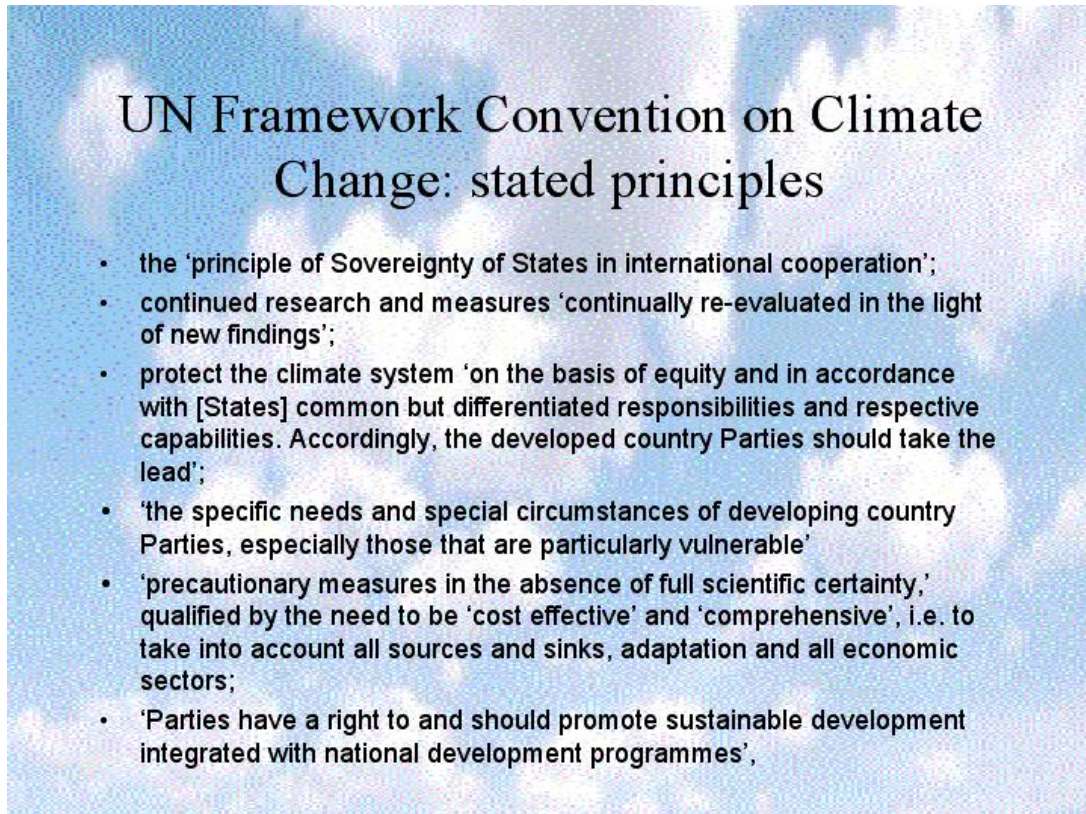
I just wanted to pursue this technological theme a bit further by putting up the result of what I personally find one of the most interesting technological modelling studies of the 1990s carried out at the International Institute of Applied Systems Analysis in Austria. They developed a global energy systems model which had, this was absolutely crucial, a

process of induced technical change. In other words, the more that you invested in technologies, the more market share there was, the more learning-by-doing, the more the costs would come down. They also had a wide range of technologies and they had cross-learning so that if you learnt in stationary fuel cells, mobile fuel cells would also improve to some degree. They simply said, “how much does the global energy system cost by the end of the century?” Of course a lot of the functions in any model like this are very uncertain and they reflected that as uncertain ranges of learning rates and so forth, and certain rates of spill-over etc, and they came out with something which to many economists was completely counter-intuitive. You might expect a nice smooth hump, like a one humped camel, with the cheapest energy system being somewhere in the middle of the range of CO<sub>2</sub> emissions and then quite a lot of uncertainty about that. In fact what they found was that the cheapest energy system spanned from very low to very high emissions, depending upon the selection of the parameters, and in fact there was a clutch at the low side and a clutch at the high side in terms of what was the cheapest, that bi-modal distribution you see there. Now, there’s a reason why I put this up, but let me come onto explain first why I think that’s there, and the author’s by and large agreed with me on this interpretation, which is related to the fossil fuel resource base. What this next overhead shows is on the left three columns the amount of carbon in different fossil fuel deposits, the mauve is the conventional reserves – the stuff that we know is out there because it’s been identified and found and is readily extractable more or less at today’s prices.



Then there's other categories, there's resources of stuff that we think is probably there, good inference and a good chance of being economic, and then above that unconventional reserves and resources. Now the point is that the amount of carbon in the proven reserves of gas and oil is actually rather limited, compared with the amount of carbon that is assumed to be emitted over the coming century in all of the energy scenarios used by climate modellers. Why? Because those scenarios either don't look at the resource base at all, or assume that there's a lot of coal use, use of coal to synthetic fuels, or there's a lot of delving into the unconventional resources, Canadian tar sands and so forth, Venezuelan oil shells. Therefore, any of those futures involve a tremendous amount of additional investment. So if we come back to the fact that, broadly what this model is saying is that you've got to do a lot of investment and learning and expenditure anyway, because sooner or later we've got to go past the conventional oil and gas proven reserves. You can either invest that in developing a global energy system which is predominantly methane and hydrogen and renewables, perhaps nuclear, which is the left-hand hump, or you can invest it in the right-hand hump, which is coal-based synthetic fuels, lots of extraction of the heavy unconventional petroleum resources and so forth. But to say that

one is necessarily cheaper than the other, we cannot do, we don't have the evidence to actually say that it's necessarily cheaper to have a high carbon future. What we can say, however, is that the predominant investment today, and predominant interest, are pushing us towards the right-hand of those two humps.



## UN Framework Convention on Climate Change: stated principles

- the 'principle of Sovereignty of States in international cooperation';
- continued research and measures 'continually re-evaluated in the light of new findings';
- protect the climate system 'on the basis of equity and in accordance with [States] common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead';
- 'the specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable'
- 'precautionary measures in the absence of full scientific certainty,' qualified by the need to be 'cost effective' and 'comprehensive', i.e. to take into account all sources and sinks, adaptation and all economic sectors;
- 'Parties have a right to and should promote sustainable development integrated with national development programmes',

Now, I'll move beyond that a little onto the international system. I just wanted to point out that we are not starting from Tabula Rasa at all, we have now had ten years this year since the signing of the United Nations' framework convention on climate change at the Rio Earth Summit, that establishes or writes down a number of the things that are implicit in what both Mike Hulme and I have said. Obviously it starts at the inter-state level, but it does make reference to the fact that any policy must be dynamic and continually re-evaluated in the light of new evidence, that it must respect and reflect principles of equity as well as sovereignty, and that as part of that the developed countries should take the lead, should take into account specific circumstances of the most vulnerable, precautionary measures in the absence of full scientific uncertainty, but qualified by things. As Mike said, it's as long as a piece of string in a way, and also it did flag

something which I think will come up more at the Earth Summit 2, WSSD in Johannesburg, which is the relationship between climate change and sustainable development. This was actually a theme which was brought out more in the IPCC's third assessment report published last year, broadly saying that reducing CO<sub>2</sub> emissions is actually quite intimately bound up with bigger questions in the structural development and the sustainability of national development from many perspectives. Interestingly this line of approach, the IPCC wanted to pursue it in a special report and that was finally vetoed by certain governments a couple of months ago, led by the US, which basically wanted to treat CO<sub>2</sub> as a specific economic problem, irrespective, or tried to be separated from, the very thorny issues of sustainable development, global equity and so forth.

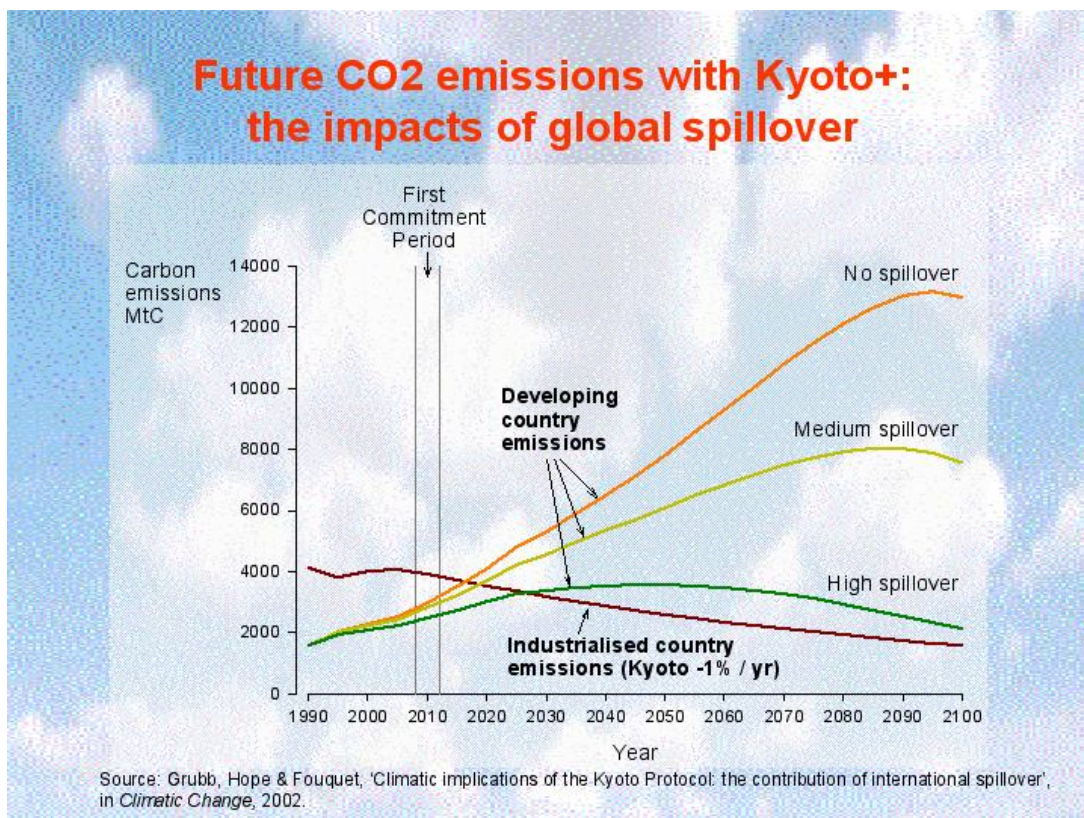
## The Kyoto Protocol: core elements

- Binding commitments to limit greenhouse gas emissions for each industrialised country ('Annex I'): specific binding commitments are a qualitative leap, bringing much complexity
- Quantified for first 'commitment period' 2008-2012;
- 'Basket' of six greenhouse gases (CO<sub>2</sub> main), plus some allowance for sinks / land-use change and forestry
- Collective commitment, to reduce Annex I emissions to 5% below 1990 levels by the first period
- Range of other provisions concerning activities in developing countries, technology transfer, policies and measures, etc.
- Subsequent periods to follow: negotiations on associated targets to start by 2005

Now, built on the principles of the framework convention, we then had the negotiating process leading to Kyoto. What Kyoto does is to establish a structure which says, the way to tackle the climate problem is to have quantified limits agreed on national emissions, initially from the industrialised countries. It sets the first commitment to be a five year average around 210, it does include the full basket of gases, although carbon

dioxide is about 80% of the total from industrialised countries, allow some off-setting against “carbon sinks” which was expanded in the subsequent interpretation of the rules last year. The collective commitment is a modest reduction below 1990 levels in that first period, and the protocol actually contains a lot of other things besides, to do with engagement of developing countries and it establishes that there will be a second and subsequent periods until the problem is addressed and negotiations on the second period have to start by 2005.

Is Kyoto adequate? Will it solve the problem? Well that’s again something as long as a piece of string for the reason that it’s a step in what is essentially tackling a century long kind of problem. I’ve tried to illustrate this in the next diagram in a pretty simplistic way, the height of the lines is simply emissions, absolute emissions, million tons of carbon per year.



The column shows the timing of Kyoto’s first commitment to period, centred on 2010 and the graph spans the century. Now, the brown line is indicated as industrialised country

emissions, saying if they achieved the Kyoto target and then followed that by agreeing subsequent reductions at the rate of 1% a year, absolute, what would the impact on global emissions be? Well, viewed from some perspectives, and indeed many economic models have been put forward to say, “well this is a silly way forward because whatever the industrialised countries do, it will be swamped by the emissions’ growth from developing countries”. The very light brown line there, labelled “no spill-over”, is indeed a fairly standard projection of what developing country emissions would be over the century if they were totally unaffected by the action taken by the industrialised world, and this kind of message has been put forward year upon year and lobbied for very strongly by those who didn’t want to see countries sign up to Kyoto, particularly from within the US. An argument, buttressed with economic models, saying that “Kyoto is ridiculous, its not going to solve the problem, industrialised country action is not where the problem lies”.

Well the reality is this is a dynamic framework and what this graph tries to show that everything really will hinge upon a) whether industrialised countries follow up their Kyoto commitments with continuing reductions and, b) what the knock-on effect is on developing country emissions. Frankly, if you give me an economic model which says “the technology’s practices and policies of developing countries in the year 2050, let alone 2100, will be completely unaffected by what the whole of the industrialised world does in the interim, I’ve got to say that’s a pretty lousy economic model and in fact politically its also untenable to suppose that we could be in a world where year upon year upon year the industrialised countries would take on stronger commitments without anything being done in developing countries. It’s not how the world works, that’s not how the convention is principled, that’s not how the Kyoto protocol is really structured or intended. There’s many components for the spill over, both technological diffusion and political spill over between what industrialised countries do in terms of honouring their commitment on leadership and what developing countries will do. So in that context I would submit Kyoto is neither adequate nor inadequate, it is simply saying “well the first step in a very long journey doesn’t get you to the end point” and what then follows is whether you keep walking, whether you can run faster and so forth. The Kyoto commitments were as good as were feasible to negotiate at the time, given the varying perspectives including some of the things I’ve outlined. I’m not going to go into the details of the politics of Kyoto and the US situation and so forth, I’m very happy to take

that in questions if you so wish, perhaps the one thing I would say was I must admit I was certainly quite chuffed at a workshop which took place a little while after the US had rejected the Kyoto protocol about alternative global frameworks. I was there as a retrograde defender of Kyoto and they got to the final session which was about radical alternatives and a US speaker gave the opening presentation, of which almost the punchline was “well sooner or later we need a framework which has binding targets sequentially negotiated” and the chairman said “but you were asked to talk about radical alternatives, what you’ve said is more or less the structure of Kyoto” and he said “well I know, but I just couldn’t think of anything else that made sense”. Obviously he didn’t want it in the framework of Kyoto, he was saying the numbers were wrong and they shouldn’t have just had industrialised countries, but its actually not very easy to think of something which is structurally completely different and which has this sort of in-built flexibility of sequential negotiating periods. Of course, moving to the second period negotiations, dragging in more countries including now the US, that’s going to be an absolute nightmare diplomatically, but it’s a bridge that somehow one has to face and start crossing.

## Assessing the international regime: core generic requirements

<b>Objectives</b>	<b>Criteria</b>
• Effectiveness	Sufficient impact to start changing long-run trajectory and expectations
• Equity	Sufficiently fair to gain long-term adherence and growing participation
• Efficiency	Justifiable aggregate economic impact - Cost/benefit/objective assessment - Minimisation of unnecessary waste
• OVERALL	Are these objectives met better with or without the current agreement?

So just in terms of how one might evaluate a global framework, and Mike Hulme just started to hint at this at the end of his talk, I think there are broadly three kinds of objectives that one has to think about; is it effective, does it have sufficient impact to start changing the long run trajectory and expectations? Second equity, is it sufficiently fair, not is it perfectly fair, is it ideal, will everyone be happy, the world's not like that. Is it sufficiently fair to gain long term adherence and growing participation from countries? That it's a deal that they think they can take back home and say "look, we didn't get everything you wanted, but". And third, is it efficient reasonably, can you unjustify the aggregate economic impact in terms of the kinds of complexities we touched on, and the minimisation of unnecessary waste. The second of those is what Kyoto's famous market mechanisms, trading mechanisms and so forth are really about. And overall, not, are all these met perfectly, but are they met better with or without the current agreement? To me it seems pretty clear that they are, and in some places met really surprisingly well. That might reflect my background of ten years at an international policy institute where I realise at the end of the day, if you work in international politics, your expectation gets so low that anything seems like an achievement. But that said, on that measure I think Kyoto did pretty well.

So, brief conclusions, I think the scientific issues are the uncertainty which implies a need for both framework of both risk and sequential decision-making and the ethics of valuation, which means you unavoidably and quite logically have a negotiating framework, a global framework as Mike said, with a strong scientific input, but without science ever really being able to determine what is "the objective answer". I think the framework convention and its Kyoto protocol are a promising institutional basis. The big issues that come out will concern the strength and coverage of second period commitments and the international diffusion of technologies that are induced in our efforts to tackle our own first period commitments. I think that's probably quite enough from me and you'll want to move onto Jonathan's thoughts and a wider discussion.

Thank you very much.

**Question 1:** *Mostly both of the lectures are very informative and they emphasised mostly on the future course of action either by environmental taxing or developing the new technologies or developing new fields for the energy and was there any attempt to modify the lifestyle to bring down the greenhouse gas emissions?*

**Dr Jonathan Koehler:** Mike Hulme actually did refer to it partly in his presentation when he started talking about adaptation strategies and adaptation options. It has to be said that certainly in my opinion that people and certainly economists in particular have long recognised that actually just achieving all these big reductions like the UK 60% reduction target, through these technology measures and through taxes or whatever you like, is actually a pretty difficult thing to do in political terms and they also then fairly rapidly noticed that there is a great deal of waste in the way that the economy is run, if you view it from the perspective of trying to reduce your energy use. The problem then is, if you start saying “OK well we could find ways of reducing our energy amount by lets say 30% in 20 years time by everybody using smaller cars or highly efficient lightbulbs or any of the many, many technologies that there are out there”, nobody knows really how you are going to achieve this in terms of either government policy measures or more particularly in terms of how people, individuals, make their minds up about what they’re going to do about what car they drive or what sort of lightbulbs they have or what sort of house they have, and then there is a very difficult situation. One of the best examples in the UK certainly is housing. The UK has an embarrassingly poor housing stock relative to the rest of Europe in particular in terms of its insulation capabilities. The English burn a lot of heat and just chuck it through old windows out into fresh air basically, and when you start thinking about the reasons for this, which people do, they say “OK the UK housing stock is relatively poor, how do we make all these new houses more efficient?” you then come up against all sorts of institutional problems, for example, most housing in the UK is built by big housing companies, they don’t care about the maintenance costs of running a house, all they care about is selling the house. To them they might put double-glazing in if double-glazing is in fashion, but they aren’t going to put particularly thick walls in or design the house so that you can move about it in an energy efficient way, or anything like that, unless they’re given an economic incentive to do so, and most of them aren’t. So there is a great potential in the reduction of demand, but it is still very difficult

to see how people can be induced to change their demands and how you can change the institutional structures like housing, like the motor car industry, in order to achieve these big sorts of reductions that are technologically feasible.

**Dr Michael Hulme:** Just a brief comment from a different perspective on lifestyle. The four different futures that the IPCC created as part of a third assessment exercise, these were global futures looking at questions of governments around the world, questions of values, and on the values issue there was a polarisation between worlds that continued on materialist pathways and worlds that evolved towards much more communitarian or environmentally based value systems, and of course we don't know how global culture and value systems will evolve, but those two extremes created very different emissions futures. Worlds that adopted greater importance on environmental values were clearly less emitting of greenhouse gases. The world has continued along materialist pathways. So the emission scenarios that were used by current?? modellers implicitly reflect these differences in value systems.

**Question 2:** *In response to Jonathan's comment there, I wondered whether that actually told us that we don't need a global management system at all for the politics of climate change to work? And instead what we need is not a kind of cost benefit analysis but a kind of political analysis – we need to put our effort elsewhere. I wondered whether either Michael or Mike would like to respond to that?*

**Professor Michael Grubb:** In one sense you're right in that negotiators can run around the planet negotiating treaties for the next fifty years, and it will change nothing unless it's implemented domestically. At the same time what I find interesting is the interaction between the international efforts and the domestic efforts, whether it's a government or indeed other parties. One sees that popping up all over the place. An awful lot of the legislation relating to not just CO<sub>2</sub> but greenhouse gases, energy markets over the last few years in the UK has started with John Prescott saying "in order to achieve our Kyoto target ....". Occasionally the things he said were totally unrelated, but its been a symbol in a sense that this is what we took on, in the context of other countries doing equivalent things given their situation. So I think that's one thing. I think that's related also to quite

a well known phenomena in some areas of particularly trade liberalisation which is governments in weaker, and I mean institutionally weaker, countries, sometimes saying “well we have to do this because the WTO makes us or because the IMF makes us”. Some of those things are bad, but some of them are actually quite good for the countries and they kind of use the global framework as the reason why they’ve got to do something which is actually probably good for the country, but faces a lot of domestic political opposition, so I think that’s another aspect. Finally I think it’s most interesting, this context, of the US situation which is almost a wonderful case study or an extreme case study in why the international framework does and doesn’t matter. It doesn’t matter in the sense that “hey, the US has opted out”, and nobody could stop them. But it doesn’t follow that therefore the US is going to do nothing, whereas it would have done masses if it had signed up to Kyoto. Arguably you’ve got almost the opposite, that it is the nature of this course in the US, was, Kyoto doesn’t make sense, it’s far too expensive, we’ll pull out, we’re the most powerful country, the global system will collapse and we’ll get around to talking about an alternative framework over the next few years. And to their astonishment the rest of the world went ahead and I think Washington was considerably mind-boggled that the rest of the world went ahead with things that they assumed were domestically, economically costly, without US participation. And the reaction within the US was very much to say “wait a minute, we’re meant to be a leading country, we’d better do something – Kyoto may not be right for us, but the rest of the world is actually taking this problem very seriously and we, the US, as responsible citizens of the world need to show that we’re doing something, and anyway we’ve got a nasty feeling that maybe the Europeans are cooking up something in terms of smart technologies, etc and we don’t want to find ourselves left out”. So you see action within individual states within the US, even international actions, north-east states within the US have negotiated with Canada about emission targets and trading arrangements, and you also see action in municipalities, several towns, the education system, a lot of them referring to the fact that there is a global effort underway here, and the US really should be part of it, even if the President doesn’t think so. So I think the question is much more complicated than you indicate, but you’re right. Global regimes by themselves cooked up by diplomats are useless, they’ve got to be embedded in the willingness and the ability and the signals that they send to domestic constituents.

**Dr Mike Hulme:** Just a brief addendum on the issue of lifestyle behaviour, consumer choice, which I guess was partly what was being alluded to earlier. Clearly there are a number of very successful examples where the state could intervene, and has intervened in our country, to alter choice, consumer choice, by providing physical incentives or regulatory signals that do end up being taken up by individual households. There's also another dynamic of course about individual behaviour and consumer choice, the dynamic of self-interest, selfishness and actually simply changes in behaviour and cultural choice that is driven by new technologies which are unpredictable and unforeseeable. So there's an interesting interaction between what can be socially engineered from the top and what is the spontaneous behaviour of the human instinct from the bottom, and I don't think we understand the way those two dynamics interact.

**Question 3:** *It's a quick follow-up really on the point that Michael Grubb was making, which was a slightly optimistic interpretation of the way that the Americans might go, and I'd like you to say what you thought about the fact that Robert Watson wasn't re-elected as Chairman of IPCC and whether that fills you with equal confidence?*

**Professor Michael Grubb:** I have no optimism at all about the behaviour of the Bush administration. I can only be quite blunt, I think the Bush administration started from a standpoint that didn't believe climate change was a real problem, and if it was then they wanted to pretend that it wasn't, and they have followed that through with ruthless determination in a number of respects. But in a sense that shows in part that this is an administration which doesn't reflect the US body politic entirely, and it doesn't have infinite power. The US is a very, very complicated place in terms of how decisions really get made at various levels. I think the removal of Bob Watson was very worrying, I don't know if many of you saw the press reports, but Bob Watson was the Chairman of the IPCC, very good scientist, very unusual in being both a good scientist and a brilliant manager and communicator, he was very effective at pushing the message of the IPCC forward and did so in pretty plain speaking, which is why a number of the lobbies in Washington wanted to get rid of him, and they succeeded. The US refused to nominate him, even though he was an original American proponent, of course also he was a Clinton proponent, so I suppose that made it less surprising that the administration refused to re-

nominate him. Other countries then wanted to nominate a US citizen, but by and large a combination of the US and many developing countries feeling they wanted a developing country meant Bob Watson was replaced. I should say his replacement, Rgendra Pachauri is a very good international energy economist, so it wasn't about that per se. But I think it was a worrying sign, we've seen many worrying signs about the willingness of the Bush administration to flout what many people consider the norms of international discourse and international behaviour with the international court, you see it in chemicals, weapons, you see it in a number of areas, and yes it's worrying, but the US is obviously the dominant power and moreover headed by an administration which is basically concerned with domestic issues and generally doesn't hear that much what the rest of the world thinks or does. I'm not sure I can really add more to that rather pointed question. Are there any defenders who want to come back at me? I'm being rather rude about the US administration here.

**Question 4:** *One point that comes to my mind is that maybe there's a risk, I'm Canadian and I think Canadians often cut themselves a lot of slack by comparing themselves to the Americans and there is a risk of talking about the American problem in global politics so much that it becomes an excuse for not kicking ourselves around more and complaining about how some people are not playing the game well enough, rather than concentrating on how we come back to the question of social responsibility and how each individual has to seize their own responsibility, rather than talking about the responsibility of others, although it is obviously important that the points remain, but the problem of the American institution is not playing along, but maybe there's a risk that it becomes an excuse for not showing an example ourselves.*

**Professor Michael Grubb:** I'm glad you spoke up there. One of the most interesting questions right now in the international climate system is whether Canada will ratify Kyoto. It is now clear the EU, and its Accession states, Russia and Japan have all committed from the highest level to get it through to the international systems this year so that it's brought into force or at least clearly entering into force by WSSD, those countries are sufficient to bring it into force as a legally binding instrument, but I think for the long term health of the regime Canadian ratification is absolutely key, because if you don't

have that we will effectively end up with two regimes. The fact that we end up with a Kyoto system and a Western hemisphere system, or at least North American system. If Canada does ratify Kyoto then you effectively do have a global system without the world's superpower as part of it, which is a very different kind of world to be in, I think. The interesting thing is right now the Canadians are only talking about ratification because the Prime Minister is determined to achieve it, most of the powers within Canada in terms of lobby the states are against it on the grounds that it will be bad for Canada if the US are not in there, so it's a highly potent, political battle in Canada right now.

**Questioner:** *Maybe the Canadian Government, Chretien, would feel that way, especially if many, many Canadians were pushing them in that direction and they would do that maybe if they, instead of always feeling good about themselves as nice clean Canadians, because the Americans are so much more filthy, actually felt very bad themselves and said "we've got to do something", and then made a lot of noise and made Chretien, although you're saying he is already committed, that would be the forces, that the individuals in that nation not cut themselves slack, but tightened their own rope, so to speak.*

**Professor Michael Grubb:** There's another quick point that may be obvious, but it's worth stating. Bush doesn't last forever and the next US presidential elections are probably three years away, which in terms of climate change overall is not that long, so there's still some room for some optimism about US policy making.

**Question 5:** *Dr Hulme you gave a very interesting breakdown of those who deny or uninterested doubters or engagers, what you didn't give us was percentages – are they too frightening?*

**Dr Michael Hulme:** We could do an interesting show of hands in this audience on using that typology. The interesting thing about that research was not the numbers, but simply trying to understand what was going on in people's minds and their own lives and the psychology of how they reacted to these different prospects. The sampling work that was done in this particular PhD is not a sample that I would want to draw large-scale

conclusions from and apply it to the population of Britain. It might be interesting to get a polling organisation to do a representative survey across the length and breadth of Britain. The point I think that was coming out, this was just a piece of PhD research of course, the point that I was simply making there is that it comes back again to the question of lifestyle and about changing behaviour and demand and so on and that is that these issues are not fanning out across a uniform citizenry, you've got deeply divided attitudes towards what we value, what our responsibility is, whether actually we believe a science. I don't know, those of you who listen to Radio Four, you may have picked up a little bit of coverage about the new climate scenarios report that we published on Friday on the Today programme, Margaret Beckett ended up making a comment about it on Friday. The following day we had a rather skittish piece from Dominic Arkwright on the Today programme again, at 8.25, which might have been entertainment, but it did nothing at all to communicate what actually we know scientifically about climate change. It was basically trying to put across the notion that the press had reported over the previous twelve months, some parts are getting warmer, some parts are getting drier, some predictions are getting wetter, some predictions are getting cooler, basically science is all over the place and at that level of reporting of what is now increasingly robust serious science to our general public it's not surprising that we've got this diversity of attitudes to what's happening to our global climate system. So I don't know where you started off the question but I wouldn't draw implications from that, simply that drawing attention to the point that we do not have a uniform human material that we're playing with here, we're deeply divided.

**Questioner:** *Absolutely. I would have predicted the divisions you've made on the basis of Myers mixed personality assessments and if you put the figures from that you end up with 52% denying, 24% uninterested, 20% doubters and only 4%, if you're lucky, engaging. But there is a good side to this. If you consider these as possible team members rather than as competitors then you start off with the engagers, and what they've got to do is to actually produce solutions which will then get the uninterested interested, and I was encouraged by what you said about the take-up of winter???, once they've been proven to work and people are interested in them.*

**Professor Harry Elderfield:** Good. That might be a good point to finish since its 7.00pm. I want to conclude very briefly by thanking our three speakers and panellists for a very interesting talk of their views about climate change research and where it's going, and if you would like to hear something of the government's view on this, then the third and final of these Allied Domecq Lecture Series is on the 14<sup>th</sup> May in London, to be held at the Royal Society and you will hear something from Michael Meacher, but I'm not quite sure what you'll hear, you'll have to go to find out. Thank you very much.