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Man-Made Climate Change

Economic Aspects and Policy Options

ZEW ECONOMIC STUDIES

Physica-Verlag
A Springer-Verlag Company

ZEW
Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

The Kyoto Protocol and the Emergence of *"Contraction and Convergence"* as a framework for an international political solution to greenhouse gas emissions abatement.

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The Kyoto Protocol, completed in the early hours of December 11th 1997, at present is no more than a potential breakthrough in the development of effective global policy for the control of atmospheric concentrations of greenhouse gases and the mitigation of human-induced global climate changes. The core issue of the negotiations has been deferred until COP4 in November 1998. The industrial countries have negotiated a compromise that subject to ratification will legally bind them to commitments beyond those in the UNFCCC. But, the ratification of the Protocol by the US still remains contingent on achieving the *"meaningful participation"* of *"key"* developing countries in the abatement regime and the multilateral acceptance of international emissions trading. This is a struggle to define property rights. These key developing countries include India and China and they have made it clear that their acceptance of trading is contingent on the achievement of *"equitable allocations"* of emissions entitlements based on achieving equal per capita entitlements globally. COP issued instructions to the technical bodies attached to the UNFCCC to *"define the relevant principles, modalities, rules and guidelines for emissions trading"* in time for COP4 in November 1998 in Buenos Aires.

GCI argues that *"Contraction and Convergence"* is the approach that can break through this deadlock and welcomes the fact that major parties and interest groups in this dispute have already acknowledged that they take this approach seriously and that it has growing support throughout the world. As a leading economics commentator Peter Jay has noted, *"… unless there is some recognition that eventually no one group of human being can expect to have an internationally recognised right to consume more of the world's limited capacity to absorb greenhouse gas emissions than any other group, it is hard to see how a globally enforceable policy can be built by consent.*" And in the words of the President of GLOBE International, *"Contraction and Convergence is not simply the right way to solve the problem, it is the only way to solve the problem."*

CHALLENGE FROM IPPC CLIMATE SCIENCE

The First Assessment Report (FAR - 1990) of the Intergovernmental Panel climate Change (IPCC) noted that atmospheric concentrations of CO2 were 25% higher (350 ppmv) than pre-industrial (280 ppmv) and rising faster and higher than anytime in the previous 160,000 years. An extremely strong correlation between rising CO2 concentrations and human CO2 emissions [mainly from fossil fuel burning] was observed from around 1800 forward. The IPCC also observed circumstantial links to rising global mean temperature and stated that immediate minimum 60% to 80% cuts in human CO2 [1]emissions were necessary if atmospheric concentrations of CO2 were to be stabilised just at 1990 levels (see chart 1). Since then, IPCC has stated that the balance of evidence suggests that there is a discernible human influence on the climate system. They also suggested the damages consequent on no abatement and further global temperature increase as being between serious and potentially catastrophic, regionally and even globally. Since 1990 there has been much investigation into what constitutes atmospheric greenhouse gas concentrations levels that do not dangerously affect the climate system. According to carbon cycle and global climate modelers, the time frame foreseen for achieving at least 60% cuts in emissions is between 50 and 200 years, depending on the ultimate atmospheric CO2 concentration goal.

[1] GCI recognises the relevance of other ghgs, but also that industrial CO2 emissions account net for over 70% of the human influence on climate change. Moreover we are primarily advocating the policy concept *"Contraction and Convergence"* for negotiating the shared ownership of greenhouse gas emissions entitlements globally. This depends on having reasonable global datasets and so far these only exist for industrial CO2 emissions.

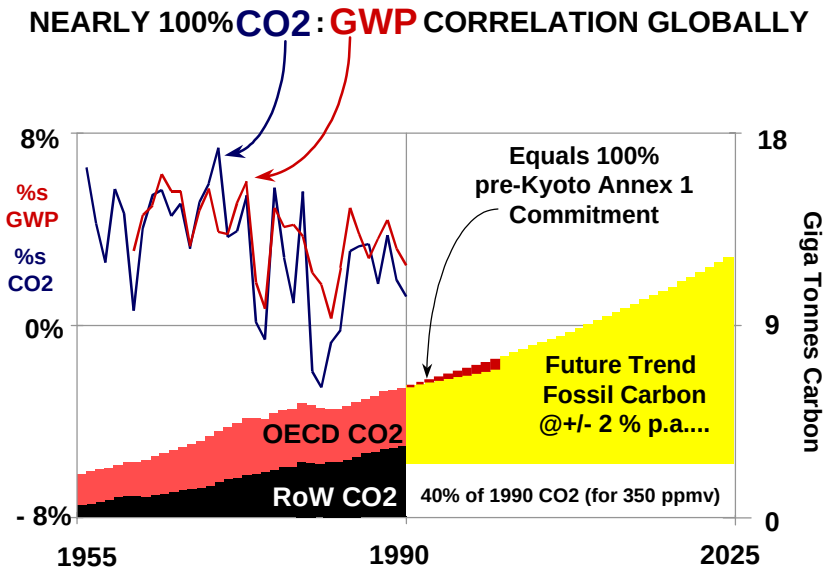
There is a real concern however, that even going to 450 ppmv (60% cuts in emissions over roughly one hundred years) may result in serious ecological and consequent socio-economic damages. The IPCC has published data derived from climate models that attempt to demonstrate the quantitative links between greenhouse gas emissions and accumulated atmospheric concentrations. (These are summarized in Appendix A).

GLOBAL SOLUTIONS ARE CONSTITUTIONAL

At the very least, sensible contingent planning requires that if the global community is to demonstrate both technically and politically that the worst of the potential damages from human-induced global climate change can be avoided, it will have to demonstrate that the cuts in emissions can be achieved. There will be a twin compromise. The rate of cutting emissions must rapid enough to halt the rise of atmospheric greenhouse gas concentrations below levels that dangerously affect the climate system. However, it must also be gradual enough to give time for non-fossil alternative energy sources and energy saving measures to be introduced so as not to precipitate an economic crisis. Moreover, the whole operation will have to be planned for inclusivity under continuous political and scientific review. Not only is it appropriate to insist that *"a global solution is required for a global problem"* as the US has repeatedly done, it is also necessary to actually come up with a global solution. This unavoidably means having to recognise and acknowledge that a global solution is by definition, constitutional. It will be the result of having first had to determine the principles upon which the rules for globally sharing finite resources will be founded and applied. In the case of climate change, this means determining the principles and rules for sharing a future global carbon budget that is also consistent with the twin compromise above The political struggles at Kyoto have brought the need for this unprecedented imperative into focus more sharply than before.

Deliberate limitation of CO2 emissions from industrial activity is certainly contentious. Dollar GDP from the formal economy has so far been very closely correlated with CO2 from fossil fuel burning (see Chart 1) and anything less than the positive growth of dollar GDP is regarded as a primary signal of macroeconomic failure. Consequently now achieving a delinking of GDP and CO2 emissions must be a primary feature of any future economic planning. Moreover, CO2 emissions and GDP are both historically and currently, very unevenly generated and distributed throughout the global economy. In simple language, it is those who have made the money who have also made the mess in the atmosphere. This is now increasing instability in global politics as well as in the global climate system, where the increasing risks of environmental adversity are increasing the risks of attendant social and political conflict. The issue of how to determine the "differentiated responsibilities" in any global programme required to achieve the necessary levels of emissions abatement is thorny and has confounded the UNFCCC negotiations all the way from INC1 in Washington in 1991 to COP3 in Kyoto in December 1997. The argument is fundamental, but is quite novel for being truly "global". Everybody regardless of levels of wealth and development is implicated, some as alleged perpetrators but all as probable victims.

CHART 1



NO PROBLEM, NO REGRETS, NO SOLUTIONS WITHOUT DEVELOPING COUNTRIES

Since 1990 we have been through three periods of argument about whether human-induced climate changes were occurring. The initial period of *"no problem"* gave way to a period of *"no regrets"* (perhaps there's a problem so do what makes sense for reasons of economic efficiency). In reality this all seems to have reflected a wish to postpone any genuine engagement with the real issues. For example John Knaess, the head of the US delegation to the Second World Climate Conference, insisted that *"simple sophomore physics reveal that the problem is real"* (greenhouse gases trap heat so more greenhouse gases trap more heat) and that the only questions were *"how much"* and *"how soon"*. It bears some reflection as to why it took seven years until June 1996 at COP2, for the US government to attempt to get behind emissions abatement policy consistent with the acceptance of human-induced climate change as a reality. It seems probable that the real argument has always been about how to compute and then most particularly *share* the future sustainable "Global Carbon Budget". Post-Kyoto we are all now openly being called to account on this point. So, since COP2 we have been in the third period called *"no solutions without developing countries"*. For the last eighteen months the call from across the board in the US has been that there has to be, *"meaningful participation by developing countries"* because *"global problems require global solutions."* This was in spite of the Berlin Mandate with its focus on developed country commitments only.

A STRUGGLE TO ASCERTAIN PRINCIPLES GOVERNING GLOBAL DISTRIBUTION

The period of tactical denial could well have related to the battle between two competing socio-economic arguments that were advanced at the outset for determining the international distribution of future CO2 emissions entitlements in the carbon budget. These were flat-rate emissions cuts globally with budget shares, or emissions entitlements, proportional either to GDP or to population. Application of each argument leads to very different distributions of entitlements globally. For example the USA in 1990 had approximately 4% of global population but emitted 25% of CO2 emissions with a GDP share to match. In the same year India had approximately 15% of global population but emitted 3% of CO2 emissions with a GDP share to match. It is no surprise therefore to find the US favored flat-rate cuts applied to shares proportional to initial GDP figures, while India favored shares proportional to population. In the World Bank's Development Report of 1992 the arguments were applied, the consequences were analysed and the inverse distributional results were compared. They noted distribution from shares equal on a per capita basis accumulated between 1950 and 1990, gave an overall negative share to developed countries stating simplistically that for that reason the alternative seemed the more feasible approach.

CHART 2 – Entitlements reduced always proportional to initial GDP

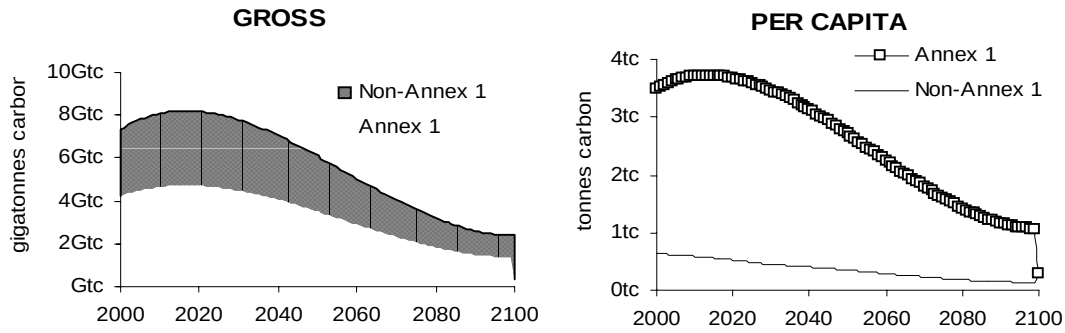
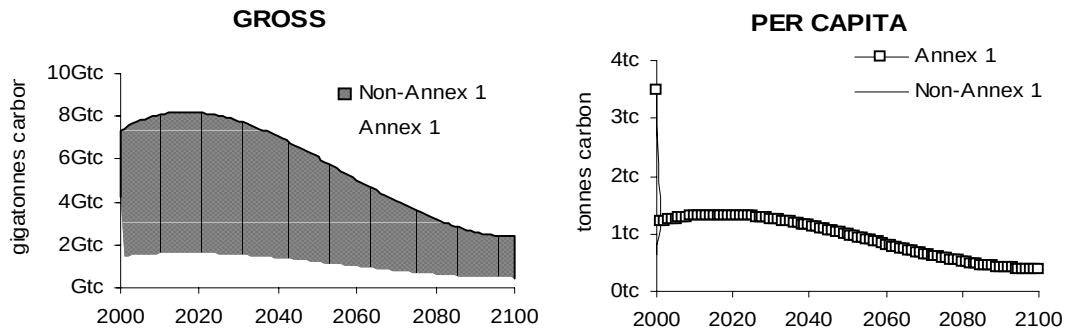


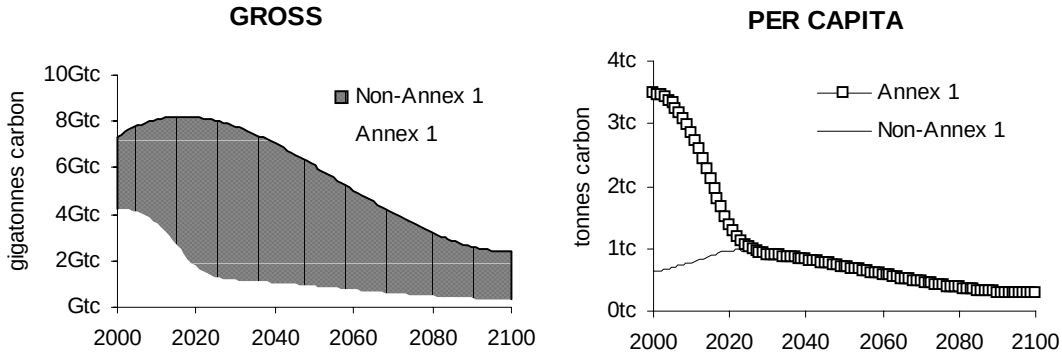
CHART 3 – Entitlements reduced always proportional to initial population



However, what the arguments have in common is that they are "pro rata" arguments where entitlements would be the result of applying a central organising principle to distribution out of necessity, simply to enable the collective contraction to be computed. The point here is that you have to make some assumption other than business-as-usual about distribution if you want to deliver the purpose of the UNFCCC, pre-eminently to deliver overall contraction of greenhouse gas emissions. Over the full period of achieving the 60% cuts in global emissions, this is unavoidably a negative-sum-game on emissions for everyone. And it is self-evident that without the application of a central organising principle to the determination of future allocations of emissions entitlements, the negative-sum-game of global carbon contraction will be unachievable. Business-as-usual and the now globally competitive character of market forces tend to engender deregulation and an erosion of democratic politics. If this culture is assumed for the management of greenhouse gas emissions, the future global carbon budget and its distribution will simply be the "invisible hand" in its malignant guise. It will be the ad hoc result of each party to the negotiations continuing the attempt to maximise its shares of the budget at the expense of all its competitors. Consequently, the future global carbon budget will expand indefinitely as the global aggregate of reluctance to clean up causing dangerously raised levels of atmospheric greenhouse gas concentration. In other words it will be the ever more visible and aggressive hand of climate change and the painful damages it will bring. This will continue unless and until there is a multilateral willingness to accept the application of a central organising principle to the determination of future international shares of what globally is a deliberately conceived and managed budget for carbon *contraction*. Put another way, more and more people now seem to accept that two hundred countries times two hundred arguments will never achieve the level of international agreement required to secure 60% cuts in emissions globally. What should also be self-evident is that the defining character of such arrangements will be based on some universally recognisable principle of equity simply to secure the necessary multilateral acceptance of Quantified Emissions Limitations Reductions Objectives (QELROS). If so it would then be recognised that any efficiencies that are achievable will be derived from - rather than give rise to - the primacy of the equity based arrangements. In other words principle and practice are inseparably linked and the old adage is true: *"principle without practice is useless and practice without principle is dangerous."*

So far, the most frequent argument of many Western economists has been that sustainable future CO2 emissions entitlements should be distributed between countries proportional to GDP precisely because of the close correlation between CO2 and GDP. Contrarily, most developing countries have argued that sustainable future CO2 emissions entitlements should be distributed between countries proportional to population because the global atmosphere and climate system are a "global commons", the sustainable use of which should be the equal responsibility of all members of the global community. If the commons belongs to anybody, it belongs to everybody. Both themes are embedded in the language of the United Nations Framework Convention on Climate Change (UNFCCC). Moreover, while the "basis of equity" is recognised in the UNFCCC in the context of international per capita emissions paths which are historically disparate, "cost-effectiveness" of global emissions abatement measures is also called for, which is portrayed as pursuing the "global benefit" (of avoided emissions) at least possible cost.

CHART 4 shows that these conflicting positions can be resolved through *"Contraction and Convergence"*. We start proportional to GDP and deliberately move to being proportional with population (here by 2030).



But so far they have been polarised to an intractable seeming deadlock. Those who see entitlements as being proportional to GDP not only get the bulk of entitlements, they have also seen themselves as the main providers of entitlements in any market that may emerge where entitlements are tradable internationally. In other words if there was emissions trading and we were following the World Bank's *"most feasible"* case (see above), India

would purchase entitlements from the USA. The US Mineworkers Association put out material making this case in the run up to COP3 in Kyoto. Contrarily, because at least 50% of any year's emissions continue to reside in the atmosphere over very long time frames, countries with low per capita consumption have argued that they are innocent of causing climate change historically, currently and even into the medium term future. The Brazilian proposals to COP3 for example attempted to define responsibility for observed global temperature rises by computing national proportions of blame as a function of nationally accumulated historical emissions. The result of this analysis shows that countries such as Brazil remain "blameless" well into the future. Bach Koomey and Krause did a related exercise in a report for the Dutch Government ("Energy Policy in the Greenhouse" – Earthscan 1989) where "blame" was linked to nationally accumulated historical per capita emissions. The result of this particular analysis demonstrated that if equal emissions entitlements were the currency for resolving the problems of global abatement, the industrial countries are already indebted to developing countries to the extent of total bankruptcy. There have been many other attempts at straightening out distributional methodology for the allocations of future emissions entitlements. They usually involve more or less complex combinations of weighted indicators such as carbon intensity of emissions, per capita GDP and per capita emissions (proposed by the Norwegians) and emissions per unit of export (favoured by coal-rich Australia). This has usually been applied to time frames well short of stabilising greenhouse gas concentrations and often to only sub-global country groupings such as the Annex One of the UNFCCC for example. Moreover, special exceptions have been achieved as well where for example the US has successfully negotiated that emissions associated with UN-backed military operations should not be added to the accounts of the countries undertaking the operations.

Faced with this degree of intractable complexity and quarreling, some commentators have pooh-poohed the need for a central organising principle altogether. Some are non-contrarians suffering from real anxieties about climate change and a process which seems fundamentally unwilling to really engage in the politics beyond denial, self-exemption and exclusivity. Often they have expectations based on accepting the continued operations of unfettered markets and link these to programs conceived in the mould of "Joint Implementation". Others suggest a general disposition towards "adaptation to" rather than "mitigation of" climate changes is a more realistic way of "submitting to" the future. This occasionally tends – probably not co-incidentally – to accompany the at least residually contrarian views of human-induced climate change, where the need for carbon contraction per se is still questioned. The adversities of climate change are seen as being on a scale from exaggerated to non-existent and the extent of human-causation of climate changes either as over-emphasized or invented and overwhelmingly irrelevant. There is also a line of reasoning which says that with or without climate change, the ability of humans to devise and operate to anything political that has a component of central planning is "ideological" and therefore undesirable and probably ineffective or unachievable in practice anyway.

"FAIRNESS" – AMBIGUITIES, STEREOTYPES AND CONFLICTS

What this reveals is that without a clearly perceived need for carbon contraction, the issue of "fairness" remains as ambiguous as ever it was. "Haves" defend unequal distribution as "fair" because rewards should be proportional to factors such as competence, initiative and sustained effort. "Have-nots" usually defend redistribution towards equal distribution as "fair" pointing to structural disadvantage usually in the context of the traditional arguments between capital and labour. In essence the "North/South" argument is no different from this albeit at a global level.

Distributional fairness, in circumstances where the increasing gap between "haves" and "have-nots" is structurally resisted, is probably easiest identified with the application of welfare economics as at least a necessary buffer against the social distortions of unmitigated market-forces. Distributional fairness, in circumstances where the increasing gap between "haves" and "have-nots" is seen as requiring reversal and even closure, probably embraces everything between the tendency to philanthropy on the one hand and the tendency to say *"when's it my turn?"* on the other. Some people (usually characterised as coming from the left and often but not always in the constituency of "have-nots") appear to be for distributional fairness. And some people (usually characterised as coming from the right and often but not always in the constituency of "haves") appear not to be. These inverse policy attitudes about "fairness" tend to centre on the distribution of socially created and privately partitioned wealth measured as GDP or the "benefit" of income alone. Seen this way arguments concerning "distributional fairness" would seem to have no altered prospects of relevance or realisation one way or the other now than in the past. Although globally the have-nots consistently have been and remain the majority, the "haves" dominate the political decision-taking related to distributional fairness. The resultant status quo embeds a trade-off between these left/right tendencies, stabilised by a well-established legal framework for continuity in property rights with much attendant academic and theoretical work explaining and justifying the "political economy" of this status quo.

In global terms, this framework has not been subjected to any pressures that seriously challenge its sustainability and therefore its legitimacy until the present and the advent of human-induced global climate changes. But in the economics of the global commons everything changes. The rules which developed for the distribution and protection of the socially "created wealth" cannot simply be transposed to encompass the "received wealth" of the commons. The commons are the nearest thing we could identify with providence itself. This is wealth we did not create nor could we. As Tim Wirth of the US State Department said on the subject last year in his lecture at Kew Gardens, *"the economy is a wholly owned subsidiary of the environment."* With this understanding of subsidiarity and the very global scale of the problem, it is not foolish us to look for new principles of wealth protection and security and distribution related to establishing property rights in the global commons.

BEWARE THE NUMERAIRE AND THE ECONOMICS OF RELUCTANCE

An eminent contributor to the climate change debate – Professor William Nordhaus of Yale University – introduced ideas for "The Economic Management of the Global Commons". However his have relied mainly on neo-classical assumptions in favour of using "Global Cost-Benefit Analysis" for this task. He and many other economists contributing to the IPCC's Second Assessment Report (SAR) maintained that the whole question of what to do about climate change is answerable through recourse to analysis of this kind. Their early results were collated in the SAR published in 1996. The results tended to portray the costs of damages from climate changes as being less than the costs of the actions for emissions abatement necessary to avoid these damages. Bluntly, it was cost effective to go along with climate change, not to resist it. The whole exercise seemed to have the character of a self-fulfilling prophecy in favour of business-as-usual. In effect it was polluters contentiously tending to put a high price on abatement and a low price on damage. The clearest example of the latter being the cash evaluation of global mortality at CO2 doubling where crudely fifteen dead Chinese equaled one dead American, despite one living Chinese emitting about one tenth of the industrial CO2 of one American. It was also despite the even more skewed history of the emissions of industrial CO2 and the fact that at least half the emissions in any year accumulate there with a residence time of about 100 years. (The US alone with an average 3% of global population over the last century and a half remains responsible for just under 35% of accumulated industrial CO2 emissions to date). In fact all damage evaluation resorted to the snap-shot convention of expressing units of damage as cash values proportional to the average levels of local income. The predictable result was that damages of all kinds in developing countries were devalued relative to the equivalent unit of damage in a developed country. So in spite of the prediction that there would be roughly five times as much damage in developing countries as in developed countries, the overall cash value assigned to the damages in developing countries was about half that of the value of the damages predicted to occur in developed countries. And all this was contributing to a global cost/benefit comparison that broadly suggested that it was cheaper to adapt to the damages from climate changes than to prevent them. Unsurprisingly it was characterised as the economics of genocide in the Indian press.

These analytical results attracted much criticism in the fora of the United Nations such as the United Nations Framework Convention on Climate Change (UNFCCC). These fora had been created especially to mediate and resolve the international policy conflicts of human-induced climate change, not to exacerbate them. The attempt to mediate some of the dispute that followed in the IPCC itself is recorded in the Summary for Policy Makers of Chapter 6 of the Working Group Three contribution to the IPCC SAR. (It is reproduced as Appendix B). The period seems in retrospect to have been one of "stressful learning". Perhaps a more relaxed and robust attitude is now possible with regard to the need to test a whole array of relevant assumptions. Some at least of these will inevitably underpin the next round of analysis and its assessment in the IPCC's Third Assessment Report (TAR) due for completion some time after the year 2000. It seems crucial in the preparations for the TAR that the economic assumptions related to the assignment of property rights in the global commons are reassessed. This is relevant because "meaningful participation" in the UNFCCC of developing countries is one of the conditions the US attaches to its ratification of the Kyoto Protocol.

It is fair to point out that much of the economic analysis reflected in the SAR was conceived during the earlier period of "no regrets". During this period, climate change as a human-induced problem was generally downplayed, alongside the continuing efforts of climate contrarians who were attempting to demonstrate that there was actually "no problem" at all. Their efforts continue at this time in an increasingly implausible way. However, at that time uncertainties to do with the climate changes were clearly more about whether the problem really existed than with concerns about actually *under*-reading the dangers of climate change and potential catastrophes. For example the most of the potential for biogeochemical feedbacks was omitted from the climate models because of their complex non-linearity. Much of this potential would contribute to the upward forcing of global temperature if the mechanisms become active. Large releases of the greenhouse gas methane from beneath tundra and icecaps as they melt will increase warming. Little understood but globally crucial CO2 sinks

in the boreal forests and elsewhere could easily switch off as the temperature rises. Increased water vapour in the atmosphere as a result of ocean warming will compound the warming effect. The range of increased temperature predicted by the models (e.g. with a best-guess 2.5 degrees Celsius rise at CO2 doubling) are inadequate because the models could only in effect assign a zero value to these factors. The quantitative results acquired have nonetheless achieved the status of "received wisdom" simply by virtue of the frequent reference made to them. When uncertainty is cited in this context it has been of the "even-handed" kind, which positions the results as being between either too high or too low. The quantitative absence of feedbacks in the models results clearly give results that err on the side of caution however.

Faced with these dimensions of complexity, it is not surprising that economics has been struggling to redefine itself in the face of global ecological imperatives. Even Professor Nordhaus by 1997 had loosened his neo-classical belt a little. In a paper for the IPIECA conference last year he commented as follows, *"Once we open the door to consider catastrophic changes, a whole new debate is engaged. If we do not know how human activities will affect the thin layer of life-supporting activities that gave birth to and nurture human civilization and if we cannot reliably judge how potential geophysical changes will affect civilization or the world around us, can we use the plain vanilla cost-benefit analysis (or even the premium variety in dynamic optimization models). Should we no be ultraconservative and tilt towards preserving the natural world at the expense of economic growth and development? Do we dare put human betterment before the preservation of natural systems and trust that human ingenuity will bail us out should Nature deal us a nasty hand?"* Having asked the questions he asserts a preference for the reasoned judgement of natural and social scientists over the judgement of philosophers and politicians. But he acknowledges the *"massive uncertainties"* and suggests that *"coping with climate change is a worthy challenge for us all."* This is all a far cry from his suggestion a few years back when he suggested that climate change was of no consequence to the US as they had air conditioning and shopping malls. Later he suggested that spotted-owl-equivalents would do just as well as money for the numeraire in the global cost benefit analyses of climate change. It was the one moment of mirth in the period of "stressful learning"; - no one at the UN could understand how 15 dead Chinamen equaled one dead Englishman if a spotted owl equaled a spotted owl. Economics is sometimes more daft than dismal.

So what do social scientists – and most particularly the neoclassical economists - now suggest is the solution to the international distributional struggle? How do we establish the pattern of the ownership of the entitlements to consume a future global carbon budget that is finite and contracting by around 60% so as to be consistent with the objective of the UNFCCC? Is the role of politicians simply to relay the wisdom of social scientists to the negotiations at the UN and so deliver the climate treaty? It certainly hasn't worked so far. And critically the US is seeking the general acceptance of the international tradability of pollution permits and the assigning of property rights in the global commons is essential to the exercise. Simply trading margins off the existing trends of pollution in the globally inequitable status quo will not bring about the reductions to which the developed countries are now legally committed. Nor particularly will it encourage the involvement of the developing countries on whose participation the process and its success so obviously depends and whose participation in an unavoidable way depends on the issue of distributional fairness globally. As the end-game of Kyoto clearly demonstrates, China, India and the Africa Group of nations are making *"equitable allocations"* and the acceptance of linking Contraction to Convergence a precondition of their acceptance of emissions trading and their involvement in any global solution. This not an invitation to have another century of neoclassical economics. It is about limits. Its more than a worthy challenge, it is wholly unprecedented in human affairs. Just as capitalism surrounded and contained communism, now the massive uncertainties of climate change engendered by them both, surround and contain them both. Discovering the way forward is a challenge more rigorous than merely worthy.

CLOSING FALSE DICHOTOMIES CAN OPEN THE WAY TO COMMON SENSE

Given disputes over early efforts, (the "descriptive" acceptance of CO2 property rights proportional to GDP, mortality evaluation being made proportional to income and so on), the allegedly left/right relationship of what is presented as "prescriptive" as against "descriptive" should be re-evaluated in a common sense way. The free-market model is described as being free choice in action and largely unfettered by prescription. People vote with their dollars every time they make a purchase in this market. And this market described as GDP, also currently describes the human causation of climate change. Here is a descriptive example of the distribution of dollars globally in the global free-market in 1990. One third of global population responsible for 90% of fossil fuel emissions had 94% of the dollar-equivalent purchasing power, while the other two thirds responsible for 10% of fossil fuel emissions had the remaining 6% of the dollar-equivalent purchasing power. Notwithstanding, the SAR economists from the wealthy group describing this market with cost-benefit analysis revealed that it was

cheaper to adapt to climate change than not. One consequence was that the dollar vote of Bangladesh for example was not big enough to weight the cost/benefit ratio towards prevention and away from adaptation. The analysis claimed to be merely descriptive and free of prescription, but for the Bangladeshis it was a prescription about learning to adapt to rising sea level. The distinction between what is descriptive and prescriptive is not as clear as the convenience of cost/benefit analysis requires. In the now altered circumstances of human-induced climate change, it is a false dichotomy. Being in any way rational and particularly having recourse to measurements of any kind whatsoever, is being both by definition. Heisenberg clarified that.

This doesn't mean we should all try and seek immediate nescience. And nor does invite a continued tendency to tolerate the unfortunate free-market requirement for the liquidation of people who haven't got any money. What common sense requires is a re-appraisal of our collective prospects freed from some of the absurdities above. It is not wrong to openly contemplate our prospects in terms of a requirement for negotiated prescriptivity in global solutions to global problems.

This re-appraisal may have already begun. At the meeting of IPCC WG3 in Oslo in August 1997, the Energy Modeling Forum (EMF) at Stanford University introduced specifications for modelers that for the first time included the device of a "prescriptive" requirement on the future distribution of global emissions entitlements. It was inter alia that the future costs and benefits of climate change control measures be evaluated in the context of carbon budgets which had been internationally distributed on the basis of a deliberate convergence to equal per capita shares globally by various predetermined dates. One of the core group members, Richard Richels, made the sanguine point that no economist can come up with sensible numbers for the international distribution of the costs of climate change policy *"until the economists had been given the rules of distribution"*. In the absence of agreement yet at the political level at the UNFCCC, the EMF had discontinued the pattern of "descriptive-only" distributional assumptions, as continued in the SAR, and admitted the expedient of at least theoretically prescribing a variety of formal convergence-based examples of distribution. Elsewhere on the theme of "Burden Sharing", in the IPIECA "Symposium on The Economics of Climate Change" (1997) he and his colleague Alan Manne, were even more specific. *"We begin with one widely discussed proposal: a transition to equal per capita emissions rights (globally) by 2030,"* again allowing the expedient of a "prescription" to "solve" what is otherwise insoluble.

It is worth emphasizing that there are three key decisions here. One is that an assumption has been made that "prescriptivity" is unavoidably part of the process. Two is that the "prescriptivity" is the result of the application of a central organising principle. Three is that the choice of central organising principle (the convergence to equal per capita) is one which has been *"widely discussed"* which could be read as evidence of the reasonableness of the idea and that these economists share that judgement about that reasonableness.

GCI's CAMPAIGN FOR EQUITY AND SURVIVAL

We have actively advocated the linking of carbon contraction to percapita convergence of emissions entitlements globally for many years. We see this as the practical expression of recognising the global link between equity and survival. It is not equity just for its own sake but the equity of necessity. And we have also pleaded the wisdom or more probably just common sense of recognising the lack of any viable alternatives to this undoubted political novelty. Consequently GCI welcomes the positive attention being given to these ideas by these academics, and also now many bureaucrats, politicians, diplomats and other NGOs.

Our attempt to make a positive contribution to this debate has been not just to pose the need for *"Contraction and Convergence"*. We have also provided and promulgated a planning model with a central organising principle for distributional equity that can demonstrate many scenarios for the generation of integrated global accounts for emissions entitlements. In these, after the given initial distribution of CO2 emissions entitlements, they are progressively distributed under any chosen (and even revisable) global cap so that the available entitlements become more proportional to population each year. This creates a pattern of international convergence to any chosen future date, from which point forward international emissions entitlements would contract pro rata on an equal per capita basis as determined by the global cap and any revision thereof. *"Contraction and Convergence"* is not a prescription per se, it is way of demonstrating how a global prescription could be negotiated and organised.

At the First Conference of the Parties (COP1) in April 1995, the Indian Government, drawing on GCI's equity-focused contributions to the IPCC WG3 sections of the SAR, proposed a solution to future global carbon budgeting. It is significant that this happened at a time when the terms of the Berlin Mandate were being drawn up. While the mandate foresaw only strengthened commitments on greenhouse gas (GHG) abatement for the

Industrial Countries of Annex One – that is with no GHG abatement commitments being contemplated for the developing countries of Non-Annex One – it is significant that the Indian Environment Minister declared: - *"We face the actuality of scarce resources and the increasing potential for conflict. Protecting the world's environment requires that development be sustainable. It also implies the implementation of a programme for convergence at equitable and sustainable par values for the use of environmental space on a per capita basis globally. In our view equal rights to carbon usage is fundamental to the convention."* (This is *"Contraction and Convergence"*). *"Policy instruments such as tradable emissions, carbon taxes and joint implementation may well serve to make matters worse unless they are properly referenced to targets and timetables to be observed by those responsible for the damage to the atmosphere and biosphere. The social, financial and ecological inter-relationships of equity should guide the route to global ecological recovery."*

Since COP1 in March 1995: -

(1) GCI has generated the model *"Contraction and Convergence"* Options [CCOptions] to facilitate negotiation in these terms of *"Contraction and Convergence"* approach (see Annex C) and
(2) And propagated the international uptake of this approach and the use of the model, through extensive outreach and international travel and attendance at international negotiations under the UNFCCC and related IPCC workshops,
(3) The European Parliament adopted a resolution for the United Nations General Assembly Special Session (UNGASS) in June 1997 explicitly based on the approach.
(4) The US government tabled a draft protocol 1997 in at the AGBM in April 1997. It enables *"Contraction and Convergence"* to be agreed so for this reason we supported the US draft.
(5) The Chinese, Indian and US Governments all have the CCOptions model with technical support as a result of their requests to GCI to provide it.
(6) The Byrd-Hagel resolution was passed through the US Senate also enabling *"Contraction and Convergence"* with much debate recognising the need for controlled growth of emissions entitlements in developing countries in the medium term alongside the need for real reductions in developed countries.
(7) The Africa Group of Nations adopted *"Contraction and Convergence"* as its position for the negotiations at COP3) in Kyoto (see Appendix C) and re-iterated this call during the final plenary session.
(8) IPCC WG3 adopted modeling specifications that included per capita convergence paths under different contraction scenarios acknowledging the normative character of this and its novelty within IPCC.
(9) The Chinese State Councilor with responsibility for Climate Change and Population policy (Dr Song Jian) has publicly affirmed (October 5th 1997) his government's position in per capita terms which are precisely and explicitly consistent with *"Contraction and Convergence"* (see Appendix D).
(10) GLOBE International adopted principles explicitly based on this approach. GLOBE also made the following proposal to a plenary session of the Third Conference of the Parties (COP3) in Kyoto. *"Let the Conference of the Parties resolve to agree to negotiate a legally binding "Equity Protocol" establishing the principle that the apportionment of global emissions entitlements be deliberately converged to a point of equal per capita shares."* (Full speech is Appendix E)
(11) Representatives of the AFLCIO, UNCTAD and the Chicago Board of Trade have publicly expressed support for *"Contraction and Convergence" as* a viable basis on which to negotiate the allocations necessary for emissions trading.
(12) The prestigious science journal "Nature" produced a special edition for Kyoto endorsing the approach.

"Contraction and Convergence" is ever more widely seen as a way of overcoming the negotiating impasse between the United States of America, the other Annex One Countries and the Non Annex countries. Potentially it resolves USA's insistence on emissions trading and "globality", where "all" or "key" developing countries must be pre-figured for abatement commitments if the general Kyoto settlement, is to achieve the necessary ratification, whilst meeting the developing countries requirement for "equitable allocations".

The test of whether global emissions trading is relevant or irrelevant is not merely "avoided emissions at least cost." Stated thus, it is not indexed to the objective of the UNFCCC. The test is stabilisation of atmospheric greenhouse gas concentrations at levels that avoid disruption of the global climate system at least cost. Here "cost" means both damage cost (regardless of whether these costs are or can be monetised or not) and emissions abatement cost required for this. However, effecting the "relevant" trade plan is contingent on establishing globally inclusive QELROs and GCI asserts is not possible without *"Contraction and Convergence"*. Thus pursuing "relevant" emissions trade commands by definition convergence as well as reducing the costs of contraction. This way gives the triple win. The first and second parties, the trading partners, win but because of the equitable distribution so do the third parties. In other words all parties and the planet win because through *"Contraction and Convergence"* with trade climate change is avoided at least cost globally.

GLOBAL EQUITY DAWNS AT KYOTO's DARKEST HOUR

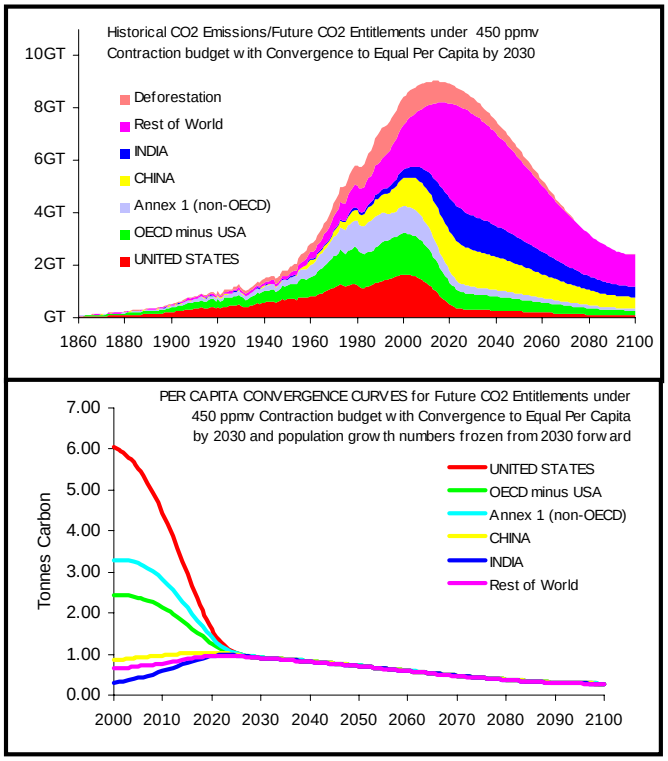
At the end of the Kyoto negotiations, the entire debate came to centre on the issues of trade and the assigning of property rights in the future carbon budget. By definition, emissions trading cannot occur until the principle of property rights has been agreed and the entitlements have been assigned and ratified.

At 3.00am when the negotiations were already into injury time, the paragraph in the draft Kyoto Protocol relating to trade came up for acceptance. The US re-iterated their insistence on the acceptance of emissions trading. The governments of China and India, contrary to people's expectations, did not rebut the idea. Instead they responded by saying that acceptance of trade depended on the issue of "equitable allocations" of emissions entitlements. The Africa group of countries intervened, re-iterating that this was why they wanted "*Contraction and Convergence*". The US replied by saying that they were attentive to the call for *"Contraction and Convergence"* but felt it was too soon. This underlined the remarks made at the GLOBE International workshop in Bonn in October 1997 by US Ambassador Mark Hambley to an international gathering of Parliamentarians, that the idea is being taken seriously in Washington. They have said since it is the only game in town.

The meeting broke for half an hour. On resumption, Chairman Estrada read out a prepared text (now known as article 16 bis). In effect the COP issues instructions to SBI and SBSTA to elucidate during 1998 the rules, principles, modalities etc relating to trade, in time for COP4 in Buenos Aires in November 1998. (A simple GCI module of global emissions trading consistent with the objective of the UNFCCC is suggested in Appendix F).

In order to make progress and avoid another effective deferment at COP4, the most urgent task for 1998 is to have these principles and rules developed in terms of the logic of *"Contraction and Convergence"* and to promote the widest uptake, acceptance and application of this approach. (The GCI Draft Protocol for *"Contraction and Convergence"* is attached in Appendix G). (The *"Contraction and Convergence"* model is described in Appendix H. The model can be down loaded from GCI's website at www.gn.apc.org/gci with a technical description of all its features). The model will compute (1) any budget with (2) any integral with (3) any take off slope and (4) any landing slope for (5) any number of countries or (6) groupings thereof with (7) linear convergence or (8) any rate of exponential convergence to (9) any chosen target date with (10) the option to "freeze" population growth beyond a chosen date. Moreover (11) each budget can be revised "in progress".

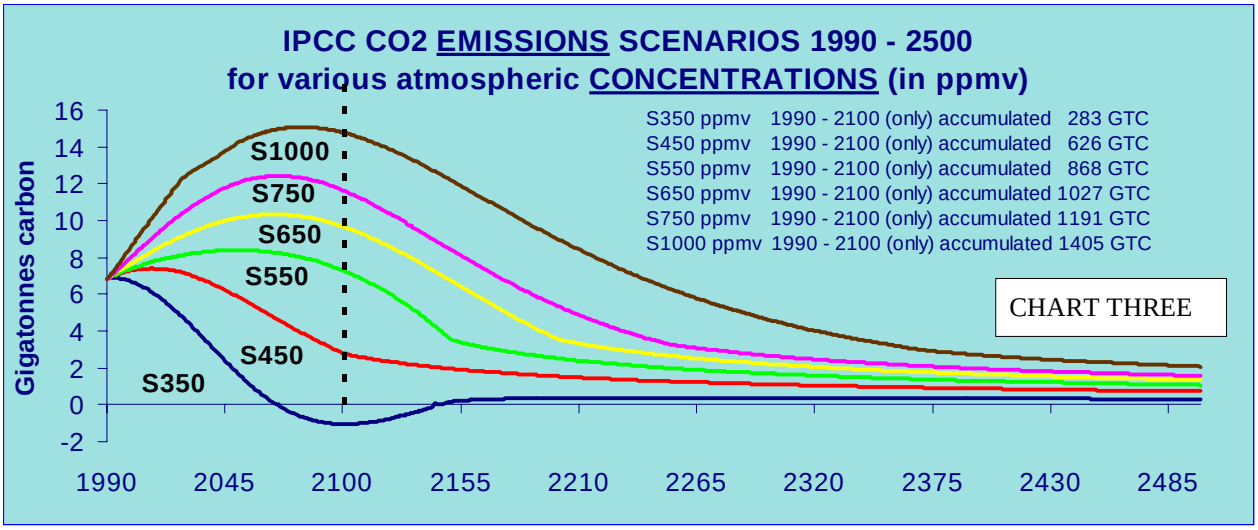
CHARTS 5 & 6 below show gross & per capita *"Contraction and Convergence"* for the world in 6 regions. The contraction profile is from 2000 for an outcome of atmospheric CO2 concentrations at 450 ppmv by 2100. The convergence pattern is from given levels at 2000 to equal per capita shares globally by 2030. Here it is achieved exponentially with population growth included until that date.



APPENDIX A

Consideration of IPCC CO2 Scenarios for Carbon Emissions

IPCC have published scenarios for different atmospheric GHG concentration levels resulting from different CO2 emissions scenarios, as in the graph below. The scenarios run through years 1990 to 2500 and are expressed in gigatonnes carbon (GTC) from CO2 annually on the left-hand axis. The accumulated emissions (integrals), between 1990 and 2100 only, are summarised in the top right hand corner of the graphic. These are also expressed in GTC. The atmospheric CO2 concentration curves are not shown, but in each case stabilisation occurs after the respective emissions contraction path of each has completed.



Integrals quoted in the right-hand corner of the graphic are obtained from the data supplied by IPCC. They are different from the integrals published by IPCC in their table, which follows. IPCC's published ranges for accumulated emissions against atmospheric concentration curves are in the table below.

atmospheric concentration of CO2 expressed in parts per million by volume (ppmv)	ranges of accumulated CO2 emissions expressed in gigatonnes carbon (GTC)
350	**300 to 430**
450	**630 to 650**
550	**870 to 890**
650	**1030 to 1190**
750	**1200 to 1300**

APPENDIX B

POLICY MAKERS' SUMMARY SOCIAL COSTS OF CLIMATE CHANGE
Chapter 6 Summary for Policy Makers IPCC WG3 SAR

The literature on the subject in this section is controversial and mainly based on research done on developed countries, often extrapolated to developing countries. There is no consensus about how to value statistical lives or how to aggregate statistical lives across countries. Monetary valuation should not obscure the human consequences of anthropogenic climate change damages, because the value of life has meaning beyond monetary value. It should be noted that the Rio Declaration and Agenda 21 call for human beings to remain at the centre of sustainable development. The approach taken to this valuation might affect the scale of damage reduction strategies. It may be noted that in virtually all of the literature discussed in this section 1). the developing country statistical lives have not been valued equally at the developed country value 2). other damages in developing countries are also not equally valued at the developing country value. Because national circumstances, including opportunity costs, differ, economists sometimes evaluate certain kinds of impacts differently amongst countries.

The benefits of limiting greenhouse gas emissions and enhancing sinks are (a) the climate change damages avoided and (b) the secondary benefits associated with the relevant policies. Secondary benefits include reductions in other pollutants jointly produced with greenhouse gases and biological diversity conserved. Net climate change damages include both market and non-market impacts as far as they can be quantified at the present and, in some cases, adaptation costs. Damages are expressed in net terms to account for the fact that there are some beneficial impacts of global warming as well which are however, dominated by the damage costs. Non-market impacts, such as human health, risk of human mortality and damage to ecosystems, form an important component of available estimates of the social costs of climate change. The literature on monetary valuation of such non-market effects reflects a number of divergent views and approaches. The estimates of non-market damages, however, are highly speculative and not comprehensive.

Non-market damage estimates are a source of major uncertainty in assessing the implications of global climate change for human welfare. While some regard monetary valuation of such impacts as essential to sound decision making, others reject monetary valuation of some impacts, such as risk of human mortality, on ethical grounds. Additionally there is a danger that entire unique cultures may be obliterated. This is not something that can be considered in monetary terms, but becomes a question of loss of human diversity for which we have no indicators to measure economic value.

The assessed literature contains only a few estimates of the monetised damages associated with doubled CO2 equivalent concentration scenarios. The estimates are aggregated to a global scale and illustrate the potential impacts of climate change under selected scenarios. Aggregating individual monetised damages to obtain total social welfare impacts implies difficult decisions about equity amongst countries. Global estimates are based upon an aggregation of monetary damages across countries (damages which are themselves implicit aggregations across individuals) that reflect inter-country differences in wealth and income - this fundamentally affects the monetary valuation of damages. Taking income differences as given implies that an equivalent impact in two countries (such as an equal increase in human mortality) would receive very different weights in the calculations of global damages.

To enable choices between different ways of promoting human welfare to be made on a consistent basis, economists have for many years sought to express a wide range of human and environmental impacts in terms of monetary equivalents, using various techniques. The most commonly used of those techniques is an approach based on the observed willingness to pay for various non-market benefits. This is the approach that has been taken in most of the assessed literature.

Human life is an element outside the market and societies may want to preserve it in an equal way. An approach which includes equal valuation of impacts on human life wherever they occur may yield different aggregate global estimates than those reported below. For example, equalising the value of a statistical life at a global average could leave total global damage unchanged but would increase markedly the share of these damages borne by the developing world. Equalising the value at the level typical in the developing countries would increase the monetised damages several times, and would further increase the share of the developing countries in the total damage estimate.

Other aggregation methods can be used to adjust for differences in the wealth or incomes of countries in the calculations of monetary damages. Because the estimates of monetary damage tend to be a higher percentage of national GDP in low-income countries than for high-income countries, aggregation schemes, which adjust for wealth or income effects, are expected to yield higher estimates of global damage than those estimated in this report.

The assessed literature quantifying total damages from 2 to 3 degrees Celsius warming provide a wide range of point estimates for damages given the presumed change in atmospheric greenhouse gas concentrations. The aggregate estimates tend to be a few percent of world GDP, with in general, considerably higher estimates of damage to developing countries as a share of their GDP. The aggregate estimates are subject to considerable uncertainty, but the range of uncertainty cannot be gauged from the literature. The range of estimates cannot be interpreted as a confidence interval given the widely different assumptions and methodologies in the studies. As noted above, aggregation is likely to mask even greater uncertainties about damage components.

Regional or sectoral approaches to estimating the consequences of climate change include a much wider range of estimates of the net economic effects. For some areas, damages are estimated to be significantly greater and could negatively affect economic development. For others, climate change is estimated to increase economic production and present opportunities for economic development. For countries having a diversified industrial

economy and an educated and flexible labour force, the limited set of published estimates of damages are of the order of one to a few percent of GDP. For countries having a specialised and natural resources based economy (e.g. heavily emphasizing agriculture or forestry), and a poorly developed land-tied labour force, the limited set of published estimates of damages are several times larger. Small islands and low-lying coastal areas are particularly vulnerable. Damages for possible large-scale catastrophes, such as major changes in ocean circulation, are not reflected in these estimates. There is little agreement across studies about the exact magnitude of each category of damages or relative ranking of the damage categories. Climate changes of this magnitude are not expected to be realised for several decades and damages in the interim could be smaller. Damages over a longer period of time might be greater.

IPCC does not endorse any particular range of values for the marginal damage of CO2 emissions, but published estimates range between $5 and $125 (1990 US) per tonne of carbon emitted now. This range of estimates does not represent the full range of uncertainty. The estimates are also based on models that remain simplistic and are limited representations of the actual climate processes in being and are based on earlier IPCC scientific reports. The wide range of damage estimates reflects variations in model scenarios, discount rates and other assumptions. It must be emphasized that the social costs estimates have a wide range of uncertainty because of limited knowledge of impacts, uncertain future technological and socio-economic developments and the possibility of catastrophic events or surprises.

(1) The value of a statistical life is defined as the value people assign to a change in the risk of death among a population.

(2) The concept of willingness to pay is indicative, based on expressed desires, available resources and information of a human being at a certain point in time. The values may change over time. Also other concepts, such as willingness to accept compensation for damage, have been advanced, but not yet widely applied in the literature and the interpretation and application of willingness to pay and other concepts to the climate problem may evolve.

(3) Due to time lags between findings in the natural sciences, their use in determination of potential physical and biological impacts, and subsequent incorporation into economic analysis of climate change, the estimates of climate change damages are based mainly on the scientific results from the 1990 and 1992 IPCC reports.

(4) See the Assessment Reports of Working Groups One and Two.

APPENDIX C

TEXT OF THE AFRICA GROUP OF NATIONS STATEMENT TO THE AUGUST 1997 AGBM

Mr. Chairman - Let me begin by adding the Africa Group support for the statement made by the Chairman of the Group of G-77 speaking on behalf of the G-77 and China. Speaking on behalf of the Africa Group, I wish to commend you on the manner in which you have presided over the negotiations in the AGBM process. This has been an extremely difficult session of meetings. However, what is crucial is to try to evaluate whether of not the Parties have made any real headway in trying to strengthen the commitments under Article 4.2 (a) and (b) and advance the implementation of Article 4.1 as was mandated to us by the Berlin Mandate.

We shall pack our bags and return home with a sense of concern about the pace of progress that has been made. Unfavourable climatic conditions will continue to plague our economies, our crops will continue to fail, national external debts will remain a problem to us and our basic social infrastructure will continue to suffer as a result of the impacts of climate change. Yet the Annex One Parties - in particular those parties that have chosen to refrain from giving us their numbers - will go home smiling, celebrating their success in holding back the negotiation process.

We are grateful to those Parties who have given us their proposals and we look forward to evaluating these proposals in order to assess the impacts they will have on our socio-economic infrastructures. Some of our countries are already in the process of implementing activities to address the problem of greenhouse gas emissions (GHG) emissions. We wait in anticipation for Annex One countries to show the necessary commitment. As we negotiate the reduction of GHG, the countries of Africa believe that there should be certain principles that need to be clearly defined.

First: There must be limits on all GHGs if the danger to our climate is to be averted. The IPCC scientific assessment report provides us with the basis for global consensus on such limits. The contrary view therefore does not enjoy much emotional, political or indeed scientific support.

Second: A globally agreed ceiling of GHG emissions can only be achieved by adopting the principle of per capita emissions rights that fully take into account the reality of population growth and the principle of differentiation.

Third: Achievement of a safe limit to global GHG emissions can be achieved by reducing the emissions of Annex One while at the same time ensuring that there is controlled growth of future emissions from Non-Annex One countries, reflecting our legitimate right to sustainable economic growth. We strongly believe that this will take us along a path to responsible climate management that allows us to reach our goal of defining a mutually agreed point of convergence and sustainable development. Such a convergence Mr. Chairman must ensure that we maintain a global ceiling on emissions to prevent dangerous interference with the climate system.

Fourth: When we look at time frames, we believe that insufficient commitment by Annex One countries will only result in delaying our influence on the climate system. If this course is maintained, then we will all suffer and the burden will be even greater for humanity in general. The burden for any future mitigation efforts on those of who have not been historically and currently responsible for creating the problem will be greater.

Mr. Chairman we recognise that per capita emissions rights, as a form of differentiation is not an easy goal. It calls for deliberate actions to attain reduction targets over time by Annex One Parties and sustainable growth in the Non-Annex One Parties. To do this Africa would need predictable financial resources, technology transfer, education, training and public awareness, systematic observation and research. We look forward to renewed co-operation with other Parties in implementing our commitments under Article 4.1.

Mr. Chairman, we must focus our attention on the most appropriate, reasonable and acceptable time frame for action. There is an over-riding pre-requisite. The time frame can not be too far away into the future if we are to avoid at all costs the dangers that global climate change poses. The current scientific evidence indicates that Africa faces decline in water resources, agricultural production and economic performance. It is therefore for this reason that we wish to register the seriousness with which we view the effective implementation of the Convention and future agreements emanating from it.

Finally Mr. Chairman, we would request that the Secretariat take note of the views expressed in this statement on behalf of the African Group of Nations and Parties to the Convention. We look forward to meaningful targets and timeframes for consideration at the next session of the AGBM. - I thank you. (Mrs. Karamanzira - Zimbabwe).

APPENDIX D

EXTRACT FROM SPEECH BY DR SONG JIAN (STATE COUNCILLOR WITH RESPONSIBILITY FOR CLIMATE CHANGE AND POPULATION) AT THE CLOSING CEREMONY OF THE CHINA COUNCIL FOR INTERNATIONAL CO-OPERATION ON ENVIRONMENT AND DEVELOPMENT (OCT 5TH 1997)

We fully understand the worldwide campaign to battle the climate change spearheaded by the European Union and Nordic Countries. The voice of small island states also brooks no ignorance. According to the United Nations Framework Convention on Climate Change (UNFCCC) and the Berlin Mandate, China bears no responsibility for reducing greenhouse gas emissions. When we ask the opinions of people from all circles, many people, in particular the scientists think that the emissions control standard should be formulated on a per capita basis. According to the UN Charter, everybody is born equal, and has inalienable rights to enjoy modern technological civilization. Today the per capita consumption is just one tenth of that of the developed countries, one eighth of that of medium developed countries. It is estimated 30-40 years would be needed for China to catch up with the level of medium developed countries. No one is entitled to prohibit families from using refrigerators or those who live or work in such a high temperature of 40 degrees Celsius from enjoying air-conditioning. However the Chinese people and government do have realized their due responsibilities for the global climate change and committed to make efforts to lower down the increase rate of greenhouse gas emissions in the following way: -

1. To control the growth of population and stop China's population from growing within thirty years. This is the decisive guarantee of protecting climate and the environment.
2. To put the exploitation of hydroelectric power resources on the top priority, and to explore other renewable energy sources, develop clean coal technologies and reduce the emissions of unit energy consumption.
3. To continue the campaign of afforestations, plant more trees, attend pasture lands, develop ecological agriculture, protect ecological environment and preserve and strengthen the ability of sinks for absorbing carbon dioxide from the atmosphere. The forest coverage is planned to be doubled to exceed thirty percent of the total territory of the country in the 30-40 years to come.
4. To raise extensively the efficiency of energy utilisation, develop new and less energy-consuming industries and reduce the consumption for per unit of GDP.

In all these fields, the scientific and industrial communities of China shall try the best to make their own contributions, and at the same time, we need international co-operation. I hope that all the members and the experts of the working groups could put forward opinions and creative suggestions.

APPENDIX E

Kyoto, 9 December 1997

SPEECH BY TOM SPENCER, MEP TO THE PLENARY SESSION OF THE UNFCCC.

I had the honour to address COP1 in Berlin. I had the impertinence to suggest that future meetings be held on the great Antarctic iceberg as a way of dramatising the urgency of our task. Kyoto is much more pleasant than an iceberg, but the urgency has intensified.

The nature of the challenge of climate change is now clear. It is not scientific. It is not technological - we are an adaptive species. As John Prescott said yesterday, the challenge is political, and I would add, it is intellectual, institutional, and ethical. After a week of debate about important details, I suggest that the time is right for a statement of even more important principle, After years of debate, about "efficiency" I suggest that your results cannot be brought to success without a statement about equity. The "sense of the Senate" resolution made the fair political point that they could not ratify a treaty, that was not seen to be fair by the American people, A treaty would have to include meaningful participation by developing countries. I would say to my friends in Congress that you cannot ask for that involvement on the basis of efficiency alone, You must specify that the nature of that involvement will be equitable. I am not a Government. I speak this morning only for an organisation of environmentally- committed parliamentarians from 47 countries. With all the humility appropriate to a non-negotiator, may I suggest a text to this great gathering of negotiators.

Many of you know the Contraction and Convergence analysis. It offers a framework for an answer. It offers an envelope of equity within which we can trade and barter our way to collective sanity in the coming decades.

Let us make a start in this direction. Let the Conference of Parties resolve " to agree to negotiate a legally binding "Equity Protocol" establishing the principle that the apportionment of global emission entitlements be deliberately converged to a point of equal per capita shares at a date to be agreed."

I invite the Government of Japan to propose such a text, which is in line with their policy statement at AGBM7. I invite the European Union, whose efforts entitle it to take a leadership role, to propose such a text. I invite the United States, which rightly takes its stand on the basis of a "global solution to a global problem" to draw the logical conclusion of its own approach, and to propose such a text.

And in response: May I invite the Africa Group whose statement in August led the way to respond to such a text. May I invite the AOSIS states whose very survival depends on our collective success to back such a proposal. May I invite the Governments of China and India to seize this opportunity of an equity protocol that would entrench in our process the principle they have correctly and courageously fought for.

In life the right thing to do is the right thing to do. It is occasionally true in diplomacy that an ethically just answer is also the only available way out of an impasse.

ANNEX F

The Ideas behind Contraction and Convergence

Fundamental Assumptions

1/ Survival and IPCC Scenarios

In accordance with the FCCC and best scientific evidence as reported by the IPCC and elsewhere, we assume that total anthropogenic emissions of CO2 over the 110-year period 1990-2100 must be in line with those set out in IPCC working group 1's 1994[1] and 1995[2] reports under the 'S350' or 'S450' scenarios.

We regard S350 as a necessary target to give a reasonable degree of belief that large-scale damage to the world economy, human lives and natural ecosystems can be averted. We also used the S450 scenario as an upper limit for consideration; under which there is a chance that damage, though serious, will be containable.

The S550 and higher scenarios we ignore, as it is clear that going for those presents a high probability that positive feedback loops, admittedly underrepresented in the modeling underlying the IPCC scenario calculations, will lead to catastrophic failure of ecosystems and of human societies. Additionally, when a chart of an S550 scenario is examined for the period of the 21st century, rather than for the much longer period used in the IPCC reports, it is clear that, even ignoring these feedbacks, S550 is virtually equivalent to business-as-usual for a large chunk of that century. In other words, adopting it is little different from a do-nothing approach.

Finally we note that, if an aim of 550ppm were agreed, and later it was desired on the basis of new evidence to change policy and aim for 350ppm instead, it would be almost impossible to do so after about 2005. Cutting back from a 450ppm target to 350, on the other hand, could be done up to about 2015.
The CCOptions workbook enables the validity of these assertions to be checked.

2/ Contraction

To implement the above, and based on data reported in [1] and [2], we select a target value for CO2 emissions to stabilise at and a target year to stabilise in. We select the target value as the highest value, up to a maximum of 40% of the start-year value, which yields a curve that does not dip below the target value. We select the target year to be as far into the future as looks workable. For an S350 scenario we suggest 2050; for an S450 scenario 2070. To compute CO2 allocations one needs also to make assumptions about future population growth. In (7) below we set out precisely how we have dealt with this issue. Our algorithm enables a schedule of total global emissions to be laid out which adds up to a desired total over the 110-year period and is normally chosen to be in line with tables presented in [1] and [2]. Given the assertion in [1] that the total climate impact of a pattern of CO2 emissions depends to a first approximation only on the total emissions, and not on the temporal pattern of those emissions, we have a reasonable basis for our assertion that our scenarios can legitimately be represented as S350 and S450 scenarios.

Scenarios where stabilisation occurs after 2100 can be represented by entering a global emissions decline rate for the year 2100. CCOptions does not attempt to look forward beyond 2100.

Note that there is no necessity to stick to 350/450/550 as targets. 400ppm might be a practically negotiable target; from which a change of plan to 350ppm looks to be possible until about 2025.

3/ Convergence

To enable international negotiations to have some chance of success, these emissions need to be allocated by countries in a way that is both achievable and is seen by all to be fair. To that end we specify that the per-capita emissions converge from their present diverse values to a standard world value, to be the same for each country, in a 'convergence year' set as 2045. 2045 is chosen because partly because using it gave a good balance between what is achievable and what can be seen to be fair. Equally importantly, 2045 is chosen because it is the United Nations' centenary year; and it seems a fruitful idea to invest that year with being the target date for achieving this limited but significant measure of international equity.

Note that there is no algorithmic need for the convergence year to be earlier or later than the contraction year. It might make for ease of negotiation to set them to be the same; but at this stage that seems an unnecessary restriction to us.

4/ Consistency with Rio Commitments

We have assumed that the 'Annex1' countries as defined in the 1992 FCCC will meet their commitment to return emissions to their 1990 levels by 2000. Even if they do not meet them, future allocations should be on that basis, otherwise the IPCC and the UN will be undermined. Modification of the model to be consistent with the Kyoto commitments is in hand, but will make only a minor impact on the process overall.

5/ Algorithms

The approach is a three-stage process, with an initial stage that extrapolates from the most recent year for which actual CO2 emissions data is available up to 2000, the scope of the pre-Kyoto FCCC commitments. Contraction and convergence proper are then started in 2000; a global contraction profile being determined first, and then a separate convergence criterion applied.

5.1/ The Initial Stage

As laid out in (4) above, we assume that Annex1 countries' emissions return to their 1990 values by 2000. For definiteness we assume that emissions from 1995 to 2000 retrace backwards the actual trajectories from 1990 to 1995. We have also had to estimate emissions for 1995, as data is only available from the UN as far as 1994 (as of May 1997). For the other countries for the remainder of the 90s decade we linearly extrapolate the trend of growth from the latest available figures.

5.2/ The Contraction Stage

For this we fit a quartic curve of the form
$z = k+ly+my^2+ny^3+py^4$
where z is the total global industrial CO2 emissions; y is the year and the parameters k,l,m,n and p are jointly determined by the following five conditions:
i: z is set for the start year of 2000 as explained in (5.1) above.
ii: z is set at the contraction target value for the contraction target year as explained in (2) above.
iii: dz/dy was set to a target value for this target year (i.e. we assume that the emissions decline rate reaches a target -- commonly zero -- at that time).
iv: dz/dy is set to 1.5% in 2000, reflecting the actual global increase in that year implied by the method described in (5.1). In the workbook, this is an adjustable parameter.
v: The area under the curve, calculated by integration of the above formula, corresponding to the total global emissions over the 110-year period, was set as explained in (2) above.
These conditions yield a set of 5 simultaneous linear equations which are solved to compute the actual values of k,l,m,n, and p.
An allowance of 50GT in total is subtracted from the 110-year target taken from [1] or [2] to take account of deforestation emissions. As even the present annual emissions rate appears to be uncertain to within at least 50% or so; and the total amount of carbon in global forests is orders of magnitude less than that in unburnt fossil fuels, we think it both justifiable and politically helpful to make this very crude approximation. The actual figure of 50GT is towards the optimistic end of the range (30GT to 90GT) used in the six IS92a-f scenarios which were set out in IPCC WG1's 1992 report [3]. We are in the process of adding in also an allowance for 'bunker fuels' – fuel used in civil air and sea transport, which are not allocated to countries and have been excluded from most calculations up to now. We plan to treat these, like deforestation, as a world overhead, and do not suggest allocating them to countries. We suggest that reductions be projected to proceed at the same rate as total global industrial emissions. For similar reasons we have not taken account at all of other greenhouse gases. These shortfalls could easily be addressed in the future when or if accurate and acceptable data becomes available.
An option is also available to enter a preset profile of global emissions from 2000 to 2100 as a set of numbers. CCOptions then applies its convergence algorithm.

5.3/ The Convergence Stage

This, the process to allocate %shares of global emissions to all the worlds' countries, is a little more complex. The ideas behind our algorithm are:
i/ to start out with 'actual' shares in 2000, as derived by the methods described above;

ii/ to converge all the shares on to actual proportions of global population in the convergence year, which, as we have explained we strongly urge be set to 2045. But the population figures used are subjected to a cap as set out in (7) below.
iii/ the actual degree of convergence allocated in each year to depend on the (potentially capped) population only for that and earlier years. This means that if these procedures were in use, the actual allocations for any given year would only depend on data then available, not on forecasts of population in some year that is then in the future.
The formula used is $s_{y+1}=s_y-(s_y - p_{y+1})\exp(-a(1-t))$
where s_y is the emissions share of a country in year y, p_y is its share of the global population (subject to the cap) in year y, t is the fractional time elapsed between 2000 and the target year (t=0 for 2000 and t=1 at the convergence year of, say, 2045), and a is an arbitrary parameter that determines the rate of convergence.
In the workbook a is adjustable. The higher the value the more the convergence happens towards the end of the convergence period, and vice-versa. Choosing a=4 gives an even balance.
This is intended to be the simplest formula that achieves the aims i-iii above.
An option has been added to converge linearly instead of using the above formula.

6/ Allocations

The actual industrial CO2 emissions allocations are then made by multiplying the global total value derived from the contraction process by each country's shares derived from the convergence process.

7/ Population Assumptions

We have used UN median figures for forecast population growth by country.
We have then used a cap on population growth for the purposes of allocation of emissions rights. This was done by notionally freezing population numbers (only) for years beyond a 'population cutoff year' at the values for that year. Note there is no assumption being made about what populations will or should be beyond the cutoff year; merely that population growth after that year should not accrue additional emissions rights. In the workbook the year is adjustable. We hold it necessary to adopt some such cap criterion, as otherwise the system will be construed as giving national governments a positive incentive to encourage their populations to grow to obtain an increasing share of emissions rights.

8/ The CCOptions Workbook

The above ideas on contraction and convergence have been actualised in a Microsoft Excel workbook, CCOptions; which is available free from the GCI web site. Excel version 5 or later is required.
CCOptions models CO2 emissions allocations from the present up to 2100, married with CDIAC data for historical CO2 emissions.

The user is presented with a panel of parameters which are adjustable within limits; and whenever new values are typed in, graphs of countries' emissions are regenerated for the time-span from 1860 to 2100. Some of these graphs have been used to support well-received presentations at various climate-change conferences from COP2 in Geneva in July 1996 on.

As well as the base C&C computation, the workbook also includes a feature to investigate what could happen if policy were to switch from a 400ppm initial target, say, to a 350ppm target at some future date. This is done by having a 'Phase two' for contraction, with user-settable start year, target 110-year CO2 emissions, and target annual emissions. The convergence process is unaffected by this.

For a brief explanation of how to use the workbook see separate document, available from the web site.

References

[1]CLIMATE CHANGE 1994 Radiative Forcing of Climate Change *and* An Evaluation of the IPCC IS92 Emission Scenarios. Cambridge University Press for the IPCC. 1995
[2]CLIMATE CHANGE 1995 The Science of Climate Change, Summary for Policymakers *and* Technical Summary of the Working Group I report. IPCC. 1996.
[3]CLIMATE CHANGE The IPCC 1990 and 1992 Assessments. WMO/UNEP June 1992.

APPENDIX H

1. Contraction of Global CO2 Emissions (e.g. by 2100 as shown for 450 ppmv)

Stabilisation of atmospheric CO2 concentrations – according to the ultimate objective of the UNFCCC – requires cuts in human emissions of CO2 in the order of 60%. This level of reductions requires a long-term budget framework with a sequence of short-term controls under constant scientific and political review.

By definition, the solution to the global problem of human-induced climate change must be a *global* solution. On a differentiated basis, all countries must be involved if the solution is to be achievable.

2. Convergence to Equal Per Capita Entitlements by a negotiated date (e.g. shown 2030)

Adherence to a globally contracting CO2 budget over several generations requires unprecedented international co-operation. The international distribution of future emissions entitlements inevitably needs to be determined on the basis of equity between the peoples of all nations. This suggests a process, which corrects the historically and currently polarised patterns of consumption globally.

We know of no method for doing this that has any chance of achieving this co-operation other than a negotiated convergence to equal per capita emissions entitlements globally.

3. International Emissions Allocations

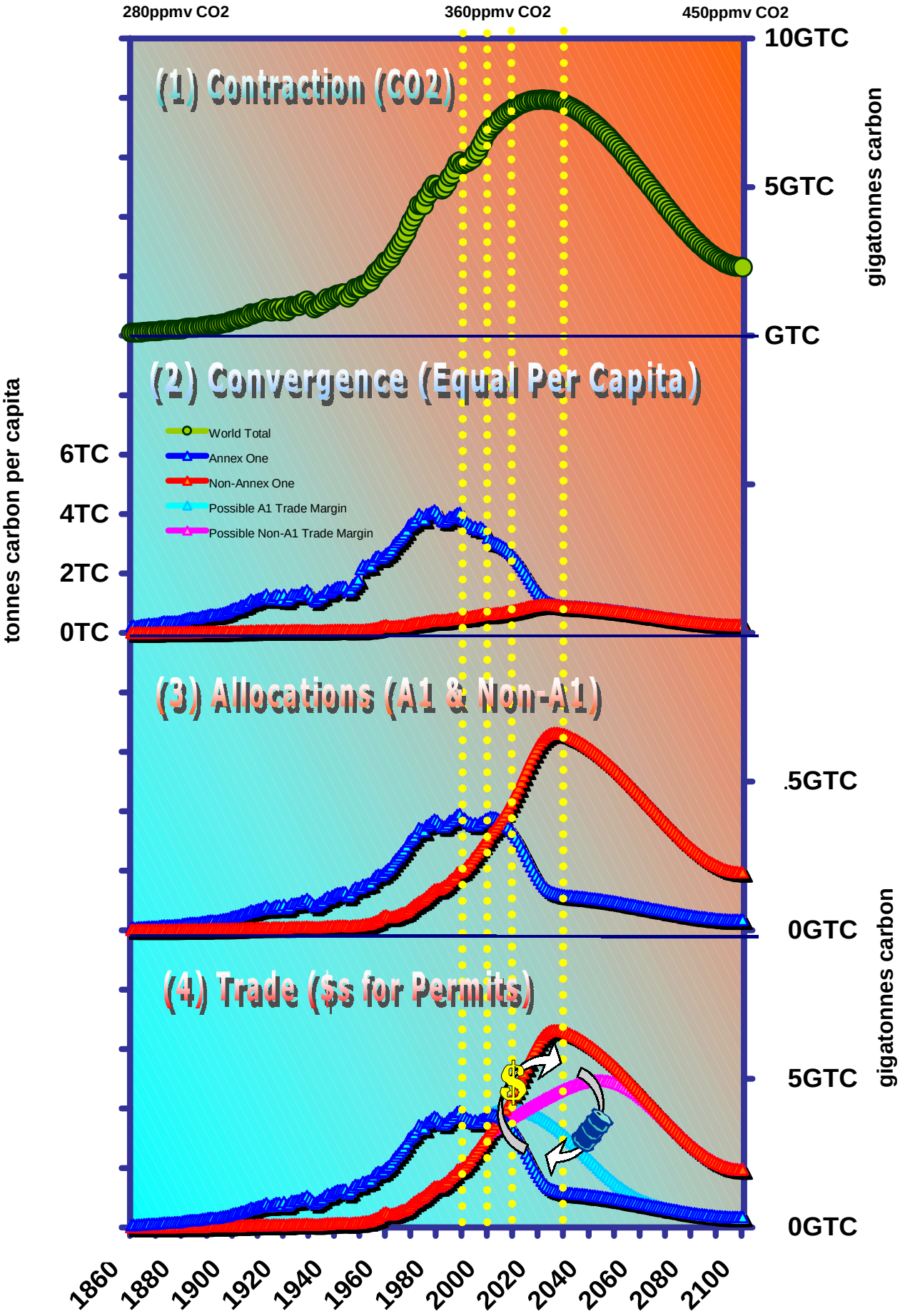
The combination of the global emissions budget and global convergence of international emissions paths gives allocations to all countries. Countries move from their current levels of emissions along trajectories determined by the combination of the *"Contraction and Convergence"* (C&C) curves.

The example shown here (450 ppmv by 2100 with Convergence by 2030) is consistent with the short-term goals of the Berlin Mandate. Annex One contracts by 15% by 2010 while Non-Annex One countries grow collectively at an average of 3% per annum until 2030.

4. Trade of Emissions Permits

National allocations are for emissions permits that can be traded. Contraction rates in developed countries can be reduced through the purchase of permits from developing countries. The resultant cash-flow could be directed to non-fossil energy based development (leap-frogging) in developing countries, while also giving a general incentive to CO2 emissions avoidance because of the value of permits.

All this provides that global emissions abatement can be achieved at least cost, thus meeting the requirements of global efficiency in a globally equitable and sustainable manner.


280ppmv CO2
360ppmv CO2
450ppmv CO2
(1) Contraction (CO2)
10GTC
5GTC
GTC
gigatonnes carbon
(2) Convergence (Equal Per Capita)
World Total
Annex One
Non-Annex One
Possible A1 Trade Margin
Possible Non-A1 Trade Margin
6TC
4TC
2TC
0TC
tonnes carbon per capita
(3) Allocations (A1 & Non-A1)
.5GTC
0GTC
(4) Trade ($s for Permits)
$
5GTC
0GTC
gigatonnes carbon
1860
1880
1900
1920
1940
1960
1980
2000
2020
2040
2060
2080
2100

APPENDIX G

CONTRACTION AND CONVERGENCE

Draft Proposals for a Climate Change Protocol

Contents:...

Overview

The Prevention of dangerous climate change is now an essential global security interest. Recognising this interest, this GCI draft document sets out some key tasks necessary for a protocol to stabilise greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system.

Pre-eminently, this requires a rapid "*Contraction*" of all human CO_2 emissions globally. Moreover, unprecedented international co-operation will be required to achieve this. Such a "*comprehensive approach*" is only likely to be adopted by most if not all nations, if it is linked to the simultaneous task of "*Convergence*" towards an equitable and sustainable level of emissions on a per capita basis globally.

This inter-linked configuration of "*Contraction and Convergence*" is fundamental to GCI's view of the entire climate change dilemma and its solution. GCI has crafted such an approach, which provides the basis for this document. Part One of the document presents the core tasks of this approach. The first proposal develops the well-established concept of national security interest to include dangerous climate change as a *global* security interest. This emphasizes the urgency of this issue and has practical implications for the decision making process and technology development and transfer. The next six proposals spell out practical steps from agreement of danger indicators through to a mechanism for the management of national quota allocations according to a scientific assessment, a contraction formula and a convergence formula.

Additionally, the document presents further proposals for a protocol. These have been drafted in response to events at the Second Conference of Parties (COP2) to the Framework Convention on Climate Change in Geneva in July 1996. While we received remarkably wide-ranging support for our proposals for "*Contraction and Convergence*", many questions were raised about the detailed implications of such an approach.

These further proposals are an attempt to map out some of these implications and are set out in Part Two. The first set concern emissions trading, air/shipping bunker fuels, other greenhouse gases and measures to deter non-compliance. The next set outlines the assessment of and compensation for climate damages, past, present and future. The next four points outline measures to aid implementation, including funding and technology transfer. The final three are concerned with education and research.

At COP2, the US Government stated that all protocols currently on the table were "*unrealistic and unachievable*". This effectively sank the AOSIS Protocol proposed by the island-states most vulnerable to climate change. However, many states considered that our "*Global Commons Initiative*" for contraction and convergence was the most plausible basis for a comprehensive long-term protocol.

We, therefore, invite all far-sighted governments to consider incorporating all or part of these proposals into their submissions to the Secretariat by 15th October 1996 for discussion at the next AGBM meeting in Geneva this December, and as the basis for a draft protocol by March 1997 in time for consideration at COP3 in Kyoto. Please always bear in mind that this is a draft document and that we would greatly welcome your opinion and expertise in developing these proposals into a viable protocol.

I. Core tasks for achieving "Contraction and Convergence"

1: Recognise the prevention of dangerous climate change as an essential global security interest.

The reduction of greenhouse gas emissions shall be regarded as an essential global security interest for humanity.

RATIONALE AND POLICY IMPLICATIONS

This proposal generalises the accepted concept of "essential security interest" to the whole of humanity. The gravity of global climate change is greater than the essential security interests of any nation and fundamental to the maintenance of international peace and security during the coming century. This justifies the urgent development of measures proposed in this protocol and places a duty on governments to regard climate change as an international emergency. This also means that action may be taken to secure the use of sustainable technology for the benefit of humanity in much the same way as governments may protect the use of military technology under the Security Exceptions for intellectual property rights as set out in Article 73 of Annex 1C of the Final Act of the Uruguay Round of Multilateral Trade Negotiations as well as national security legislation.

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2. Agree danger indicators

Agree a list of specific, quantifiable indicators to define "dangerous anthropogenic interference to the climate system" as stated in Article 2 of the Framework Convention. The indicators shall be listed in the protocol and their quantitative values shall be reviewed annually by SBSTA with advice from IPCC. The values should reflect the precautionary principle and take account of the time lag between emissions and climatic changes. The indicators shall be applicable on any geographical scale to include local damages induced by global climate change.

CoP shall commission detailed recommendations for suitable indicators and their appropriate values. The following suggestions are put forward as a starting point:

a) relative sea level rise to a threatening level at any location;

b) increased coastal erosion that forces evacuation of inhabited land or loss of wetlands;

c) global mean surface temperature rise or significant regional temperature changes over a given time period;

d) an annual increase in the number of tornadoes or tropical cyclones in any region beyond current natural variability;

e) a significant reduction in permafrost area, resulting in release of natural methane;

f) significant changes in regional or sub-regional precipitation resulting in prolonged droughts or frequent flooding;

g) an increase in bush and forest fires above natural variability;

h) loss of marine and terrestrial ecosystems and species;

i) substantial prolonged reduction in marine primary production (plankton, algae);

j) a significant contraction of either polar ice cap and / or glaciers;

k) a major prolonged change in ocean circulation, such as the north Atlantic current or El Nino / Southern Oscillation;

l) a spread attributable to climate change of any human, animal or plant disease;

m) direct impact of climate change on human health;

n) economic damages attributable to climate change.

These danger indicators should be reviewed on a regular basis by IPCC as new scientific evidence becomes available and revised by the CoP when prudent to do so.

RATIONALE AND POLICY IMPLICATIONS

This Task puts key scientific indicators for dangerous climate change at the centre of the protocol. The "definition of adverse climate change" (FCCC Article. 1, 1) and "dangerous anthropogenic interference with the climate system" (Article. 2) need to be set out in the form of specific danger indicators based on best scientific advice and the precautionary principle (Article 3).

Each indicator should reflect a distinct impact resulting from climate change and should be defined in quantifiable terms on a global, regional and subregional scale. Where possible they should indicate both the danger threshold and potentially dangerous rates of change. The choice of indicators should take into account the considerable time lag between greenhouse gas emissions and subsequent climatic response.

The prospect of breaching any one of the indicators should be sufficient to require preventative action, on the grounds of the precautionary principle, even though it may only affect one area of the world directly. On the basis of equity, damages must be avoided on a local scale since many of the most vulnerable countries are neither responsible for global warming nor in a position to adapt to the harmful effects. Local climate-change-induced damages may not be traded off against the pursuit of global economic growth, because it is impossible to sensibly create a consensus around the quantification of such damages in terms of rising risks of ecological and political instability (see also II.A.1).

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3. Decide CO2 concentration target and timetable

A stabilisation target and timetable shall be agreed for atmospheric CO2 concentrations. The target should be set by applying the precautionary principle to avoid the danger indicators agreed under Section I.1 (above). This target shall initially be 350 ppmv to be achieved by the year 2100 . The target shall be reviewed every five years by IPCC as new scientific evidence becomes available and revised by the CoP if the danger indicators clearly show that it is prudent to do so.

Rationale and policy implications

Dangerous changes in the climate system are a result of specific greenhouse gas concentrations in the atmosphere, so it is necessary to set a specific ceiling on the amount of CO2 in the atmosphere. In absence of better scientific understanding of climatic feedback processes (listed in section II.D.2), the initial target of atmospheric CO2 stabilisation at 350ppmv by the year 2100 is chosen such that the system remains close to the bounds of our present knowledge. This can be achieved by following a future emissions scenario in which the cumulative CO2 emissions are similar to those of IPCC S350.
When reviewing this target, IPCC should take into account predicted changes in the concentration of other greenhouse gases (considered further in section II.A.3).

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4. Set annual global CO2 emissions budgets according to a "contraction" formula

The Conference of the Parties shall set a net global anthropogenic carbon emissions budget for each year throughout the period of contraction to meet the stabilisation objective as defined in I.3 above. This shall be calculated according to a mathematical formula which defines an emissions scenario that leads to stabilisation of emissions at around 2045. The formula may be reviewed annually five years in advance to take account of revisions to the stabilisation target set under proposal 3 as well as changes in natural sinks and sources based on scientific advice of the IPCC.

Rationale and policy implications

Stabilisation of CO2 concentrations requires a global ceiling on emissions which contracts over time until they reach the target of 350 ppmv. The "contraction" formula would define a realistic emissions scenario which avoids both unachievable annual emissions reductions and temporary net negative emissions in the future. The formula should refer to all anthropogenic sources and sinks of CO2, i.e. changes in emissions resulting directly from human activity, including anthropogenic changes of natural sinks and sources. Natural "equilibrium" sources and sinks should be considered in the science behind the emissions scenario, but should not be included in this global anthropogenic emissions budget.

The formula will need to be reviewed annually to take account of changes both to the concentration target and of actual sinks and sources of CO2. However, in order to reduce uncertainty for both planning and trading purposes each annual review will adjust the budgets five years in advance.

Implementation will require setting up a Scientific Panel drawn from the SBSTA and approved by the CoP to agree the formula and recommend annual CO2 budgets.

The target date of 2045 is suggested because it lies within the window for realistic contraction and coincides with the centenary of the United Nations.

For the purpose of illustration only, a sample "contraction" formula is available from GCI.

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5. Calculate relative national shares of the global budget according to a "convergence" formula.

Each country shall be allocated an annual, relative share of the global emissions budget (set according to section I.4 above) using a consistent formula to calculate the proportion for each country for each year. The allocation shall be set such that national shares move gradually from present emissions levels to equal per capita emissions levels by a fixed "convergence" year (e.g. 2045). Provision shall be made for bunker fuels for shipping and air transport (see II.A.2).

RATIONALE AND POLICY IMPLICATIONS

This task gives effect to the principle of equity set out in Article 3.1 of the FCCC while recognising that equal per capita allocations would be neither acceptable nor feasible for Annex I countries if implemented immediately. The formula therefore provides a predictable and viable method of achieving a convergence to equity. National shares would be based initially on current emissions levels, or for Annex 1 countries, those levels already specified by commitments under the UNFCCC , and would then converge to the same per capita level by the target date of 2045. After this relative shares would remain constant.

Calculation with the convergence formula will use the UN median population estimates. These population statistics may be reviewed if necessary at the request of a majority of the CoP.
However, after a fixed year (e.g. the convergence date) population figures could be frozen.

The relative national shares are independent of the annual scientific reviews, although the actual allocations of emissions (allocated in section I.6) will of course vary according to the global budget agreed. Annual shares would be calculated for all countries, whether or not they are Parties to the Protocol, and shall be set out in an Annex to the protocol as tables.

For the purpose of illustration only, a sample "convergence" formula is available from GCI.

The establishment of fixed national emissions budgets will encourage investment in appropriate technology and allow for the possibility of orderly emissions trading, but this depends crucially on having finite net CO2 budgets calculated according to a formula that produces a predictable level of
permissible emissions from the present to the stabilisation date, to achieve the concentration target set in Section I.3 above.

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6. Allocate national CO2 emissions quotas.

National emissions quotas shall be calculated for each year by multiplying each country's relative share set by the convergence formula (agreed according to Section I.5) by the annual global emissions budget (set by the "contraction" formula agreed according to Section I.4). These quotas shall be measured in tonnes of carbon.

RATIONALE AND POLICY IMPLICATIONS

The national allocations are described as 'quotas' rather than entitlements or rights to emit CO2 in order to emphasise that the atmosphere and climate system are a global commons which cannot be appropriated by any state or person but whose use must now be shared by common consent. The formula approach provides for the most effective way of establishing a consistent and equitable allocation of emissions quotas.

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7. Establish criteria and mechanisms for quota management

Establish a mechanism for the international management of quota allocation, accounting and verification based on criteria consistent with these proposals. The quotas shall cover "net anthropogenic emissions" resulting from human activities, including reduction of natural sinks minus deliberate natural sinks enhancement.

RATIONALE AND POLICY IMPLICATIONS

The allocations would refer to "net anthropogenic emissions" of CO2. This is defined as all emissions resulting from human activities, including reduction of natural sinks minus deliberate natural sinks enhancement. However, this should exclude changes in natural sources and sinks caused directly by global climate change. This definition encourages sustainable forestry, for example, but avoids crediting the existing natural resource endowment of each country. We recognise that some countries have deliberately retained such resources whilst others have already diminished them, therefore this will be accounted for in the task concerning historic debt (section II.B.3). Natural sink enhancement will only be credited within national boundaries, not within any global commons. For example, credit will not be given for enhancement of the CO2 sink into the ocean.

The proposed mechanisms would also arbitrate in case of dispute over budgeting anthropogenic sources and sinks.

It is not necessary to allow for crediting of sink enhancement or emissions reduction within other countries, known as Joint Implementation, since this can effectively be achieved through the emissions quotas trading system (section II.A.1).

This proposal completes the procedure for applying "contraction and convergence".

II. Draft proposals to achieve contraction and convergence

A. Related tasks for control of greenhouse gas emissions

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1. Set up a system for emissions trading

Establish mechanisms for real-time emissions trading between parties to the Protocol under strict conditions of contraction and convergence. Trading shall be restricted to a proportion of the annual emissions quotas, defined as permits, and limited to one year in advance. The mechanism should be transparent and avoid financial feedbacks that would undermine the ultimate aim of the Convention and its protocols.

RATIONALE AND POLICY IMPLICATIONS

The criteria for a trading regime should set out the basis on which possible trading regimes will be assessed. These will inevitably need to balance the different interests and needs of parties to the Convention. In deciding on a suitable mechanism, parties should consider the work already done by UNCTAD in this area and continue to involve it in the development thereof.

A trading regime would initially be developed under the SBI which would continue to supervise the process for CoP. However, once agreed, emissions trading would require a set of robust institutions capable of acting on behalf and under the supervision of CoP. Trading must be open, transparent, efficient and well regulated. The regulatory bodies must also ensure that TEPs are not bought or sold under coercion of any kind.

Emissions trading would also address the issue of "carbon leakage" to countries with relatively lower emissions. This would particularly be the case if purchasing rights of permits were extended to TNCs.

As the mechanism comes into effect, Joint Implementation will no longer become an issue as the trade will help to redress emission imbalances, while the incentive to invest in climate friendly technology remains by releasing quotas for trade.

The mechanism must also ensure that trading is developed primarily as an efficient means of reducing emissions and must not compromise future generations on the principles of inter-generational equity. The implications of this international trade on intra-national equity will also need to be examined and addressed. The increased value of emission quotas from international trade must not detrimentally affect the disadvantaged in national societies. 'Contraction and convergence' applies within countries as well as between them.

Given the historic link between growth of monetary GDP and CO2 emissions, there is a danger that trade in CO2 quotas and any other increase in financial activity as a result of this Protocol will simply increase global purchasing power leading to an increase in CO2 emissions. This would be contradictory to the purpose of the Convention. Another danger is that trade in Emissions Quotas increases inter-national financial liquidity to produce inflation or other instability, as occurred following the OPEC oil price rises. These dangers might be addressed by the creation of a carbon-free "green currency". A study of the potential of carbon-free currency should be commissioned for consideration by CoP in future.

Moreover, existing purchasing power disparities between developing and developed countries can only be aggravated by creating a trade mechanism which continues to exploit the arbitrary advantage enjoyed in the international markets of economies based on hard currencies. This is especially relevant in view of the fact that it ignores the much higher efficiencies of soft currency based economies when national dollars-per-ton efficiencies are adjusted for purchasing power parity (PPP).

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2 Require International Airline and Shipping companies to purchase CO2 emission quotas.

CO2 emitted by all aircraft or shipping must be accounted for within the global emissions budget by requiring international transport companies to purchase emissions permits.

RATIONALE AND POLICY IMPLICATIONS

Currently, aircraft on international flights, or shipping in international waters, can purchase untaxed fossil fuel which is not included in any national carbon account. Air transport in particular is one of the fastest growing sectors of global CO2 emissions, and must be constrained in a similar manner to other carbon intensive economic activities. Fiscal measures which might achieve this, such as an international tax on bunker fuels, would require a global authority to predict and control demand. On the other hand, if airline or shipping companies have to purchase emissions permits the market will ensure a "level playing field" with land-based transport.

This measure will also ensure that all emissions are constrained within the contraction / convergence global budget (sections I. 3,4,5), whilst the price of the quotas is passed on to the consumer of the transport, rather than becoming the responsibility of governments.

It may be possible to extend this option to purchase emissions quotas to other Trans National Corporations (TNCs). This would have the advantage of discouraging "leakage" or carbon-intensive production to countries where emissions are cheaper, since the TNCs could purchase emissions quotas from countries with a surplus, without needing to relocate.

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3. Consider national targets for anthropogenic emissions of other greenhouse gases

Draw up a timetable for agreeing constraints on concentrations of greenhouse gases other than CO2, with specific targets for each gas, as scientific knowledge of their biogeochemical cycles becomes sufficiently reliable. The allocation of budgets should be based on the same task of equity as used above for CO2, whilst giving special consideration to each country's need to exploit its natural resources and agriculture.

RATIONALE AND POLICY IMPLICATIONS

Concentrations of greenhouse gases other than CO2 are rising fast and must be brought under the FCCC. Gases with similar sources and atmospheric lifetimes may be grouped together and some substitution of these may be possible within the national budgets. Some international trading of emissions quotas may also be considered. However, agreement on one greenhouse gas should not be delayed whilst awaiting better knowledge of the other greenhouse gases.

Greenhouse gases other than CO2 fall into two main categories:

For wholly man-made gases such as most CFCs, HCFCs and SF6, an early agreement could be reached. Production of some of these gases is already constrained under the Montreal Protocol for protection of stratospheric ozone. Their major sources and sinks are already sufficiently quantifiable. National budgets for these gases should be allocated using the same principles of "contraction and convergence", allowing for trading if necessary, as outlined for CO2 in Sections I.2 through to I.5 above. Some of these gases have long lifetimes, and therefore their Global Warming Potential relative to each other is effectively independent of the time horizon used. These gases could be substituted within national budgets.

However, on the basis of inter-generational equity and long-term sustainability, production of the very long-lived gases should be tightly constrained and phased out as soon as possible. If a time horizon were agreed, the global emissions budget for the shorter-lived gases could be linked to that for CO2 by means of their Global Warming Potential (defined by IPCC).

Methane (CH4) and Nitrous Oxide (N2O) are significant greenhouse gases produced by a mixture of anthropogenic and natural sources. The sources and sinks are still poorly defined. Methane emissions are rapidly increasing both as a result of changing agricultural practice (cattle, irrigation) and leakage from natural gas installations. However, Methane has a short atmospheric lifetime and therefore it is not helpful to define a Global Warming Potential relative to CO2. To account for the greater potency of Methane as a greenhouse gas, international standards of best practice should be agreed for industry and agriculture. Financial penalties collected when these standards are breached, could be used to fund the development and transfer of improved technology to reduce Methane emissions.

Nitrous Oxide has a longer lifetime than Methane but makes a smaller contribution to current global warming, and is less well understood. More research is urgently needed on the cycles of both of these gases.

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4 Devise potential sanctions, penalties, and compensation.

Request the Secretariat to draw up options for a system of proportional progressive sanctions and penalties for non-compliance with the protocol, taking account of experience of international, regional and national legal instruments and the review of selected non-compliance, dispute resolution and implementation review procedures (FCCC/CP/1995/Misc.2) prepared by the interim secretariat.

Income raised from penalties could contribute to measures to aid implementation and relieve damages, as listed in Section II.B.3 below.

RATIONALE AND POLICY IMPLICATIONS

There are at present no incentives to comply with the FCCC or the protocol. By contrast, the 1994 GATT agreement contains extensive procedures for dispute settlement, including conciliation, mediation, arbitration, establishment of panels, rights of third parties, remedies, and compensation.
Penalties should be in proportion to excess emissions of greenhouse gases, and considerably higher than the current purchase price of tradable emissions entitlements or investment benefits from the excessive CO2 emissions.

The virtue of a tough system of penalties is that it will encourage compliance and reduce the likelihood of it being used.

B. Tasks on climate damages

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1. Monitor climate damages

Require Parties to prepare an inventory of damages and damage trends, both past and present, directly attributable to climate change. These should include human health and mortality, economic impacts, loss of habitats, species and biodiversity, impact on agriculture, and coastal erosion.

RATIONALE AND POLICY IMPLICATIONS

Damage due to climate change has already begun and estimates of possible future damage, casualties and refugees have been made. The aim of this measure is to compile a comprehensive database of damages which would provide both a benchmark for the danger indicators proposed in proposal 2 above.

Research on climate-related damages should be funded by an international programme whose emphasis should be on impacts to developing countries.

Data on damages should be presented in their original units rather than using monetised values. Such values based on the method of "willingness to pay" imply rights by income which is fundamentally inequitable. International aggregation of damage data for the purpose of a global cost-benefit analysis is not appropriate, since the majority of damages will be inflicted on developing countries whereas most of the CO2 emissions, and hence mitigation costs, are currently the responsibility of the industrialised countries.

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2 Plan for emergencies

Require all parties to draw up contingency provisions for future emergencies which may arise from climate change, such as flooding, drought, crop failure or disease.

RATIONALE AND POLICY IMPLICATIONS

Damage due to climate change has already begun and estimates of possible future damage, casualties and refugees have been made. These should be updated regularly as a basis for arranging emergency relief and compensation payments. Liability for compensation payments is considered in Section II.B.3.

Contingency plans should be also prepared for the potential relocation of entire populations from small island states and low-lying regions to the territory of Annex 1 countries.

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3. Consider options for damage compensation and historic debt.

Request that the Secretariat prepare a study of options for damage compensation due to climate change based on best practice in insurance and national compensation schemes, and for historic debt in relation to emissions by Annex I countries prior to 1990, for consideration at CoP4.

RATIONALE AND POLICY IMPLICATIONS

Insurance companies and governments are currently making large scale payments in respect of damages caused by asbestos, radiation and other anthropogenic causes. European and US law also include provision for civil, statutory and criminal liability for environmental damage. Countries and companies which emit CO2 above the danger level should be under no illusion that they can avoid paying for damage caused by excess CO2 emissions, thus increasing incentives to comply with the Convention and Protocol. Careful consideration needs to be given to historic emissions when foreseeability of damages could not reasonably have been expected and the precedents under tort thus become less relevant. The argument of historic debt, nevertheless, still holds as developing countries will, in future, not have the option of unrestrained emissions on which developed countries based their historic growth.

For these reasons, Annex 1 Parties should be required to make provision for climate change related damages in their national budgets and planning mechanism.

CO2 has a long lifetime in the atmosphere, and historic data shows that a constant fraction of emissions has remained airborne, although there is no guarantee for this fraction to remain constant in the future. Therefore, to a first approximation, a country's responsibility for global warming depends on its cumulative emissions integrated over time. Industrialised countries have thus accumulated an historic debt compared to developing countries. Applying the principle of per-capita equity to historic data, it is possible to create a formula for calculating cumulative debits or credits, which might be used for allocating damage liability.

An international panel should be set up by SBSTA to resolve disputes over damage claims; this should include advice from both climate scientists and insurance experts.

For the purpose of such calculations, estimates of cumulative emissions of CO2 should include historic deforestation and other land use changes. Some countries have preserved much of their natural forest resources, whereas others have exploited them and consequently have more land on which to replant new forests. For consistency in accounting, it is necessary to include this form of historic debt if national emission entitlements are to be based on net anthropogenic emissions (i.e. including changes in natural sources and sinks).

C. Tasks on Policies and Measures to aid implementation

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1. Establish financial mechanisms to aid implementation

The SBI shall establish mechanisms by which money can be reliably collected and distributed for global programmes to implement the Convention. Decisions on spending shall be made through a fair and transparent mechanism accountable to CoP.

Funding is required for the following:

Climate Research (see section II.D.2)
Education, training and awareness (see section II.D.1).
Monitoring climate damage (see section II.B.1).
Technology Transfer (see section II.C.2).
Activities currently funded by the GEF
Administration of the CoP and the Secretariat
Administration of emissions trading (see section I.7 and II.A.1)
Emergency Relief and Damage Compensation (see section II.B.2 and II.B.3)

Funding sources may include:

A tax on trading of emissions entitlements (as in section II.A.1)
Penalties for non-compliance (as in section II.A.4)
According to cumulative historic debt (as in section II.B.3)

RATIONALE AND POLICY IMPLICATIONS

Activities which are critical to the success of implementing the Convention, should be able to rely on secure funding. This is already required for the Financial Mechanism under Art. 11 of the FCCC, and the commitments set out in Art. 4 c, d and h. However, present arrangements are unsatisfactory as funds are reliant on the goodwill of a few Parties which then control their use. Binding mechanisms must be set up to enable money to flow directly from the cause of the climate change problem (i.e. greenhouse gas emissions) towards funding its solution. This would encourage a reduction in CO2 emissions, although the main mechanism for achieving this should remain the allocation of emission entitlements according to Contraction (section I.3) and Convergence (section I.4).

Liability to pay compensation for damages should be linked directly to cumulative historic debt as outlined in section II.B.3.

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2. Establish mechanism for development and transfer of sustainable technologies

The development, diffusion and use of the most sustainable technologies, practices and processes which minimise greenhouse gas emissions shall be regarded as an essential global security interest as defined in section I.1. To this end, a mechanism should be established under the protocol to aid the development within and transfer to developing countries of sustainable technologies.

The transfer of outdated or second-hand, carbon-inefficient technology should be controlled and preferably prohibited.

RATIONALE AND POLICY IMPLICATIONS

Explicit measures and positive incentives are urgently needed to stimulate the development and transfer of the most climate-friendly sustainable technology. Such technology should:

(a) be carbon efficient or based on renewable energy sources
(b) be an appropriate scale for the local community which it serves
(c) be independent of expensive supplies or repairs from distant companies.
(c) not damage the local environment (as do, for example, large hydropower schemes)
(d) not entail unacceptable risk (as do nuclear power stations)

Measures to stimulate the development and diffusion of climate-friendly technology would include

(a) establish a technology transfer fund (paid for according to section II.C.1)
(b) fund research, development and diffusion of sustainable technologies, particularly in developing countries
(c) create an international inventory of climate-friendly technology
(d) promote best practice and sharing expertise between countries
(e) identify gaps and opportunities in national and multilateral technology programmes
(f) limit the period for which patents on relevant technologies may be held without being exploited for the benefit of humanity

A substantial transfer of outdated, carbon inefficient technology from developed to developing countries is currently widespread. This has the effect of prolonging the detrimental contribution of this machinery or technology on global carbon emissions.

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3. Phase out fossil fuel subsidies

Agree mechanisms to phase out all subsidies for fossil-fuels. Transitional procedures and financial support shall be made available to developing countries in order to achieve a smooth transition and avoid penalising the poor.

Rationale and policy implications

Subsidies for the use of fossil fuels both increase global warming and distort the efficient allocation of resources through markets. Definitions of subsidies should be carefully established and the needs of the poor fully taken into consideration.

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4. Require consistency in international policy-making

Set up an international task force to ensure that all international agencies, treaties and agreements actively contribute to reducing CO2 emissions as an essential global security interest. This should be backed by a resolution to the United Nations General Assembly to require all international agencies, treaties and agreements take the climatic implications of their actions fully into account and to support the implementation of the UNFCCC and its protocols.

RATIONALE AND POLICY IMPLICATIONS

There is a danger that trade liberalisation under the 1994 GATT agreement, investment by the World Bank and economic measures by the IMF and central banking system as well as actions by other agencies increase CO2 emissions or otherwise undermine the objectives of the FCCC. The aim of this
task is to ensure that all international decision-making takes full account of the Climate Convention. A precedent for this task was established by the Ministerial Declaration on the Contribution of the World Trade Organisation to Achieving Greater Coherence in Global Economic Policymaking of 15 December 1993.

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5. Establish a forum for local governments

Recognising the important contribution local governments make in implementing climate friendly policies and technologies at a local level, an international forum on climate change for local governments should be established with rights of representation as an observer to CoP under Art. 7 (6). The role of this forum would be to allow sharing of experiences and making relevant policy recommendations to national governments and CoP. This body could also discuss issues of intra-national equity arising from the restraint of carbon emissions.

RATIONALE AND POLICY IMPLICATIONS

A considerable proportion of sustainable policies and technologies are most effectively implemented at a local level and local governments can, therefore, play an important role in emissions reductions. The exchange of information on a local level would complement the transfer of technology on a national level as outlined in Section 2.9. The forum would also be the ideal organ to voice any problems of intra-national inequities arising from national and international implementation of the protocol and specifically the trade mechanism.

D. Tasks on research and education

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1. Enhance education, training and awareness

Require all Parties to increase their commitment to education, training and public awareness of climate change under Article 6. This should encourage an holistic perspective emphasising the links between local and global processes, both natural and economic, and convey the full scale of the climate change problem as a survival issue. This must be underpinned by better understanding of the basic science of climate change.

Commission a feasibility study to establish options for an international system of greenhouse gas labelling to provide immediate public awareness of the extent to which a particular product or service contributes to emissions of CO2 or other greenhouse gases and to create incentives to reduce carbon consumption.

Require parties to report annually to the CoP on the following matters:

(a) the extent and nature of education, training and public awareness undertaken;
(b) organisation, finance and target audience thereof;
(c) independent evaluation of the effectiveness of such education and training;
(d) results of an independent poll of public awareness of climate change, its effects and measures needed to reduce emissions to a sustainable level;
(e) progress on greenhouse gas labelling
(f) actions to curb promotion of carbon consumption.

RATIONALE AND POLICY IMPLICATIONS

Most countries have done relatively little to fulfil their commitments under Article 6 of the UNFCCC. Raising awareness of the way in which fossil fuels and other products increase global warming has a significant role in motivating individuals, companies and countries to reduce such consumption. If all goods and services carried a conspicuous and unambiguous statement of the CO2 or other greenhouse gases emitted by their production and disposal, this would enable people to make more informed choices. Public awareness and education on global warming is in constant competition with the advertising power of the air, car and fossil fuel industries. In view of the gravity of climate change, serious consideration should also be given to measures which curb the promotion of activities responsible for carbon emissions, similar to those currently applied to alcohol, tobacco, pharmaceuticals and other drugs. There is much public confusion over the science and impacts of climate change. This should be tackled both as a core part of school curricula, and as specifically tailored training programmes for employees, stressing measures for alleviating impacts of their field of work on global climate change, and vice versa.

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2. Strengthen climate research, particularly into feedback processes

Increase research into physical, biogeochemical, social and economic climatic feedback processes. Such research requires international consistency to ensure that the different processes can be combined in integrated models, whilst also encouraging researchers to investigate new processes. This should be co-ordinated principally through the International Geosphere Biosphere Programme (IGBP) and World Climate Research Programme (WCRP). IPCC and SBSTA (when calculating the emissions ceiling according to section I.2) should attempt to take account of the cumulative risk from low-probability positive feedbacks. When IPCC presents predictions or scenarios of global climate changes, there should also be less emphasis on global average temperature trends, and more on regional differences, particularly regarding the sulphate aerosol effect.

RATIONALE AND POLICY IMPLICATIONS

There are particular dangers that the effects of climate change may trigger uncontrollable feedback loops that accelerate global climate change further than would be expected from current IPCC predictions, and exacerbate regional anomalies. Some known examples of such natural climatic feedback processes are listed below:

a) Clouds: Different levels of clouds can have opposite effects on climate, since they both trap terrestrial radiation and reflect solar radiation. Clouds and water vapour also transport much latent heat. Thus it is difficult to resolve the feedbacks. Clouds may also be seeded by sulphate aerosols, both natural and anthropogenic.
b) Ice sheets: Polar warming may increase ice melt, but also increase snowfall. This affects:
 * Global albedo (proportion of sunlight reflected to space)
 * Sea level
 * Local ocean salinity and albedo and hence circulation and ecology
c) Ocean circulation:
 * Arctic warming or increased freshwater input to the North Atlantic (ice melt, rainfall) could halt deep water formation, weaken the North Atlantic Current, and thus make NW Europe much colder.
 * Increased frequency of El Nino circulation in the Pacific affects climate world-wide.
d) Ocean ecology: Changes in phytoplankton ecology might be caused by:

*increased stratification of the water column, due to surface warming. would reduce nutrient (Nitrate, Phosphate, Iron) supply from bottom waters.
* increased nutrient runoff from rivers due to changing land-use.
* increased UV-B flux due to stratospheric ozone loss.
The effect of this might be to change:
* the export of Carbon from surface water to deep water by the "biological pump".
* the alkalinity of surface water due to calcifying algae. Calcification puts CO2 back into the atmosphere.
* the production of greenhouse gases (N2O, CH4, other hydrocarbons)
* the production of Dimethyl Sulphide which (as sulphate aerosols) seeds clouds over the ocean and thus significantly influences global albedo
* ocean fish stocks
e) Terrestrial ecology: warming and drying in high latitudes may cause:
* release of greenhouse gases CH4 and N2O from melting permafrost
* release of CO2 from peat bogs, if drying allows aeration.
* increased forest fires and subsequent CO2 release
* reduced snow cover, particularly if forest replaces tundra, with consequent change in albedo.
The "CO2 fertilisation effect" may cause:
* increased CO2 uptake by terrestrial vegetation
* changes in evapotranspiration and hence local rainfall and groundwater.
Vegetation changes will affect albedo and also surface roughness which affects wind.
f) Flooding of coastal wetlands by rising sea level, particularly in the tropics, may cause substantial release of CH4 and N2O.

There is presently much confusion among policymakers about the cooling effect of sulphate aerosols produced by fossil fuel combustion. It should be stressed that the aerosol effect is short-lived and local, whereas the arming by CO2 is long-lived and global. Such differences are obscured by an emphasis on global average temperature trends, which should be remedied within IPCC.

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3. Study the responsibilities of trans-national corporations and finance

Set up two working groups to examine the role of international finance and transnational corporations respectively in relation to CO2 emissions, in order to report on
(a) the extent to which their activities contribute to or abate global warming
(b) differential responsibilities between corporate sectors
(c) examples or models of good practice in regulation, incentives, statutory or voluntary codes, reporting requirements or other measures for encouraging corporations and investment fund managers to cut CO2 emissions
(d) the contribution or otherwise of small and medium businesses to global warming
(e) recommendations for specific measures to enhance the contribution of investment finance and transnational corporations to stabilising CO2 emissions

RATIONALE AND POLICY IMPLICATIONS

Representatives of transnational corporations are active participants in the climate change negotiations and major players in both sustainable and carbon energy industries. The majority of world trade and a substantial proportion of global production is conducted by transnational corporations, while international financial flows are the driving force in trade and industry throughout the world, often more powerful than governments. The aim of these two study groups would be to examine the specific role of these two major types of economic agents to identify measures to enhance their contribution to stabilising greenhouse gas emissions.