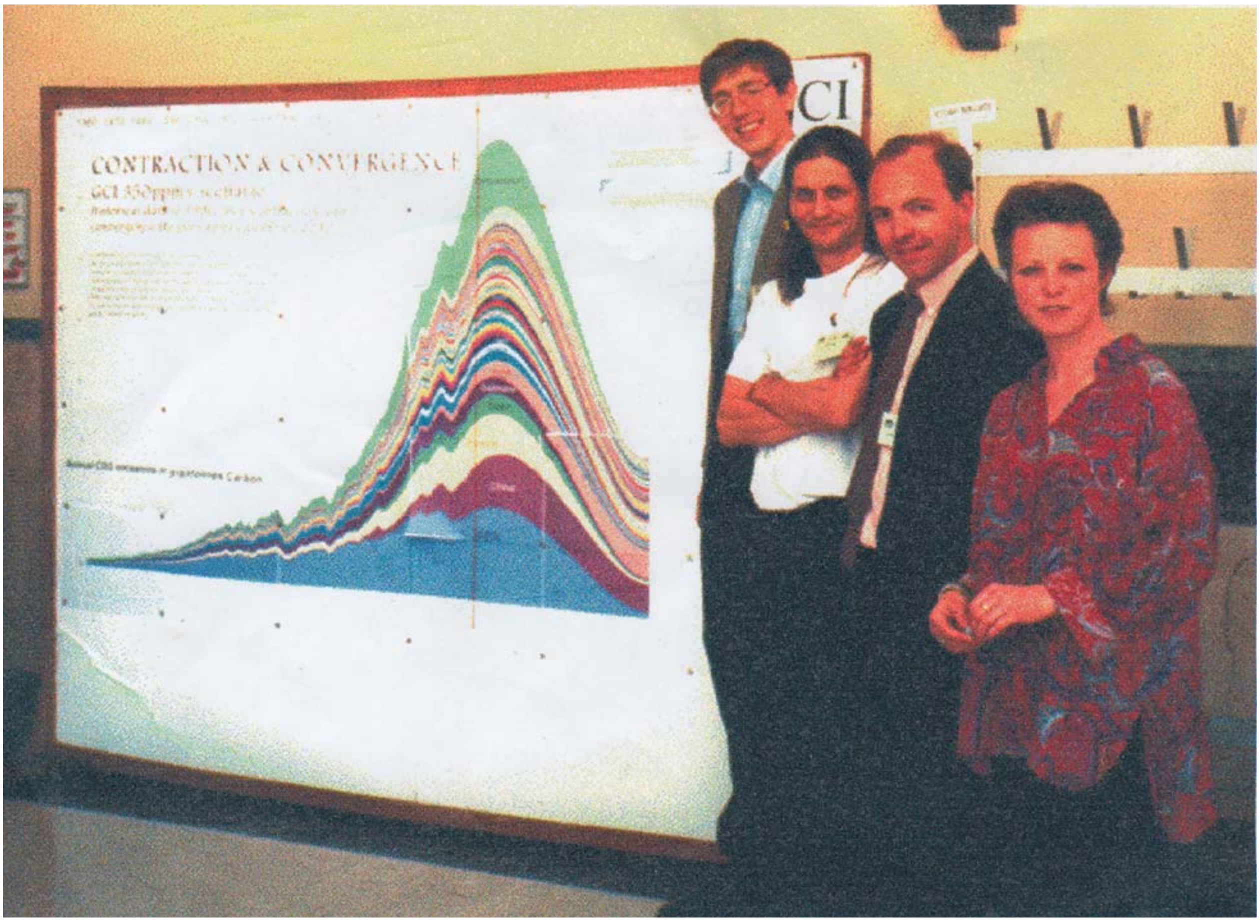

Some GCI members at the 2nd ‘Conference of Parties’ to the United Nations Framework Convention on Climate Change [Geneva 1996].

Contraction and Convergence (C&C) was formally tabled that year and here we defended it at rates consistent with a 350 ppmv atmospheric stabilisation target.

Starting in 1989, GCI proposed the thesis of “Equity & Survival” to the UN 1990-92. Through 1993-94 we countered its ‘economic’ antithesis of ‘Efficiency with No-Regrets’ as the ‘Economics of Genocide’.

From 1995 onwards GCI has formally tabled the Synthesis of ‘Contraction & Convergence’ [C&C] at the UN, since when it has become the most widely cited, and arguably widely supported methodology in the process.

The Paper that follows was presented to the ZEW conference in Mannheim Germany in June 1997. We tried to continue the defence of 350 ppmv

The paper was ultimately published by ZEW through Springer Verlag in an updated form where this defence was edited out: -

http://www.gci.org.uk/papers/zew.pdf

"CONTRACTION AND CONVERGENCE"

A GLOBAL SOLUTION TO A GLOBAL PROBLEM (GCI DRAFT 03/06/97)

"Principle without practice is useless but practice without principle is dangerous." (Old Japanese Saying)

'This means devising and implementing a programme for convergence at equitable and sustainable par values for consumption of fossil fuel on a per capita basis globally." (Indian Government COP1)

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At the Second World Climate Conference in 1990, GCI presented an agenda for solving the global crisis of climate change. This was essentially the proposition of *"Equity for Survival".* We argued that whilst the traditional proposition of equity for its own sake was a dream, unless the new and more rigorous proposition of equity for survival was adopted, the nightmare of global climate destabilisation would follow.

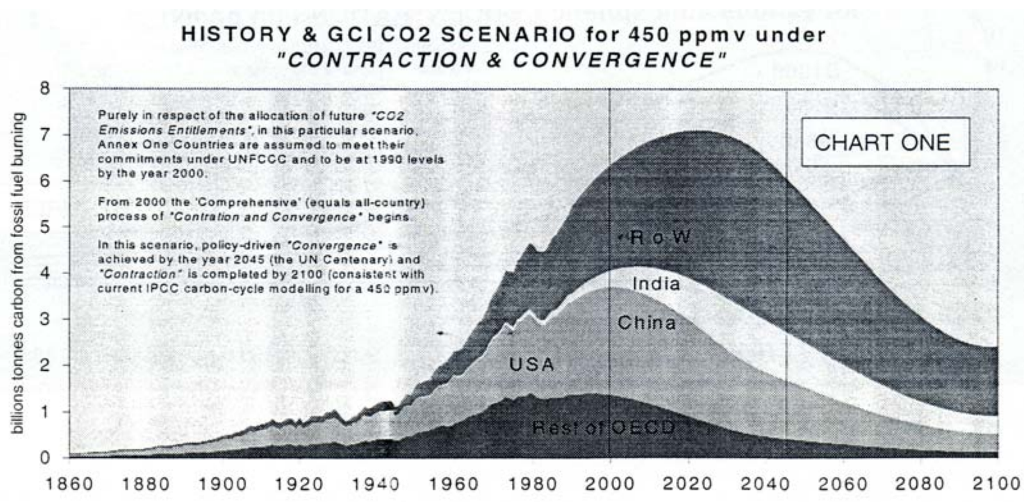
Limits to growth - certainly of fossil fuel consumption - must now be observed if we are to avoid this climate crisis. Until now however, the limits-free expectations encouraged by the success of laissez-faire economics have been obscuring this. It will be impossible to observe these limits unless, from now on, implementation is internationally configured in a way which corrects the skewed distribution between the rich and poor. This converts a merely moral dilemma into a moral imperative. Because everyone - regardless of status - is now increasingly vulnerable to the impacts of climate change, the rich have little choice but to share the burden of contraction fairly.

Encouraged by the growing political recognition of this dilemma, GCI has been devising a greenhouse gas abatement methodology based on *"Equity and Survival".* We call it *"Contraction and Convergence".* Early results of this were published to good effect at the Second Conference of the Parties (COP2) and these have been distributed widely since then. To demonstrate the procedure, an all country graphic covering the period 1860 to 2100 was compiled as a demonstration example. It shows the history of fossil fuel consumption using data from Carbon Dioxide Information Analysis Centre (CDIAC). And it also shows a future budget of suggested *"CO2 Emissions Entitlements"* consistent with an outcome of CO2 concentrations in the atmosphere of 450 parts per million by volume (ppmv) by the year 2100.

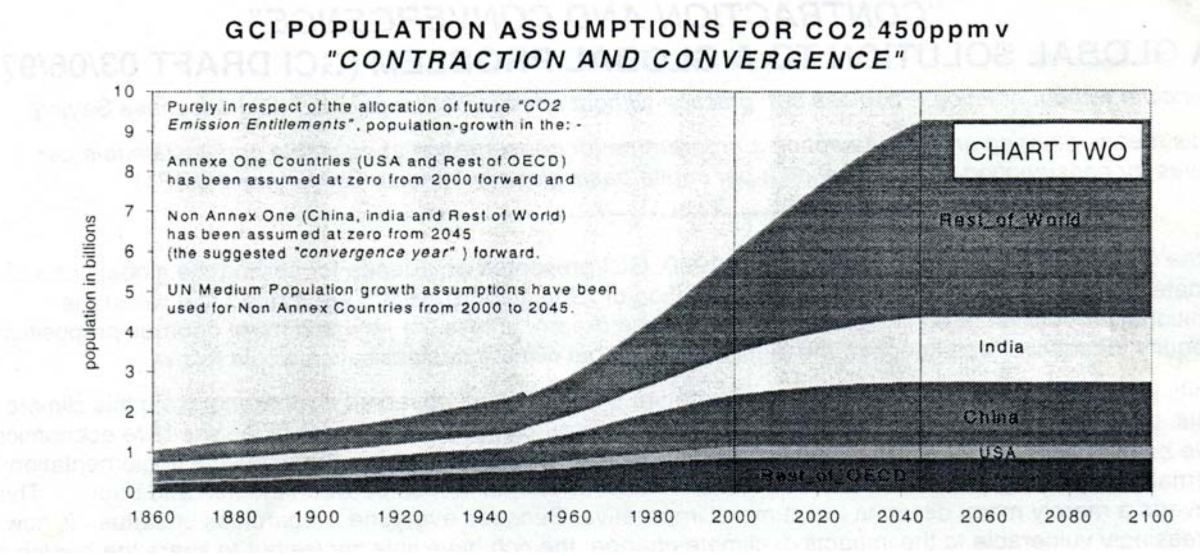
This is *"Contraction".* Contraction of CO2 output is the imperative for ecological survival. We observe that such a global consumption path is less dangerous than a path with an outcome of 550 ppmv, but do not wish to imply that we regard the 450 ppmv as being without dangers. We are already taking substantial damages at the present concentrations of around 360 ppmv.

But the budget also distributes available future entitlements to emit CO2 so that they are equalised on a per capita basis globally by - in this example - 2045, the year of the UN Centenary. This is *"Convergence"* and convergence is the political equity imperative. We consider that a failure to face and secure a global commitment of this kind will result in a perpetual stalemate in the international political process to the extent that the agreement and delivery of global abatement targets will become less and less possible.

"Contraction and Convergence" is intended to show how to shape a global GHG abatement strategy so as to solve the political and ecological double-jeopardy of climate change. Below is a simplified version.



The graphic below shows our assumptions re. future population growth in the budget above.

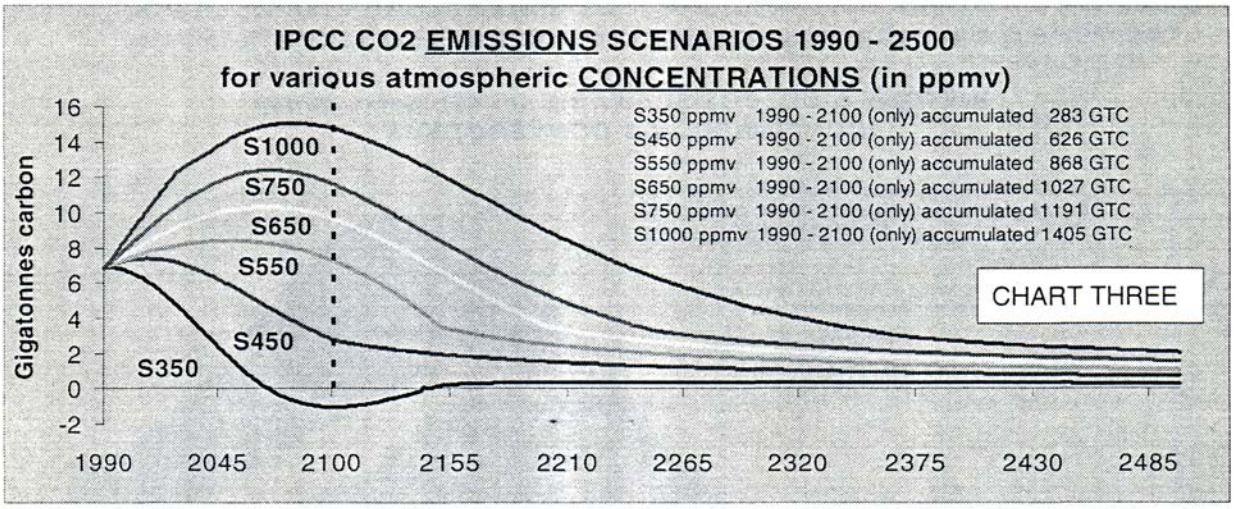


If *"Contraction and Convergence"* is adopted as the tool for managing CO2 and other greenhouse gases (GHG), there will be a transition to a point (convergence) where future entitlements to emit will have become proportional to population. Forecast of population may assume critical importance and be the subject of negotiation. However, it could be counter-productive to create an incentive for countries to increase their share of the global emissions budget through population growth. We suggest that a starting position should be that Annex One Countries are *regarded as* stable from 2000 forward, and that Non-Annex One Countries are *regarded as* stable from the "Convergence" year forward (in this case 2045). This is portrayed in the graphic above using UN Medium fertility projections for Non-Annex One Countries. We are not here implying or advocating population policy per se.

Consideration of IPCC CO2 Scenarios for Carbon Emissions

Before going on to assess which Contraction Budget and which Convergence Date to select, we consider the data provided by the IPCC climate modellers with regard to future 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.



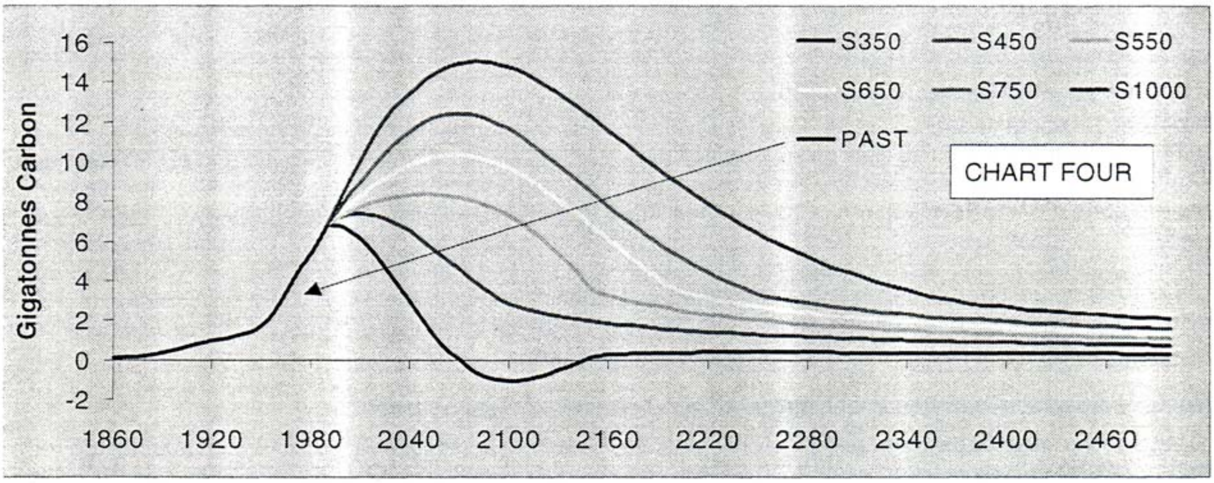
IPCC's ranges for accumulated emissions against atmospheric concentration curves are in the table below.

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	1200 to 1300
550	630 to 650
650	870 to 890
750	1030 to 1190

Comparing these Industrial Carbon Emissions Scenarios to the Past Record

Now we proportion these suggested future emissions paths and their integrals with past emissions. This seems important as most of the IPCC's future projections are - in GCI's judgement - unrealistically carbon-dependent. The price of fossil fuel will soar, along with the damages their use will cause. Just for the 350ppmv scenario, future atmospheric loading would be above an average of 3 to 4 gigatonnes annually for the next 100 years, i.e. the integral would be more than twice the integral emitted since the beginning of industrialisation.

The graphic below adds these past emissions from 1860 until 1990 and is represented by the black curve on the left hand side of chart four. The integral of these past emissions is 212 GTC with an annual emissions rate rising to more than six gigatonnes annually.



Globally we are already taking significant damages as a result of altered weather patterns associated with this record. As a result of this integral - i.e. even minus all future emissions - the effect of this historic loading will increase the forcing of adverse climate changes well into next century. This suggests that a change away from this emissions trend as soon as possible is the only prudent option. Prevention is better than a cure which may not even exist.

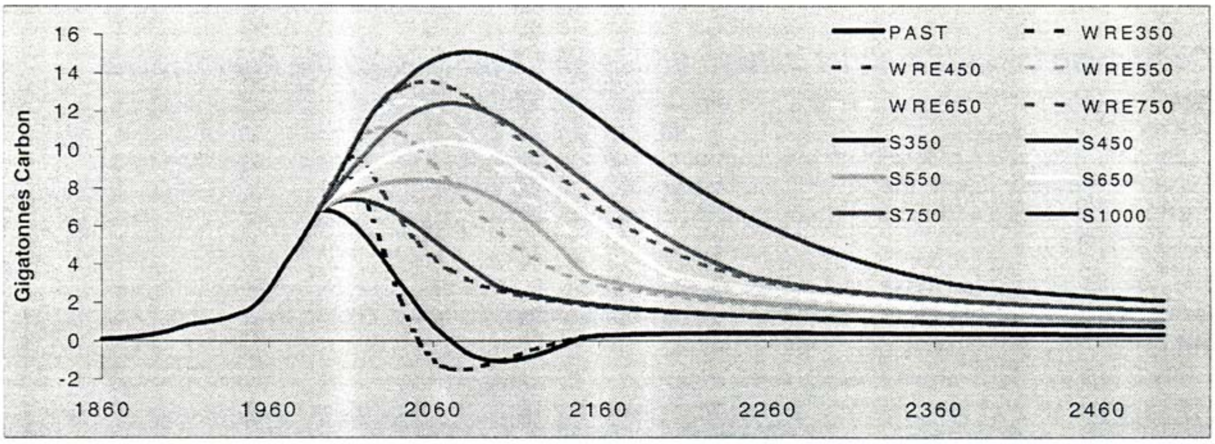
Even the future range of integrals for 350ppmv (300 - 430 GTC) embraces twice the amount already emitted. This alone clearly augurs an increased rate and intensity of damages. In spite of this the IPCC declared this -its most stringent future abatement path - to be '"ludicrous" because of the 'apparent' but actually quite specious requirement for negative emissions. (We comment further on this particular dispute below in the section "Same Integrals - Different Curves • Accelerated Response").

Going ludicrous in the other direction however, the IPCC saw fit to model scenarios which explored the theoretical possibility of emissions paths to 550, 650, 750 and 1,000 ppmv CO2. These are constantly represented in charts three, four, five and six. They heroically span a period of 500 years into the future. In fact the 1000 ppmv scenario embraces an integral of an additional nearly 1.5 trillions tonnes of carbon emissions to the atmosphere just for the first hundred years, nearly six times the amount emitted so far. The integral for the entire 500 year period is nearly 4 trillion tonnes.

The damage implications of such a scenario represent a new element of irresponsibility in the IPCC which is quite surprising and unwelcome.

Same Integrals, Different Curves - Ware’s "Delayed Response"

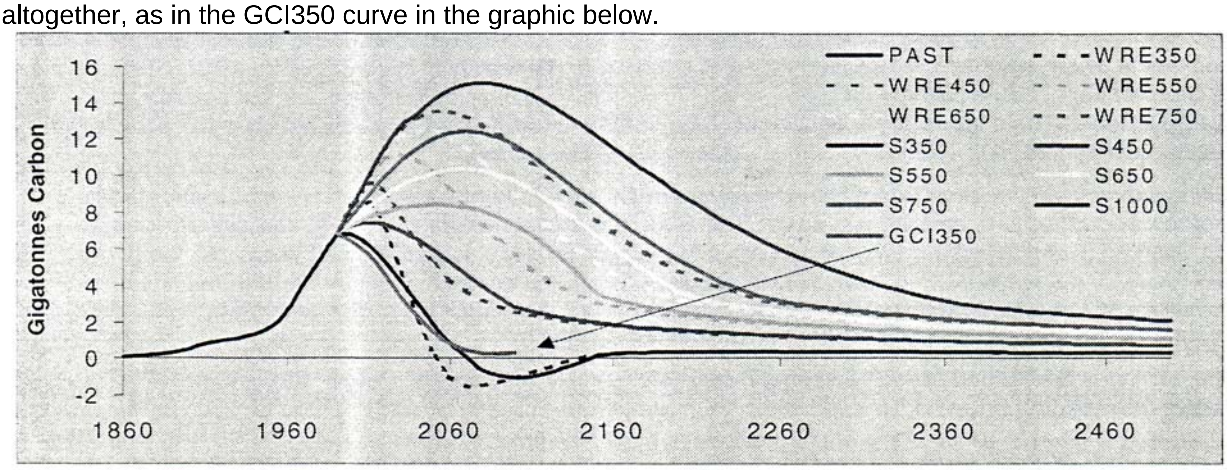
IPCC assert that it is the integrals of the emissions scenarios, rather than the different possible rates of emissions, which primarily determine the ultimate atmospheric concentration outcome. Based on this assertion, Tom Wigley and two US economists Richels and Edmonds (WRE) redrew the curves (the rates of emissions) whilst keeping to the same integrals, as in the graphic below. These "delayed response "curves are represented by the dotted lines. For example IPCC's S450 curve is the solid red line and should be paired with the dotted red line which is the WRE "delayed response "curve with an equivalent integral. The WRE curve goes upwards for longer, but comes down more sharply once contraction begins. Each of the coloured pairs of solid and dotted lines have the same integral.



The justification for the "delayed response" approach was an industrial economics argument. This suggested that if capital accumulation were not interfered with in the short-term, there could be a more rapid technological transition to de-carbonisation later. This argument was widely challenged and in fact rejected in Working Group Three of the IPCC - the Economics Working Group. It takes the global community deeper into the zone of uncertainties than is consistent with an ecological risk minimisation strategy. In spite of this, these curves have now come to be a major feature of the IPCC's Technical Paper III entitled "Stabilisation of Greenhouse Gases: Physical, Biological and Socio-Economic Implications" emanating from Working Group One - the Science Group. This is part of a pattern of evidence showing the progressive politicisation of the 'scientific' judgements of Working Group One. This is a matter of concern as this is the group on whose work the climate-change policy community almost entirely depends.

Same Integrals, Different Curves - "Accelerated Response"

"Delayed response" is far from being the only feasible, desirable or necessary option. It can also be argued that "accelerated response" \s feasible, desirable and possibly necessary. Consider the S350 and WRE350 curves. The IPCC declared these "ludicrous" because they required "negative emissions" (below zero emissions) during the latter part of the 21st century. However, negative emissions are not necessary by definition. The required integral can be achieved as a net figure through "sink-enhancement" to the extent of the negative emissions requirement. Moreover, the gross curve can be recalculated instituting the required abatement measures earlier in the cycle, obviating the requirement for negative emissions altogether, as in the GCI350 curve in the graphic below.



It is sensible to rescue the 350 ppmv reference. Now, at 360ppmv, we already experience damage. With feedbacks impending, we do not know if rapidly increasing damages may yet demand a return to this path.

WHICH CONTRACTION BUDGET? WHICH CONVERGENCE DATE?

These are the two main questions that arise once the twin-policy approach is accepted in principle. We will address 'which budget?' first, as the imperative of convergence only arises as a derivative of the imperative of contraction even if in turn, contraction is only practically achievable once global convergence has been accepted, agreed and configured.

The budget should be 'risk-averse'. It should seek to keep atmospheric GHG concentrations as near to present levels as it is possible to do. We are already taking significant damage from the accumulated CO_2 emissions from fossil fuel burning between 1860 and 1990. It should be constantly remembered that atmospheric concentrations (not shown in the graphs) theoretically stabilise only decades to centuries after contraction of emissions has been completed. Also, most known feedback mechanisms are not modelled into these runs. And while their interactive effects on climate forcing are still too complex to simulate in the models, the feedback signs are predominantly assumed positive - i.e. giving increased warming.

Put simply, the curves are drawn against necessarily simplified and very incomplete interpretations of how the climate system may behave under the impact of GHG emissions, should they continue. Furthermore, these are CO_2 indicators only - in other words all other GHGs are omitted. Minus any interactions and feedbacks, the equivalent net heating effect of the other GHGs could be around an extra 25%. For CO_2, IPCC suggests just for the 450 and 650 curves, temperature rises above pre-industrial levels of between 1.5 and 4.5° C.

So it is crucial to temper any sense of certainty or security implied by the IPCC's figures. They are heroic long-range projections. They are cumulative emissions budgets over a period of 500 years into the future with the IPCC having presented integrals for the first 100 years only. Moreover, already by 2100, the 550, 650, 750 and 1000 ppmv budgets, are each delivering an annual CO_2 output greater than output in 1990. This is the equivalent of delaying serious global contraction policy by a century. Such a delay carries unjustifiably high damage risks. Already by 2100, even the 350 ppmv budget contemplates around two times the amount of emissions accumulated between 1860 and 1990. In the light of the rising impact trends apparently associated with just this history, even the budget returning us to 350 via 400 ppmv seems fraught with risks. A 280 ppmv goal may yet prove necessary.

WHICH BUDGET?

So the question of 'which budget' is best dealt with in the following manner. Anything higher than 450 ppmv should be regarded strictly as propaganda originating from the commercial and industrial lobby, particularly the fossil fuel sector, in other words from people who remain opposed to any change to the status quo. Moreover, faced with the risks of irreversibility and the unknowns about how close to thresholds of irreversibility we may already be, it is also clearly absurd to decide specifically 'the budget' as though we were going to decide it and then adhere to it come hell and high-water. The initially agreed budget will inevitably have to be reviewed and revised (we suggest at a maximum five yearly interval). In other words, if we started out in Kyoto with a global agreement to follow "Contraction and Convergence" on a 450 ppmv path, we might well have had to revise this downwards to a 350 ppmv path or less, even if the evidence of damages and human causation continued to come in only at the rate already established.

Knowing this, it makes no sense at all to set out for 550 ppmv or above, because we can already see that a subsequent revision downwards to 350/450 ppmv paths would prove politically impossible because the necessary contraction rates would prove too high, and possibly for ecological reasons as well because uncontrollable feedbacks might be activated.

In this time leading up to Kyoto the paramount need is to break the deadlock in the global negotiations so that the US demand for commitments to emissions restraint from everyone is accepted but on conditions which clearly exact from them a reciprocal commitment to some process of convergence inside the limits which a global cap on emissions represents.

Seeking this, we see the possibility of an alliance of some major Annex One and Non-Annex One Countries and possibly AOSIS becoming committed to a process of "Contraction and Convergence" ending deadlock between Annex One and Non-Annex One countries of the last six years and winning the first stage of the global campaign to adopt the strategy of "Contraction and Convergence" by Kyoto. We do not believe that any party to the UNFCCC can seriously or successfully oppose this linkage if this formation emerges.

WHY CONVERGENCE AND WHICH DATE?

The historical argument of equity for its own sake - here "convergence" per se - never gained enough force by itself to more than slightly mitigate the socially polarising tendencies of industrial and monetary laissez faire. However, the argument of equity for survival is unavoidable and urgent once the imperative of observing global limits to GHG emissions is recognised. A global cap on these will not be agreed widely enough unless correcting the global maldistribution of present and future energy use is accepted and enacted by formal agreement as well. If for example the scenario chosen is 450 ppmv (later revised to 350 ppmv), i.e. contraction completing in 2100 (or as soon as 2045), we feel that 2045 - the UN Centenary - is a powerful symbolic date to which the "convergence" programme should be focused. The politics of saving the planet is going to need all the help it can get.

If any industrial or industrialising countries were to continue pursuit of ecological and political roulette intent on avoiding contraction or the linkage of convergence to contraction, meaningful international agreement on abatement strategy would - in our judgement - fail to materialise and contraction per se will become unachievable and major damages will become an inevitability. We will probably enter an era in which mitigation and abatement policy intentions will become irrelevant as progressively unstoppable momentum takes us towards the irreversibility of major equilibrium shifts in the system as a whole.

If an effective global abatement strategy does not emerge by the Third Conference of the Parties (COPS) in Kyoto, this psychology of 'adaptation' (rather than 'prevention' and 'mitigation') will seriously begin to take root as the default option, with millions of people being put at profound risk.

At this time, the industrial policy attitude is still to regard abatement as the greater cost against the lesser cost of mass death and damages due to human and industrially induced climate change. If these circumstances persist, it may well consolidate a general strategic orientation favouring adaptation. IPCC's Second Assessment Report (SAR) Working Group Three (WG3) already presented this absurd abatement-cost to damage and mortality cost ratio.

GCI does not believe any sensible policy can emerge - or should even be countenanced - which intentionally or unintentionally runs such risks.

GCI's Solution - "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 CO_2 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 modelling 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 was 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 spreadsheet 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 CO_2 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 CO_2 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 CO_2 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.

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 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 "Annex"!' 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.

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 existing 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 Annex"! 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. 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+my2+ny3+py4

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 zero for this target year (i.e. we assume that emissions stabilise 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 spreadsheet, 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 value 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 unburned 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]. 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.

5.37 The Convergence Stage

This, the process to allocate % shares of global emissions to all the world's 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 onto 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 subject 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 $s_{y+i}=s_y-(s_y - p_{y+1})exp(-a(1-t))$

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 2045), and a is an arbitrary parameter that determines the rate of convergence.

In the spreadsheet 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.

6/ Allocations

The actual industrial CO_2 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 to 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 populations for years beyond a 'population cut-off year' at the values for that year. Note there is no assumption being made about what populations will or should be beyond the cut-off year; merely that population growth after that year should not accrue additional emissions rights. In the spreadsheet the year is adjustable, we recommend 2020. We hold it necessary to adopt some such cap criterion, as otherwise the system might give national governments a positive incentive to encourage their populations to grow to obtain an increasing share of emissions rights.

8/ The CCOptions Spreadsheet

The above ideas on contraction and convergence have been actualised in a Microsoft Excel spreadsheet, CCOptions; which is available from GCI on a shareware basis. Excel version 5 or later is required.

CCOptions models CO_2 emissions allocations from the present up to 2100, married with CDIAC data for historical CO_2 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 on.

As well as the base C&C computation, the spreadsheet 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 CO_2 emissions, and target annual emissions. The convergence process is unaffected by this.

We now present a brief explanation of how to use the spreadsheet.

How to use the CCOptions spreadsheet

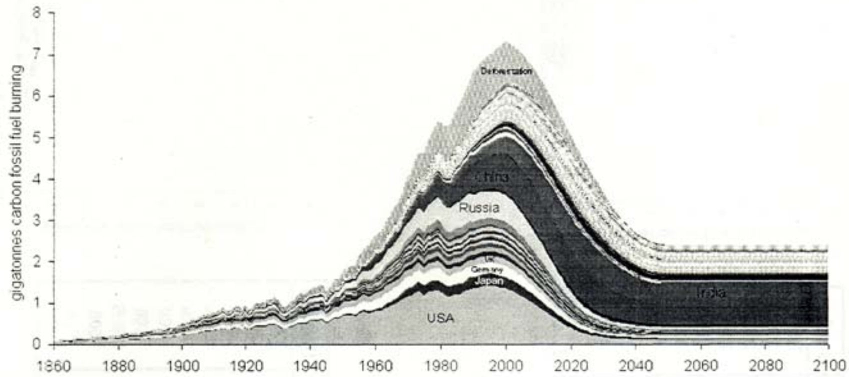
It is recommended that for initial use, two windows are displayed, the top one being the top 13 rows of the spreadsheet, which contains all the user-adjustable parameters as well as some key numerical results; the second one containing the main chart of the historical allocated emissions.

On a fast PC, simply retyping a desired different set of parameter values results in the direct recomputation of the results and chart(s). On a slower PC, it is better to use the Excel option to switch calculation to manual to avoid lengthy computation of unwanted intermediate results.

The following parameters can be entered.

GCI recommended values, which the spreadsheet is shipped with, are shown in the second column. We also show a set of values which illustrate the impracticability of switching from a 550ppm target to a 350ppm target after 2005. The algorithm in this kind of case generates an emissions curve which dips below the target level-a sign that the scenario being considered is impractical.

Parameter	Recommended value	Values to show S550 commitment
Initial year global industrial CO2 emissions growth rate	1.5%	1.5%
Convergence year (can be up to 2100)	2045	2045
Population cutoff year (can be up to 2060, due lack of data). If later than the convergence year, has no effect.	2020	2020
Contraction year (can be up to 2100)	2050	2100
Contraction level of industrial CO2 emissions (as % of 1995).). This is the %age that emission are planned to be reduced to.	25%	40%
Speed of convergence parameter	4	4
Planned total 110-year industrial CO2 emissions (GTC)	325	820
Phase2 start year. Set to 2100 if no phase 2 is required	2100	2010
Phase2 contraction year	<irrelevant>	2045
Phase2 contraction level	<irrelevant>	20%



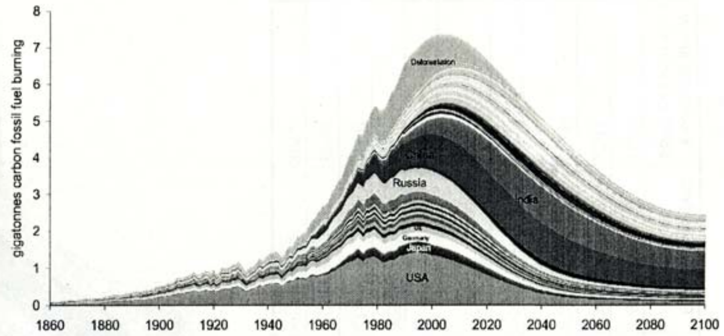
References

[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

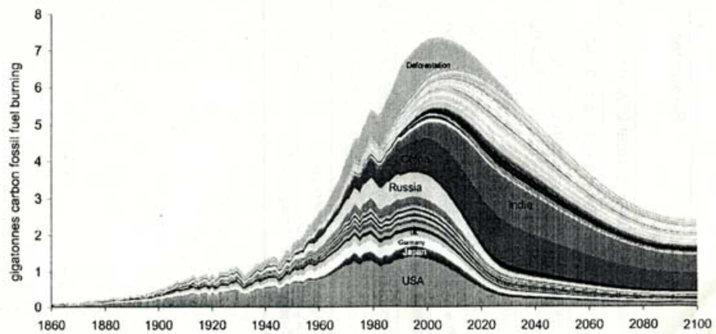
[2]CLIMATE CHANGE 1995 The Science of Climate Change, Summary for Policymakers *and* Technical Summary of the Working Group I report. IPCC. 1996.

[3]CLIMATE CHANGE The IPCC 1990 and 1992 Assessments. WMO/UNEP June 1992.

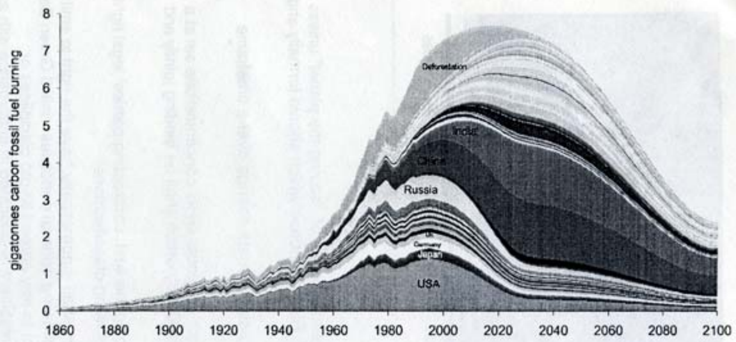
Parameter	Setting
Initial year global CO2 growth rate	1.50%
Convergence year (up to 2100)	**2100**
Population cutoff year (up to 2060, due lack of data)	**2020**
Contraction year (up to 2100)	**2100**
Contraction level of CO2 emissions (as % of 1995)	**40%**
Speed of convergence parameters	**4.00**
Quartic(1) or cubic(0)	**1.00**
Start year	1995
Planned total 110-year emissions	**500**
Total 110-year emissions (Bill)	504
Peak US decline rate	4.98%



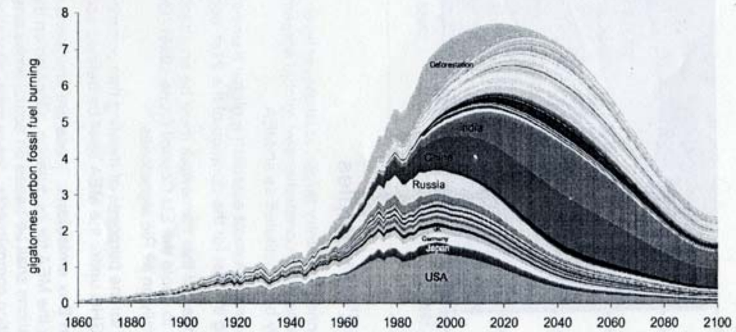
Parameter	Setting
Initial year global CO2 growth rate	1.50%
Convergence year (up to 2100)	**2045**
Population cutoff year (up to 2060, due lack of data)	**2020**
Contraction year (up to 2100)	**2100**
Contraction level of CO2 emissions (as % of 1995)	**40%**
Speed of convergence parameters	**4.00**
Quartic(1) or cubic(0)	**1.00**
Start year	1995
Planned total 110-year emissions	**500**
Total 110-year emissions (Bill)	504
Peak US decline rate	7.79%



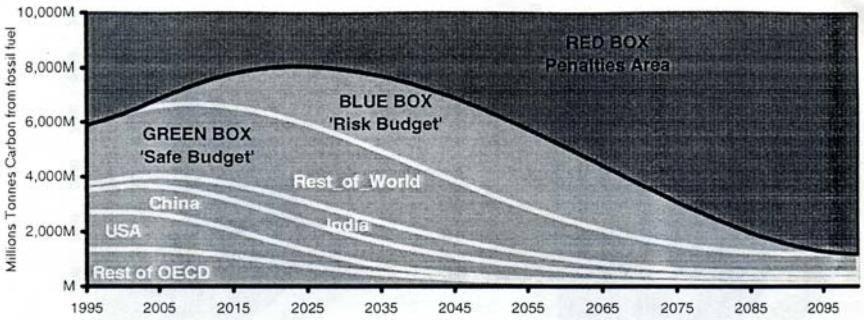
Parameter	Setting
Initial year global CO2 growth rate	1.50%
Convergence year (up to 2100)	**2045**
Population cutoff year (up to 2060, due lack of data)	**2020**
Contraction year (up to 2100)	**2100**
Contraction level of CO2 emissions (as % of 1995)	**30%**
Speed of convergence parameters	**4.00**
Quartic(1) or cubic(0)	**1.00**
Start year	1995
Planned total 110-year emissions	**626**
Total 110-year emissions (Bill)	625
Peak US decline rate	6.85%



Parameter	Setting
Initial year global CO2 growth rate	1.50%
Convergence year (up to 2100)	**2100**
Population cutoff year (up to 2060, due lack of data)	**2020**
Contraction year (up to 2100)	**2100**
Contraction level of CO2 emissions (as % of 1995)	**30%**
Speed of convergence parameters	**4.00**
Quartic(1) or cubic(0)	**1.00**
Start year	1995
Planned total 110-year emissions	**626**
Total 110-year emissions (Bill)	626
Peak US decline rate	4.08%



An interesting variant of the GCI Scheme has been adopted by Globe International based in Brussels.



GLOBE's Principles

1. No Annex X country target, at whatever level, can or will succeed in terms of "saving the planet" unless it forms part of a comprehensive, global agreement involving All Rio signatories which should formally and legally be constituted as an MEA.
2. Such an MEA must establish a global framework for tackling global climate change over a timeframe lasting at least for the duration of the 21st. century.
3. The heart of that framework must be an absolute maximum limit on global GHG concentrations set at a level, to quote the EU Council (June 1996) "lower than 550ppm CO2", which shall be binding jointly and severally on all Rio signatories.
4. That, for the purposes of meeting that commitment and enforcing the limit, contracting parties' legal right to emit GHG under the MEA shall be defined according to the following classifications:

   Green Box emissions: these are emissions that each country shall automatically have the right to emit under the MEA for its duration, allocated on the basis of the following general principles: initial Green Box allocations shall be based on actual emissions in 2000, subject to any agreed Kyoto disciplines or reduction commitments; these initial allocations shall be progressively re-allocated in accordance with an agreed "glide path" such that, by a designated target year (e.g. 2045), each country has an "emissions standstill" allocation determined in accordance with an identical right to emit (e.g. a per capita entitlement); that, following the designated target year, each country shall be subjected to an identical "roll-back" commitment the end result of which is for the global Green Box entitlement to 350ppm CO2. Green Box entitlements shall be tradable between nations, by common consent, but subject to conditions that shall not be less stringent than those applicable to the Blue Box.

   Blue Box emissions: for a transitional period to be agreed (but in any event not longer than the duration of the period to achieve the Green Box 350ppm objective), a global reserve shall be established from which either countries or corporate entities shall be able to "purchase" emission rights additional to those allocated under the Green Box at an established price and according to certain agreed conditions based on the principle of graduation to ensure adequate "differentiation" for developing countries. In certain strictly defined circumstances, Blue Box allocations may be made on more favourable terms to Annex X countries where these can demonstrate GHG abatement achievements that have been defined as "credits" towards Blue Box allocations. All the funds raised by Blue Box allocations shall be devoted to designated GHG abatement activities in non-Annex X countries.

   Red Box emissions: all GHG emissions in excess of those permitted by the Green Box and not verifiably allocated under the Blue Box shall be prohibited and subject to penalties to be established and enforced under the MEA.
5. 5.That the MEA should establish a "Panel" (which may consist of all parties or a sub-group of them) to make Blue Box allocations and to adjudicate on Red Box disputes (and to impose binding penalties) for which the decision-making procedure shall be directly linked to the Green Box entitlements in force (e.g. voting rights re-allocated every ten years concomitant with Green Box "quotas").