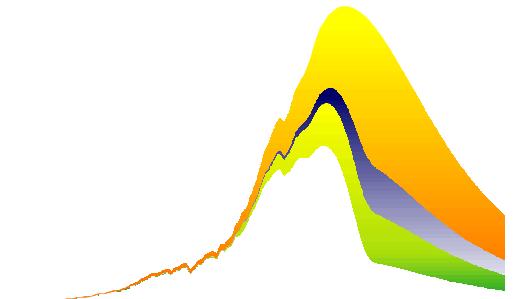


“*Contraction & Convergence*”

(C&C)

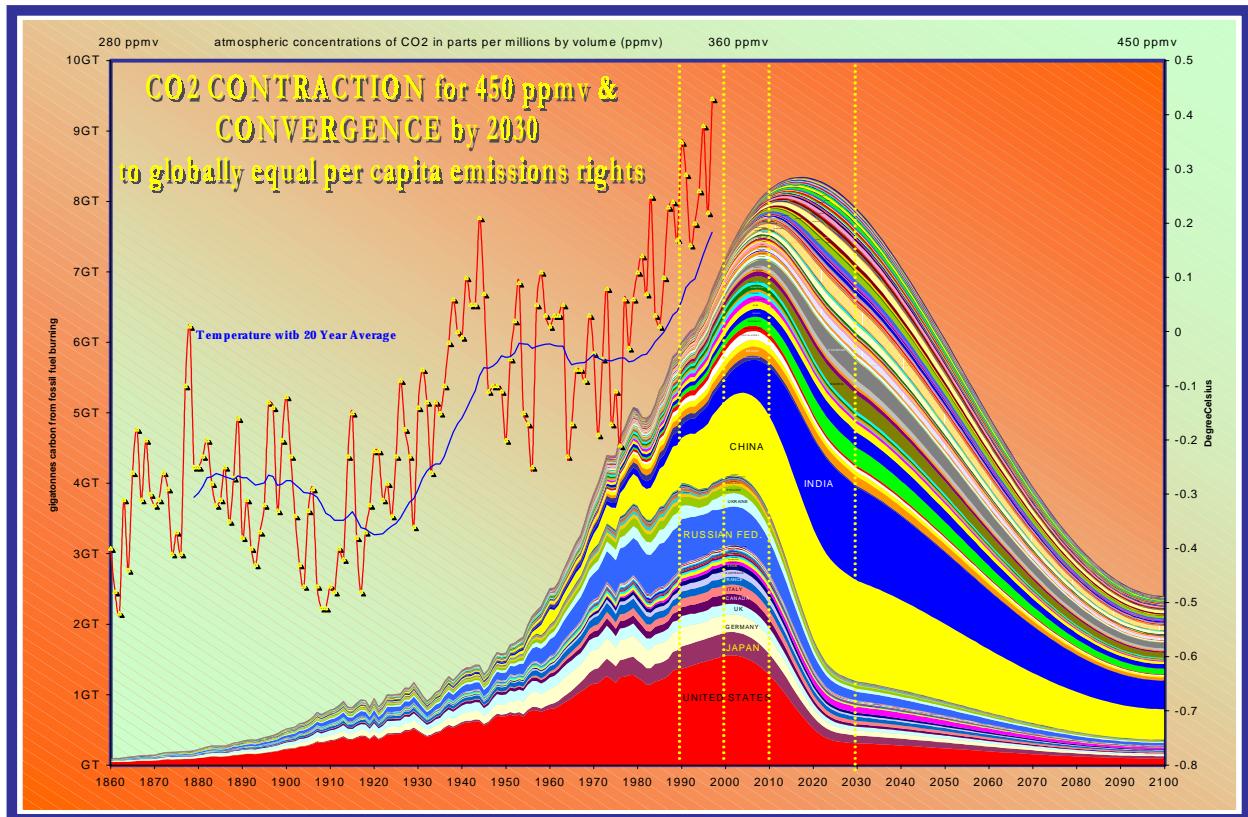
**A GCI Policy Briefing
on Climate Change to the
Performance Innovation Unit
for the UK Government
Climate Energy Review**



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'Contraction and Convergence' is an International Framework for UK and Global Energy Policy and avoiding dangerous climate change



ORIENTATION

The Performance Innovation Unit's announcement of a review of UK energy policy observed that: -

"The project's outputs will be a key input to the UK Government's future policy on security and diversity of energy supply and on climate change including its response to the Royal Commission on Environmental Pollution (RCEP) report on 'Energy – the Changing Climate'."

In chapter four of the RCEP report - *"The Need for an International Agreement"* – a key recommendation was for the adoption of *"Contraction and Convergence"* (C&C): -

"The government should press for a future global climate agreement based on the contraction and convergence approach, combined with international trading in emission permits. Together, these offer the best long-term prospect of securing equity, economy and international consensus."

In this document, GCI re-iterates this RCEP recommendation to the PIU and the UK government. As an indication of the weight the RCEP gives to this advice, it is made third in a list of a total of 87 recommendations.

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RESPONSE TO PIU PROJECT SCOPING NOTE

Significant Links

1. This paper by the Global Commons Institute (GCI) is a response to the UK Government's Performance Innovation Unit (PIU) review of energy policy and avoiding dangerous global climate change announced in June 2001.

2. The PIU's announcement of the review observed that: -

"The project's outputs will be a key input to the UK Government's future policy on security and diversity of energy supply and on climate change including its response to the Royal Commission on Environmental Pollution (RCEP) report on 'Energy – the Changing Climate'."

3. The approach GCI puts forward here is to re-state our advocacy of "*Contraction and Convergence*" (C&C) as the most logical way to organise the international effort to avoid dangerous climate change.
4. The C&C approach has evolved over ten years whilst working within international institutions: - especially the Intergovernmental Panel on Climate Change (IPCC) climate science and policy groups, the United Nations Framework Convention on Climate Change (UNFCCC) and various other organisations such as the Royal Commission on Environmental Pollution (RCEP).
5. GCI first formally presented C&C at the 2nd Conference of the Parties to the UNFCCC in Geneva in June 1996. Since then awareness and reference to the model has grown significantly throughout the world.
6. After thorough, prolonged debate, IPCC's 3rd Assessment published this year that the: -
"... formulation that carries the rights-based approach to its logical conclusion is that of Contraction and Convergence" (C&C)."
7. After specific interaction with GCI, the RCEP published in June 2000 the report to which the PIU now responds, namely "*Energy – the Changing Climate*" which advised the UK government to: -
"... press for a future global climate agreement based on the Contraction and Convergence approach, combined with international trading in emission permits. Together, these offer the best long-term prospect of securing equity, economy and international consensus."

Summary

1. Through their effect on the global atmosphere, historic patterns and future projections of global and UK energy consumption are increasing the trends towards catastrophic damages from global climatic change. No credible uncertainty remains as to whether these trends have actually now been established. Remaining uncertainty about these trends is now only to do with how much damage, how soon and to whom.
2. Achieving security and prosperity for all is therefore now inseparable from the overarching need for concerted global effort to arrest these trends with precautionary, risk-averse actions within a framework of goal-specific international policy co-ordination.
3. Achieving this framework will not result '*deus ex machina*' from the increasing uncertainties of economic globalisation. Thus far, this globalisation is largely comprised of the random growth and aggregation of economic activity; - in a word 'guesswork'.

4. Achieving a global framework to harness this guesswork in the pursuit and indeed the process of ‘sustainable development’, is now the key challenge. It requires us to realise the development of the existing international framework for coping with climate change, represented by the UNFCCC, in terms of a precautionary and inclusive, global rights-based agreement – a constitution - that balances the pursuit of prosperity and security in a durable yet flexible way for generations to come.
5. This issue is inseparable from ‘rights’ and - as the IPCC implies - the logic of situation we are all in leads inexorably to the framework of “*Contraction and Convergence*”.

The Growing Sense of Urgency¹

The research compiled by IPCC in their 3rd Assessment indicates the future risks of damages rising out of control are grave and will compound with the underlying trends in unsustainable development. That is why: -

- In December 1999, the heads of the US National Ocean Atmosphere Administration and the UK Meteorological Office stated, "*We are in a critical situation and must act soon.*"²
- In January 2000, one thousand Corporate CEOs at the Davos World Economic Forum said, "*Averting climate change is the greatest challenge facing the world,*" asking, "*why has more not been done to avert its devastating trends?*"
- In October 2000, the UK Prime Minister said, "*... we have to face a stark fact; neither we here in Britain, nor our partners abroad, have succeeded in reversing the overall destructive trend. The environmental challenge continues to grow and become more urgent. There are alarming changes in our atmosphere, in global temperatures, in weather patterns, in sea levels and in the protective ozone layer. As a result, across the world millions face drought, flooding, disease.*"³
- In the same month the UK Chartered Institute of Insurers (CII) published a research report which said, "*the current rate of increase in damage from natural hazards is 12% pa and the rate is accelerating. Given that the global sum of such losses was \$100bn in 1999 (Munich Re, 2000), it would outstrip global GDP (growing at 3% pa) by 2065, if the trends persist.*"^{4 5}
- In March 2001, the UK Prime Minister said, "*The process is accelerating. For some parts of the world, particularly the poorer parts, the effects will be catastrophic.*"⁶

Comment on stated Scope of PIU Project

1. The PIU documents project planning for fifty years. This may appear to be long-term but, given the persistent and pervasive properties of global climate change, it is only part-term when what is required is full-term. The UK and the international community cannot meaningfully plan how to respond to climate change unless the scope is both full-term and global. In the fifty years of climate change projected in the PIU figures, Britain and the world will have become more deeply entrenched in the trends of rising atmospheric greenhouse gas concentration, temperature and damages from climate change than we are at present, with these trends potentially casting a shadow over hundreds of years.⁷

¹ See Appendix One for overview of trends and generic scenario typology

² The Independent 24/12/99

³ Tony Blair's speech to the CBI/Green Alliance 24th October 2000

⁴ CII Research Report March 2000

⁵ See Appendix One overview of trends chart three of five-stack page 13

⁶ Tony Blair's Green speech 6th March 2001

⁷ See Appendix One

2. Moreover, while the PIU correctly stresses that climate change is a global challenge to which global solutions are required, no vision is yet presented by the PIU as to what international arrangements are necessary to ensure that the changes they are tasked with arguing nationally, are meaningful in terms of successful full term global climate protection. In other words it is necessary to realise and deal with the fact that whatever success UK-based solutions may achieve at home, in the absence of global agreement they will increasingly be overwhelmed by failure in the wider systems.
3. The necessary vision for success arises from acceptance that securing the objective of the United Nations Framework Convention on Climate Change (UNFCCC) is sine-qua-non to a sustainable future development process nationally and internationally. This in turn requires a framing a solution that provides to the rapid and orderly international retreat from fossil fuel dependency.
4. At present PIU's project documentation states; -
 - “ . . . the project’s conclusions will be a key input to the Government’s . . . response to the RCEP report on Energy;
 - CO₂ emissions pose a global challenge . . . likely to rise by between 1-3% per annum globally to 2050 . . . with CO₂ emissions from UK energy consumption likely to rise by between 0.01-0.3% per annum to 2050 . . . deep cuts in greenhouse gas emissions - of the order of 60-80% worldwide - will be needed over the coming decades if the risks of global warming and associated severe impacts are to be avoided;
 - the challenge this poses for the UK is recognised by the UKCIP;
 - the RCEP says this translates into a 60% reduction in UK emissions by 2050;
 - but this needs to be put in a global context where the UK accounts for about 2% of global climate change emissions;
 - it will look at energy policy for Great Britain to 2050 with the main aim of setting out the objectives of energy policy developing a strategy that ensures current policy commitments are consistent with longer-term goals;
 - that while the challenges are explored in a UK context, they are global challenges to which global solutions will be required.”
5. However, the figures quoted by the PIU result from two key challenges taken by the RCEP, namely what should the: -
 - global rate of emissions contraction be consistent with a safe level of CO₂ equivalent atmospheric concentration?
 - international rate of emissions permits convergence to equal per capita entitlements globally be that is consistent with a logical and realistic pre-distribution of the tradable equity created using the principles of C&C?
6. In other words, the figures used by the RCEP follow directly from the application of C&C as an organising principle for dealing with climate change
7. The relevant reasoning in the RCEP Report reads as follows: -
 - “4.47 . . . our view is that an effective, enduring and equitable climate protocol will eventually require emission quotas to be allocated to nations on a simple and equal per capita basis.
 - 4.48 A system of per capita quotas could not be expected to enter into force immediately. At the same time as entitling developing nations to use substantially more fossil fuels than at present (which they might not be able to afford), it would require developed nations to make drastic and immediate cuts in their use of fossil fuels, causing serious damage to their economies.

- 4.49 . . . Over the coming decades each nation's allocation would gradually shift from its current level of emissions towards a level set on a uniform per capita basis. By this means 'grandfather rights' would gradually be removed: the quotas of developed nations would fall, year by year, while those of the poorest developing nations would rise, until all nations had an entitlement to emit an equal quantity of greenhouse gases per head (convergence). From then on, the quotas of all nations would decline together at the same rate (contraction). The combined global total of emissions would follow a profile through the 21st and 22nd centuries which kept the atmospheric concentration of greenhouse gases below a specified limit.
- 4.50 The upper limit on the concentration of greenhouse gases would be determined by international negotiations, as would the date by which all nations would converge on a uniform per capita basis for their emission quotas, and the inter-mediate steps towards that. It would probably also be necessary to set a cut-off date for national populations: beyond that date, further changes in the size of a country's population would not lead to any increase or decrease in its emission quota.
- 4.51 In table 4.1 17 we have applied the contraction and convergence approach to carbon dioxide emissions, and calculated what the UK's emissions quotas would be in 2050 and 2100 for four alternative upper limits on atmospheric concentration. We have assumed for this purpose that 2050 would be both the date by which nations would converge on a uniform per capita emissions figure and the cut-off date for national populations.¹⁸ If 550 ppmv is selected as the upper limit, UK carbon dioxide emissions would have to be reduced by almost 60% from their current level by mid-century, and by almost 80% by 2100. Even stabilisation at a very high level of 1,000 ppmv would require the UK to cut emissions by some 40% by 2050.
- 4.52 The UK-based Global Commons Institute has taken the lead in promoting contraction and convergence, and has developed a computer model which specifies emission allocations under a range of scenarios. The concept has been supported by several national governments and legislators. Some developed nations are very wary of it because it implies drastic reductions in their emissions, but at least one minister in a European government has supported it.²⁰ Commentators on climate diplomacy have identified contraction and convergence as a leading contender among the various proposals for allocating emission quotas to nations in the long term.²¹
- 4.53 The other ingredient that would make an agreement based on per capita allocations of quotas more feasible is flexibility of the kind already provided in outline in the Kyoto Protocol. Nations most anxious to emit greenhouse gases in excess of their allocation over a given period will be able and willing to purchase unused quota at prices that incline other countries to emit less than their quota, to the benefit of both parties. The clean development mechanism, which allows developed nations to claim emission reductions by sponsoring projects that reduce emissions in developing nations to levels lower than they would otherwise have been, can also be seen as a form of trading.
- 4.54 In the longer term trading by companies in emission permits, drawn from national emission quotas determined on the basis of a contraction and convergence agreement, could make a valuable contribution to reducing the global costs of stabilising greenhouse gas concentrations while transferring resources from wealthy nations to poorer ones. Trading needs to be transparent, monitored and regulated, and backed by penalties on nations which emit more than they are entitled to. If it became merely a means of enabling wealthy nations to buy up the emission entitlements of poor countries on the cheap, thereby evading taking any action at

home, trading would not serve the cause of climate protection. Nor would it if developing countries which had sold quota heavily went on to emit in excess of their revised entitlements.”

8. The PIU document fails to reveal this reasoning that led to the figures they are quoting. The RCEP explicitly do reveal the reasoning and the calculus that led to these figures.
9. If this omission persists in the PIU’s analysis and output, the figures become misleading and the PIU exercise becomes potentially meaningless or even dangerous.
10. GCI, the RCEP and an increasing number of other agencies, argue that securing a global framework C&C agreement is the only credible and logical way to organise for the achievement of the objective of the UNFCCC along with the aspirations of sustainable development. This framework will enable us to integrate key global, national and local considerations. Similar to those identified in the PIU documentation which are to:-
 - co-operatively set - if competitively meet - the long term targets for the global emissions reductions that are necessary to stabilise rising concentrations of atmospheric CO₂ equivalent, global temperature and damages;
 - resolve or at least reduce the worsening conflicts between local and global perspectives, short, long and full-term considerations and debates arising that attempt to trade-off competitively monetised autarchy with social stability and the imperatives of environmental security objectives;
 - attempt future security and diversity of energy supplies over the long term through the full-term demand-management of the retreat from fossil fuels alongside supply-side measures that encourage the development of renewable technologies, new infrastructure and stable international pricing conditions energy and fuel markets;
 - encourage appropriate international investment and incentives to be able to cope with the supply shocks, including those consequent on incipient oil and gas depletion;
 - resolve or reduce conflicts where the higher energy prices might help to advance environmental objectives will aggravate fuel poverty and potentially reduce competitiveness in production.
11. The PIU indicates that its report will be presented to the Prime Minister by the end of the year. Mr Blair has indicated that he is committed to going to Rio + 10 next year to provide leadership on (*inter alia*) international climate change policy.
12. Citing the RCEP, Mr Blair has already publicly quoted the unqualified figure of 60% reductions in the UK by 2050, worded so as to imply that the RCEP have advised that this will slow the rate of climate change.⁸
13. However, the RCEP advised the UK government to seek an international “*Contraction and Convergence*” agreement saying that - *in this global C&C context* - the slowing of the causation of climate change might occur.
14. In order not to misrepresent the RCEP, engender misunderstandings and make potentially fruitless attempts to evolve international efforts to avoid dangerous climate change, it is essential this C&C context is argued in the report presented by PIU to Mr Blair, just as it has been done by GCI, in the RCEP report itself and in numerous other reports and fora.
15. To re-iterate: - a C&C agreement has become sine-quo-non to avoiding dangerous climate change and the achievement of sustainable development both locally and globally.

⁸ Tony Blair’s speech to the CBI/Green Alliance 24th October 2000

Essential Proposition of “Contraction and Convergence” (C&C) by GCI

Countries agree a reviewable global greenhouse gas (ghg) emissions 'contraction budget' targeted at an agreed precautionary, stabilised future value for atmospheric ghg concentrations.

The internationally tradable shares in this budget are then agreed on the basis of 'convergence' from now, where shares are broadly proportional to income, to a target date in the budget timeline after which they remain proportional to an agreed base year of global population.

Revenue from this trade could and would best be directed to the development and deployment of zero emissions energy techniques and technologies.

The organizational sequence works as follows: -

Contraction - On the basis of precaution, all governments collectively agree to be bound by such an atmospheric target. This makes it possible to calculate the diminishing amount of greenhouse gases that the world can release for each year in the coming century. Subject to annual review, this total carbon emissions 'budget' is the aspect of the process described as 'contraction' .

Convergence - On the basis of equity and logic, 'convergence' means that each year's ration of this global emissions budget is shared out so that every country progressively converges on the same allocation per inhabitant by an agreed date, for example by 2030.

It recognises access rights to the 'global commons' of the atmosphere on the fundamental principle of globally equal rights per capita, to be achieved by smooth transition.

It also recognises there has been an argument that suggests C&C creates an incentive for population growth. Consequently the model provides a mechanism whereby this argument is answered through setting a base year for population figures in any year of the negotiators choosing.

To show that the principles of C&C pre-exist the rates of their application, three examples of contraction and convergence budgets are shown alongside: -

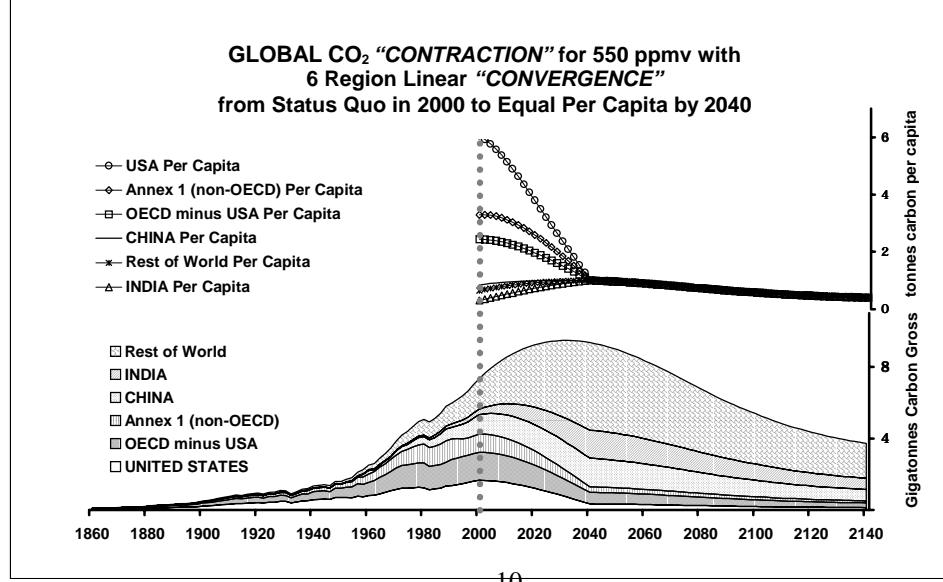
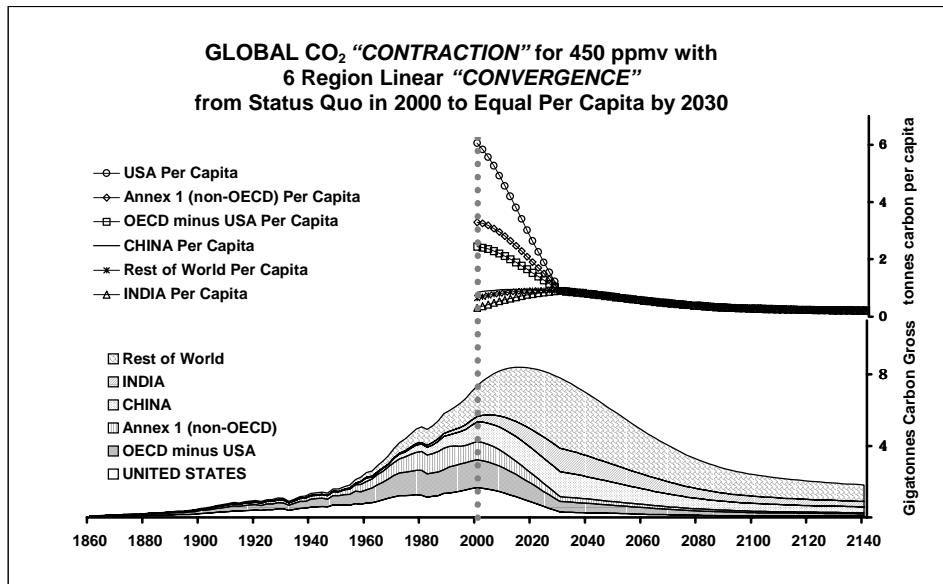
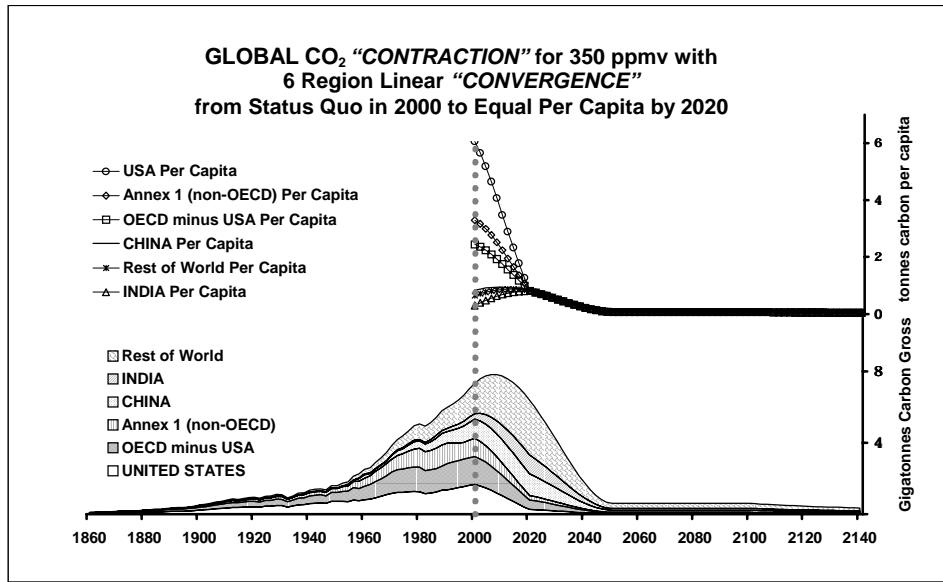
1. the first is the most climate risk-averse and achieves a 90% emissions globally by 2050 in order to stabilise atmospheric CO₂ concentrations back at 350 parts per million by volume (ppmv) by 2100.
2. the second carries higher risks and achieves a 60% emissions globally by 2100 in order to stabilise atmospheric CO₂ concentrations at 450 parts per million by volume (ppmv) by 2100. Potential additional positive feedback.⁹
3. the third carries yet higher risks achieves a 60% emissions globally by 2140 in order to stabilise atmospheric CO₂ concentrations at 550 parts per million by volume (ppmv) by 2150. Potential additional positive feedback.¹⁰

Emissions Permit Trading - Countries unable to manage within their shares would, subject to agreed rules, be able to buy the unused parts of the allocations of other countries. Sales of unused allocations would give less developed countries the income to fund development in zero-emission ways. Industries in developed countries would benefit from the export markets this restructuring would create.

Sustainable Growth - C&C does not place a straightjacket on growth per se by its limitation on fossil fuels. Instead, it averts catastrophic losses by promoting the development and growth of zero carbon energy technologies necessary to achieve prosperity and make development sustainable.

⁹ See Appendix One – The Lags in a 450 ppmv scenario

¹⁰ See Appendix One – The Lags in a 550 ppmv scenario



C&C and the UNFCCC

*" . . . must achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system "¹¹
". . . should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity "¹² . . . the developed country Parties must take the lead in combating climate change "¹³ . . . (while) the share of global emissions originating in developing countries will grow to meet their social and development needs. " "¹⁴*

The Kyoto Protocol is an incomplete response to the UNFCCC because Developing Countries are excluded from the formal regime of emissions control. Nor will the targets selected even begin to achieve atmospheric stabilization of greenhouse gases. A global C&C framework is the most logical and effective way to secure global participation in the process and achieve stabilization of atmospheric greenhouse gas concentration.

C&C and the Kyoto Protocol

As the UNEP CEO Topfer recognised in June 97, C&C the logical extension of the Protocol: -

"The review system of Kyoto mechanisms can ensure equity. Currently CO₂ emissions rights are allocated according to existing emissions patterns with a specified reduction percentage for various countries within a certain period of five years (2008-2012). The redistribution through the Kyoto Protocol could be continued until emissions rights are uniformly distributed on a per capita basis. This will be a critical element to ensure the poor also get rights to utilise the world's environment, or in this limited case, the assimilative capacity of the atmosphere, a global commons resource."

C&C and the US BYRD HAGEL Resolution - June 1997

In July 1997 US Senators Byrd and Hagel tabled a resolution about the US involvement with the Kyoto Protocol. It rehearsed all their objections to what they felt was the 'flawed' character of the Berlin Mandate and the impending Kyoto Protocol.

"Now, therefore, be it resolved that: - The US should not be a signatory to any protocol to, or other agreement regarding, the UNFCCC of 1992, at negotiations in Kyoto in December 1997, or thereafter, which would mandate new commitments to limit or reduce greenhouse gas emissions for the Annex I Parties, unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period."

The crucial detail in the Byrd Hagel Resolution is in that two defining distinctions are maintained between: -

1. Annex One Parties (Developed Country Parties) and Developing Country Parties.
2. 'limit' ghg emissions and 'reduce' ghg emissions. Limitation of ghg emissions is controlled positive growth of ghg emissions and reductions of ghg emissions is controlled negative growth of emissions.

Putting these concepts together in the same compliance period, translates into a formal process of "*Contraction and Convergence*". Annex One Parties will reduce (or contract) their ghg emissions while the Developing Country Parties will limit their ghg emissions (so as to converge with Annex One Country Parties). This will not emerge by accident. It can only emerge by design and consent. For authors and supporters of the resolution, "*Contraction and Convergence*" provides the logical answer.

¹¹ UNFCCC Article 2

¹² UNFCCC Article 3.1

¹³ UNFCCC Article 3.1

¹⁴ UNFCCC Article 3.3

A View of the Benefits of C&C from the Financial Sector

The principle aim of the UNEP Financial Institutions movement has been to support sustainable development. This is fully compatible with members' commercial objectives, because the demand for financial services thrives in a sound and foreseeable economic environment, which is what sustainable development provides.

Climate change poses a sustainability challenge to financial institutions (FI's) in three key ways:

1. It will accelerate the damage to assets and economic output from natural disasters. This will reduce the return on assets, and reduce the insurability of many activities.
2. It will create an economic risk for carbon-heavy assets, since mitigating climate change will mean significant curbs on future greenhouse gas emissions.
3. It will provide opportunities to invest in the solutions that will be adopted to channel economic activity towards a carbon-light economy e.g. emissions permit-trading, CDM, AIJ, and more generally, the expansion of technologies in renewable energy and energy efficiency.

Economic damage from natural disasters is rising sharply, and already poses a threat to development in poorer countries, according to the World Bank. The Third Assessment Report of IPCC noted that climate change has only just begun to contribute to this trend, and can be expected to aggravate the trend. This means that even the limited involvement of the insurance industry (currently only about 20% of losses are covered) is likely to diminish, placing a heavy burden on other stakeholders.

Regarding investment in energy-intensive sectors, the risks and rewards are hard to quantify because of the lack of political progress on full-term objectives. Without reliable information about the future value (or liability) of such assets, it is not possible to calculate rates of return. This uncertainty is harmful to financial involvement in these areas.

Business needs a coherent full-term global agreement that provides a framework for economic operations within a context that is sustainable in social and ecological terms. Such a framework will also help to release the pressure from natural catastrophes. Contraction and Convergence is the logical, and indeed the only, well-framed proposal that fills this vacuum.

The present political debate is focused on the details of "Kyoto". This is useful but is ignoring the need for a full-term answer to the problem. And, given the difficulties encountered with the Kyoto Protocol, it would be better to start as soon as possible on framing the full-term approach. A fresh impetus is needed to move on. Given the decadal scale of business planning, and the high stakes involved, the UNEP FI initiative has a legitimate interest in finding a solution.

Consequently, on July 19th 2001, the UNEP FI held a public meeting and a press conference at the United Nations climate negotiations in Bonn. Their message was to promote '*sustainability*' by trying to implement the '*small step of Kyoto*' along with climate friendly '*policies and measures at national level*' and '*the need to establish a long-term framework such as "Contraction and Convergence" (C&C)*'.

They said this is so '*because we do all need to know where we are going*' and that '*C&C is such a framework as it is consistent with the principles of the UNFCCC*' and quite '*possibly the framework to take the whole process forward*'.

APPENDIX ONE - SCENARIOS

Overview of climate trends with and without C&C

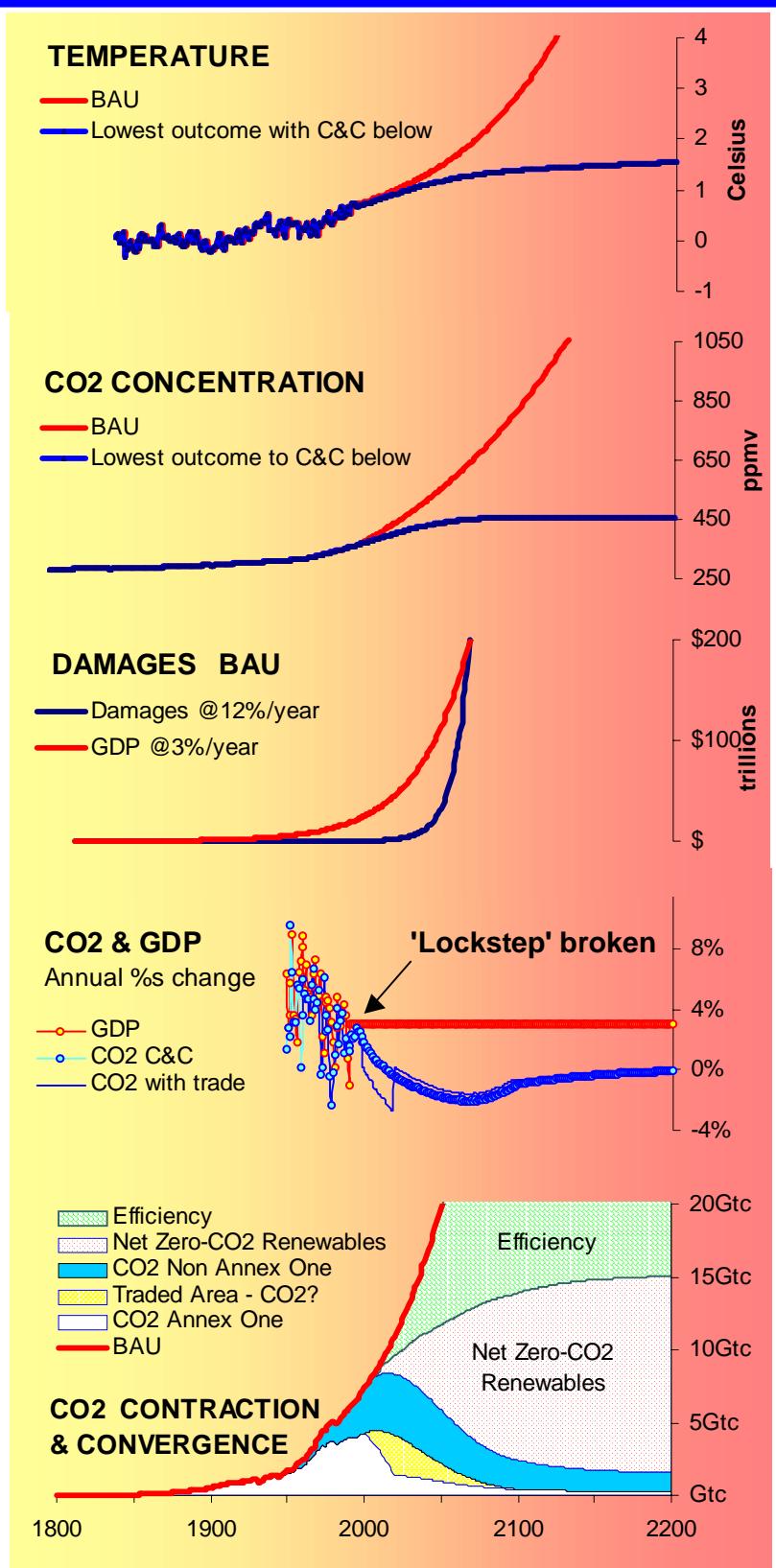
Surface temperature from 1860 until 2000 shows an overall rise of 0.9°C. The future projections are following CO₂ emissions and atmospheric ghg concentrations (in ppmv - parts per million by volume). The red line shows Business-as-Usual (BAU) where the underlying emissions grow at 2%/yr. The blue line shows the lowest possible climate sensitivity - a rise of 1.5°C - assuming a contraction by 2100 of 60% in annual emissions.

Recorded atmospheric CO₂ concentration from 1860 until 2000 shows an increase of 34% over pre-industrial levels. This is a rise both higher and a faster than anywhere in the ice-core sampling back 440,000 years before now. Concentrations are rising as the result of accumulating emissions. In future, the worst case is the red line as BAU. The best case sees this concentration stabilised at 70% above pre-industrial levels due to a 60% contraction in the underlying emissions by 2100.

Damages here are the global economic losses (Munich Re) for the four decades past for all natural disasters projected at the observed rate of increase of 12% a year in comparison to global \$GDP at 3%. If the global trends continue BAU, damages will exceed GDP by 2065! The risks will soon rise beyond the capacity of the insurance industry and even governments to absorb. Damages will rise for the century ahead even with emissions contraction, but the rate can be reduced with Contraction, Convergence, Allocation and Trading (C-CAT).

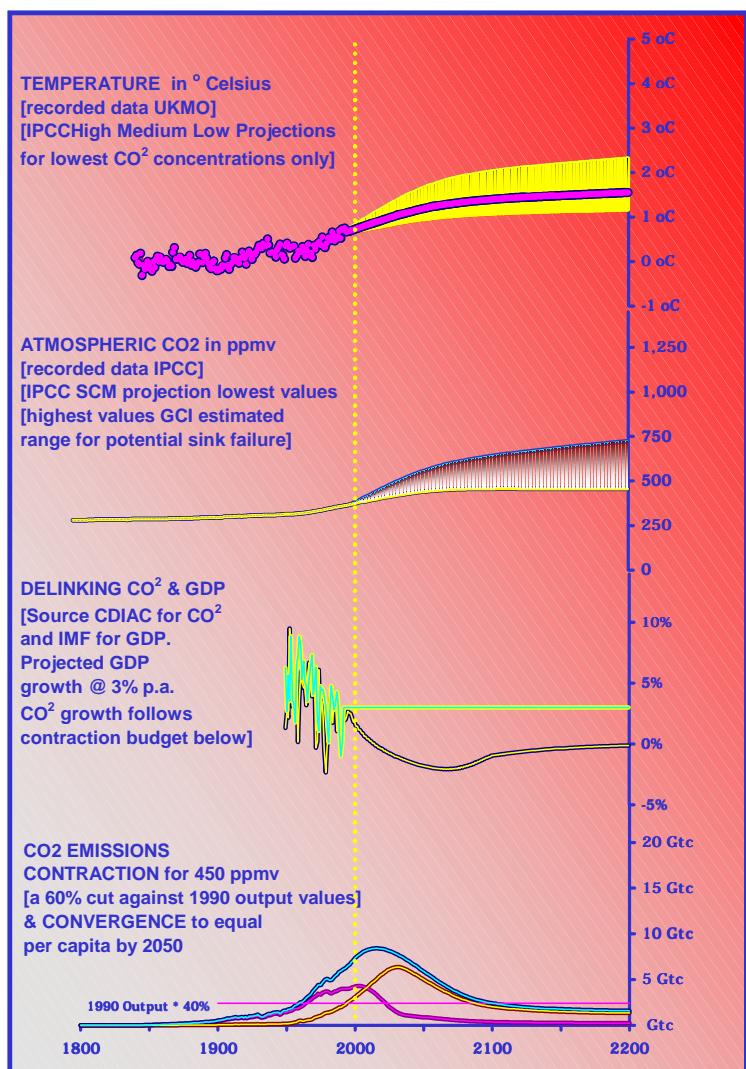
For the past four decades, the output of CO₂ and GDP from global industry have been correlated nearly 100% (known as 'lockstep'). Breaking the lockstep is essential. Future GDP is projected here at 3% a year. Future CO₂ goes to -2% with the retreat from fossil fuel dependency shown below, that limits CO₂ concentrations to 70% above pre-industrial levels, shown above. If the traded area is also converted to zero-emissions supply (below), the carbon retreat might achieve up to - 4% a year.

The red line shows BAU CO₂ emissions. The solid segments show "Contraction, Convergence, Allocation and Trade" [C-CAT] to manage emissions down by at least 60% within a given time frame (2100 here) with an agreed 'contraction budget' (here 680 billion tonnes of carbon). The internationally tradable shares of this budget (here, 100 billion tonnes) result from convergence to equal per capital emissions by an agreed date and population base year (here 2020). If this is invested in zero-emissions technologies, risk and damages are lowered further as the budget is then net of these emissions as well. The renewables opportunity is the difference between C-CAT and BAU. It is worth trillions of dollars per annum - the biggest market in history.



The 'Lags' in a 450 ppmv CO₂ Scenario

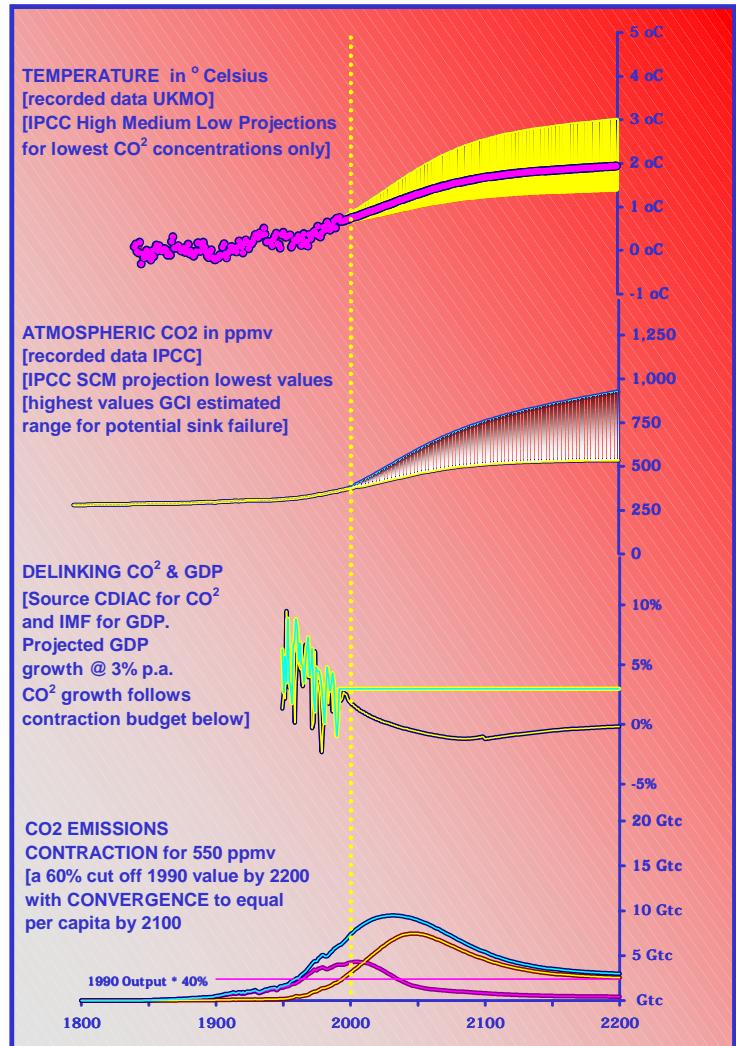
The following graphics make clear the lagged sequential structure of events that are triggered by release of CO₂ emissions from human sources. Only CO₂ is used to portray the case made, as it is only for these emissions that reasonably complete global datasets exist. Human CO₂ emissions, 80% of which come from fossil fuel burning, represent over 70% of the net anthropogenic forcing of global mean temperature. So assuming no sudden surprises, the temperature values recorded are about 30% less than they will be when all the equivalent effect of the other gases such as methane are included. The observed events of the past two hundred years are shown as well on the left-hand half of these graphics. The sequence of recorded events showing the relationship between rising emissions and rising atmospheric concentrations is beyond dispute. UKMO, NOAA and the IPCC accept the functional link via rising concentrations, between rising ghg emissions and rising global mean temperature.



The period 2000 to 2100 shows a 450 ppmv "Contraction" budget for human CO₂ emissions. Annual CO₂ emissions are reduced to 40% of 1990 value by 2100 and remain so until 2200. Here "convergence" between Annex One and Non-Annex One is set to reach globally equal per capita emissions entitlements by 2050. Contraction is pro rata from then onwards. In 1800 atmospheric concentrations of CO₂ were 280 ppmv. By 1998 they reached 263 ppmv. During the emissions contraction, concentrations continue to rise slowing to 450 ppmv by 2100. This assumes the sinks function as before, re-absorbing roughly half of each year's human emissions. If sinks were to fail, concentrations could rise higher on the path shown with an upper limit reaching 750 ppmv by 2200. The temperature curves shown here are linked only to CO₂ and its lowest concentration path. Temperature is set at 0.0° C in 1800 and 0.7° C up in 1998. The range continues rising by between 1 and 2.4° C as late as 2200 (best guess at 1.5°). Rising sea level at 3 to 10 cm per decade is not shown and continues beyond the stabilisation of temperature.

The 'Lags' in a 550 ppmv Scenario

Here, from 2000 to 2100 a 550 ppmv "Contraction" budget for human CO₂ emissions is shown. Annual CO₂ emissions are reduced to 40% of 1990 value by 2200. "Convergence" between Annex One and Non-Annex One is set to reach globally equal per capita emissions entitlements by 2100. Contraction is pro rata from then onwards. During the global contraction of emissions, concentrations continue to rise slowing to 550 ppmv by around 2150. This assumes the sinks function as before, re-absorbing roughly half of each year's human emissions. If sinks were to fail, concentrations could rise higher on the path shown with an uppermost path reaching 950 ppmv by 2200 and rising. Again, the temperature curves shown are linked only to CO₂ and its lowest concentration path. Temperature is 0.0° C in 1800 and 0.7° C up in 1998. The range continues rising by between 1.5 and 3° C as late as 2200 (best guess at 2°). Rising sea level as before is not shown but continues at between 3 and 10 cm per decade and goes beyond the point of stabilisation of temperature.



In the 450 ppmv case the annual rate of contraction reaches over 2% per annum. In the 550 ppmv case the annual rate of contraction reaches just over 1% per annum. GDP in both cases is assumed to grow constantly at an average of 3% per annum. But when we compare the extent of delinking of CO₂ emissions and GDP between the 450 budget and the 550 budget, the general rate of de-linkage (or gain in terms of \$s per tonne carbon) is between 4 to 5% per annum. This is unprecedented. Yet in any scenario set on stabilising atmospheric concentrations, this is the scale of achievement required. So short of just trying to adapt to climate change, these efficiency gains have to be made. Moreover, because the higher ppmv scenarios incur more damages from climate, more of GDP will have to be diverted into damage compensation with less for avoiding emissions and de-carbonization strategies. Since we have to execute the solution at a rate that exceeds that at which we create the problem, soonest is best as the higher the concentration path the worse the odds of doing this become.

APPENDIX TWO – GUESSWORK FRAMEWORK

"CARBON BUDGET" SCENARIOS COMPARED

This section compares three ways of looking at the evolution of future global budget of CO₂ emissions from fossil fuel burning.

FRAMEWORK - The Precautionary Principle (PP) budget (GeoPolity)

This budget assumes the need for early need for a formal constitution of "*Contraction and Convergence*". In principle the UNFCCC is the United Nations Framework Constitutions for "*Contraction and Convergence*".

It is consistent with the 'Geopolity' model argued by Shell International in their Report of the World Business Council on Sustainable Development (WBCSD).

GUESSWORK - The Efficiency Gains Only (EGO) budget (JAZZ)

This budget assumes the complete absence of a political framework and the need for controls. It is consistent with the deregulated 'JAZZ' position espoused in the WBCSD report.

FRAMEWORK DELAYED - The Wigley, Richels and Edmonds (WRE) budget

This budget assumes the delay in instituting a framework can be made up for later. It was a fudge dreamed up by one climate scientist and two economists who asserted it within the IPCC. The 'scientific' argument is that as long as a given integral of future carbon emissions remains constant, the rate of emissions can be varied with no effect on the ultimate concentration outcome. The 'economic' argument is that it buys time. The truth is that it just subtracts benefits from developing countries and future generations whilst increasing risks in the name of guesswork.

Since the Kyoto Protocol is caught between framework and guesswork, its positioning is 'framework-delayed' with the danger of decaying to pure guesswork.

The levels of atmospheric CO₂ concentrations, temperature rises and dollar per tonne carbon efficiency gains associated with each budget concept are shown as well (colour-coded).

The primary policy level of choice examined here is that between the need for framework and the rejection of framework in favour of guesswork; - in other words between the PP or WRE concepts on the one hand, and the EGO concept on the other. The international debate has already reached this stage and there is a growing acceptance that the framework will be necessary.

This means that the next choice is between introducing it sooner rather than later, in other words between the PP concept and the WRE concept. The IPCC states that the key determinant for the stabilisation level of concentrations is not so much the emissions trajectory but the total amount emitted between now and the time of concentration stabilisation. If so, we appear to have some flexibility over the timing of reductions.

However, the WRE curves were produced in the belief that it is better to wait for technological improvements to make reductions more cost efficient before embarking on them. It uses a capped emissions trajectory to deliver a given concentration level but keeps the trajectory on a business-as-usual (BAU) path for as long as possible before making sharp reductions since technology should have improved considerably by then, making the necessary reductions cheaper.

The flaw in this argument is that this trajectory will require more rapid reductions and hence much greater economic efficiency gains once we depart from BAU. Assuming a steady annual growth of the economy at 3%, economic efficiency gains measured in CO₂ emissions per unit of GDP would have to improve by up to 7% per annum. Even if this is feasible, the implementation costs will probably outweigh the cheaper technology. Furthermore, capital investments made along the BAU path early on may have to be made redundant before the end of their normal life span. Both sets of curves have a similar emissions trajectory, but the precautionary approach tries to limit the maximum rate of emissions reductions by imposing an early departure from BAU. This reduces the risk of not being able to meet the greater reductions without major economic disruption.

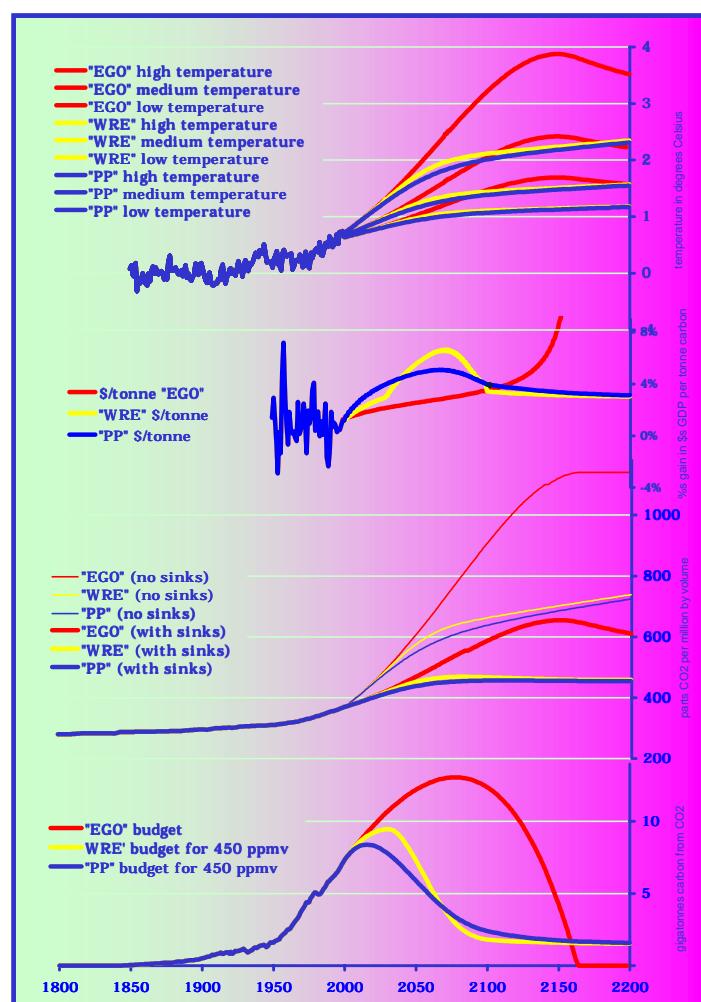
It is widely accepted that even on present technology we can take ‘no regrets’ measures to reduce CO₂ emissions by up to 30%. If this is the case, there is little point in delaying this action and placing a heavier burden on future generations. Furthermore, it seems that technological efficiency gains and low-emission technology is incentive driven. There have to be clear targets for industry to aim for.

If we decide to follow the WRE curves and find that the rapid reductions down the line are not realistic, we will face an ever-growing struggle to control CO₂ concentrations along the EGO path. This scenario also represents the most optimistic position where a zero emissions economy can be achieved driven by economic efficiency gains alone. Whichever way it is interpreted, the EGO scenario represents a gradual improvement in the rate of economic efficiency gains. Due to the limits of thermodynamics, gains would have to be made through completely new technology such as nuclear fusion as well as massive improvements in current renewable energy. If recovery from delayed action proves impossible because the required technological fixes do not emerge, CO₂ concentrations will rise above 650 ppmv with no stabilisation - let alone reduction - in prospect. This is clearly not an option in accordance with the objective of the UNFCCC.

Scientifically, there may appear to be little to distinguish the PP and the WRE control options in terms of their climatic impact. But just the earlier arrival at 450 ppmv and corresponding temperature rise may take us to thresholds of instability the retreat from which is then dependent on crash control programmes for reduction which will be more costly than the earlier and milder controls of PP.

The PP approach is also more sensible than the WRE and the EGO approach because it initiates best use of present options. It reduces the risks of large-scale unpleasant surprises down-stream and with “*Contraction and Convergence*” in place, encourages compliance because it is both more intra and inter-generationally equitable.

Following this reasoning, pursuit of the EGO approach either by default or design is the least prudent option possible.



'EGO-deception' with the 'good news' of 'efficiency-gains only'

BP- Amoco says that the six and a half billions of tonnes of fossil fuel burnt in 1998 was half a percent less than the year before. The World Watch Institute says that this is uniquely good news. For the first time ever, we are 'slowing global warming' but continuing to generate dollars of economic growth while doing so. We are they said, becoming more 'efficient' and shall therefore have cake and eat it after all. As the table alongside suggests, if the measurement described as 'good news' has happened only three times in 48 years of economic growth shown since 1950, the other 46 were a continuous trend of 'bad news'.

The response to this in the serious media (Financial Times, BBC etc) was enthusiastic and credulous. The divorce heralded was between those long-term stable marriage partners, economic growth and fossil fuel consumption with the planet's climate system and atmosphere being cited as third party.

| | TC | GTC | GTC%/s | TC\$/m | GDP | GDP%/s | \$s/TC | \$s/TC%/s | Carbon Fell | GDP grew | Efficiency Grew | Efficiency Grew faster than GDP | Quadruple win | Efficiency versus GDP |
|------|-----|-------|---------|--------|----------------------|---------|---------|-----------|-------------|----------|-----------------|---------------------------------|---------------|-----------------------|
| 1950 | 1.6 | 1.60G | | 239.9 | \$6,669,445,602,334 | 106.25% | \$4,168 | | | | | | | -6.10% |
| 1951 | 1.7 | 1.70G | 106.25% | 245.6 | \$6,921,824,104,235 | 103.78% | \$4,072 | 97.68% | no | yes | no | no | no | -6.03% |
| 1952 | 1.8 | 1.80G | 105.88% | 239.4 | \$7,518,796,992,481 | 108.62% | \$4,177 | 102.59% | no | yes | yes | no | no | 0.00% |
| 1953 | 1.8 | 1.80G | 100.00% | 234 | \$7,692,307,692,308 | 102.31% | \$4,274 | 102.31% | no | yes | yes | no | no | 0.00% |
| 1954 | 1.8 | 1.80G | 100.00% | 228.8 | \$7,867,132,867,133 | 102.27% | \$4,371 | 102.27% | no | yes | yes | no | no | 0.00% |
| 1955 | 2 | 2.00G | 111.11% | 236.7 | \$8,449,514,152,936 | 107.40% | \$4,225 | 96.66% | no | yes | no | no | no | -10.74% |
| 1956 | 2.1 | 2.10G | 105.00% | 241.1 | \$8,710,078,805,475 | 103.08% | \$4,148 | 98.18% | no | yes | no | no | no | -4.91% |
| 1957 | 2.2 | 2.20G | 104.76% | 241.9 | \$9,094,667,217,859 | 104.42% | \$4,134 | 99.67% | no | yes | no | no | no | -4.75% |
| 1958 | 2.3 | 2.30G | 104.55% | 239.8 | \$9,591,326,105,088 | 105.46% | \$4,170 | 100.88% | no | yes | yes | no | no | -4.59% |
| 1959 | 2.4 | 2.40G | 104.35% | 242.8 | \$9,884,678,747,941 | 103.06% | \$4,119 | 98.76% | no | yes | no | no | no | -4.29% |
| 1960 | 2.5 | 2.50G | 104.17% | 241.5 | \$10,351,966,873,706 | 104.73% | \$4,141 | 100.54% | no | yes | yes | no | no | -4.19% |
| 1961 | 2.5 | 2.50G | 100.00% | 234.6 | \$10,656,436,487,639 | 102.94% | \$4,263 | 102.94% | no | yes | yes | no | no | 0.00% |
| 1962 | 2.6 | 2.60G | 104.00% | 233 | \$11,158,798,283,262 | 104.71% | \$4,292 | 100.69% | no | yes | yes | no | no | -4.03% |
| 1963 | 2.8 | 2.80G | 107.69% | 235.5 | \$11,889,596,602,972 | 106.55% | \$4,246 | 98.94% | no | yes | no | no | no | -7.61% |
| 1964 | 2.9 | 2.90G | 103.57% | 231.9 | \$12,505,390,254,420 | 105.18% | \$4,312 | 101.55% | no | yes | yes | no | no | -3.63% |
| 1965 | 3.1 | 3.10G | 106.90% | 230.5 | \$13,449,023,861,171 | 107.55% | \$4,338 | 100.61% | no | yes | yes | no | no | -6.94% |
| 1966 | 3.2 | 3.20G | 103.23% | 229.5 | \$13,943,355,119,826 | 103.68% | \$4,357 | 100.44% | no | yes | yes | no | no | -3.24% |
| 1967 | 3.3 | 3.30G | 103.13% | 228.9 | \$14,416,775,884,666 | 103.40% | \$4,369 | 100.26% | no | yes | yes | no | no | -3.13% |
| 1968 | 3.5 | 3.50G | 106.06% | 227.9 | \$15,357,612,988,153 | 106.53% | \$4,388 | 100.44% | no | yes | yes | no | no | -6.09% |
| 1969 | 3.7 | 3.70G | 105.71% | 229.2 | \$16,143,106,457,243 | 105.11% | \$4,363 | 99.43% | no | yes | no | no | no | -5.68% |
| 1970 | 4 | 4.00G | 108.11% | 234.1 | \$17,086,715,079,026 | 105.85% | \$4,272 | 97.91% | no | yes | no | no | no | -7.94% |
| 1971 | 4.1 | 4.10G | 102.50% | 233.9 | \$17,528,858,486,533 | 102.59% | \$4,275 | 100.09% | no | yes | yes | no | no | -2.50% |
| 1972 | 4.3 | 4.30G | 104.88% | 232 | \$18,534,482,758,621 | 105.74% | \$4,310 | 100.82% | no | yes | yes | no | no | -4.92% |
| 1973 | 4.5 | 4.50G | 104.65% | 229.3 | \$19,624,945,486,263 | 105.88% | \$4,361 | 101.18% | no | yes | yes | no | no | -4.71% |
| 1974 | 4.5 | 4.50G | 100.00% | 224.5 | \$20,044,543,429,844 | 102.14% | \$4,454 | 102.14% | no | yes | yes | no | no | 0.00% |
| 1975 | 4.5 | 4.50G | 100.00% | 220.4 | \$20,417,422,867,514 | 101.86% | \$4,537 | 101.86% | no | yes | yes | no | no | 0.00% |
| 1976 | 4.8 | 4.80G | 106.67% | 222 | \$21,621,621,621,622 | 105.90% | \$4,505 | 99.28% | no | yes | no | no | no | -6.62% |
| 1977 | 4.9 | 4.90G | 102.08% | 218.7 | \$22,405,121,170,553 | 103.62% | \$4,572 | 101.51% | no | yes | yes | no | no | -2.11% |
| 1978 | 5 | 5.00G | 102.04% | 211.8 | \$23,607,176,581,681 | 105.37% | \$4,721 | 103.26% | no | yes | yes | no | no | -2.11% |
| 1979 | 5.2 | 5.20G | 104.00% | 216.6 | \$24,007,386,888,273 | 101.70% | \$4,617 | 97.78% | no | yes | no | no | no | -3.91% |
| 1980 | 5.2 | 5.20G | 100.00% | 209.3 | \$24,844,720,496,894 | 103.49% | \$4,778 | 103.49% | no | yes | yes | no | no | 0.00% |
| 1981 | 5 | 5.00G | 96.15% | 198.3 | \$25,214,321,734,745 | 101.49% | \$5,043 | 105.55% | yes | yes | yes | yes | yes | 4.06% |
| 1982 | 4.9 | 4.90G | 98.00% | 194.6 | \$25,179,856,115,108 | 99.86% | \$5,139 | 101.90% | yes | no | yes | yes | no | 2.04% |
| 1983 | 4.9 | 4.90G | 100.00% | 188.6 | \$25,980,911,983,033 | 103.18% | \$5,302 | 103.18% | no | yes | yes | no | no | 0.00% |
| 1984 | 5.1 | 5.10G | 104.08% | 186.6 | \$27,331,189,710,611 | 105.20% | \$5,359 | 101.07% | no | yes | yes | no | no | -4.13% |
| 1985 | 5.3 | 5.30G | 103.92% | 186.5 | \$28,418,230,563,003 | 103.98% | \$5,362 | 100.05% | no | yes | yes | no | no | -3.92% |
| 1986 | 5.5 | 5.50G | 103.77% | 186.6 | \$29,474,812,433,012 | 103.72% | \$5,359 | 99.95% | no | yes | no | no | no | -3.77% |
| 1987 | 5.6 | 5.60G | 101.82% | 184.2 | \$30,401,737,242,128 | 103.14% | \$5,429 | 101.30% | no | yes | yes | no | no | -1.84% |
| 1988 | 5.8 | 5.80G | 103.57% | 183.4 | \$31,624,863,685,932 | 104.02% | \$5,453 | 100.44% | no | yes | yes | no | no | -3.59% |
| 1989 | 5.9 | 5.90G | 101.72% | 181.2 | \$32,560,706,401,766 | 102.96% | \$5,519 | 101.21% | no | yes | yes | no | no | -1.75% |
| 1990 | 5.9 | 5.90G | 100.00% | 179.3 | \$32,905,744,562,186 | 101.06% | \$5,577 | 101.06% | no | yes | yes | no | no | 0.00% |
| 1991 | 6 | 6.00G | 101.69% | 180.8 | \$33,185,840,707,965 | 100.85% | \$5,531 | 99.17% | no | yes | no | no | no | -1.68% |
| 1992 | 5.9 | 5.90G | 98.33% | 176 | \$33,522,727,272,727 | 101.02% | \$5,682 | 102.73% | yes | yes | yes | yes | yes | 1.71% |
| 1993 | 5.9 | 5.90G | 100.00% | 170.4 | \$34,624,413,145,540 | 103.29% | \$5,869 | 103.29% | no | yes | yes | no | no | 0.00% |
| 1994 | 6 | 6.00G | 101.69% | 167.9 | \$35,735,556,879,095 | 103.21% | \$5,956 | 101.49% | no | yes | yes | no | no | -1.72% |
| 1995 | 6.2 | 6.20G | 103.33% | 166.8 | \$37,170,263,788,969 | 104.01% | \$5,995 | 100.66% | no | yes | yes | no | no | -3.36% |
| 1996 | 6.3 | 6.30G | 101.61% | 162.9 | \$38,674,033,149,171 | 104.05% | \$6,139 | 102.39% | no | yes | yes | no | no | -1.65% |
| 1997 | 6.3 | 6.30G | 100.00% | 157.2 | \$40,076,335,877,863 | 103.63% | \$6,361 | 103.63% | no | yes | yes | no | no | 0.00% |
| 1998 | 6.3 | 6.27G | 99.50% | 152.6 | \$41,077,981,651,376 | 102.50% | \$6,553 | 103.01% | yes | yes | yes | yes | yes | 0.52% |

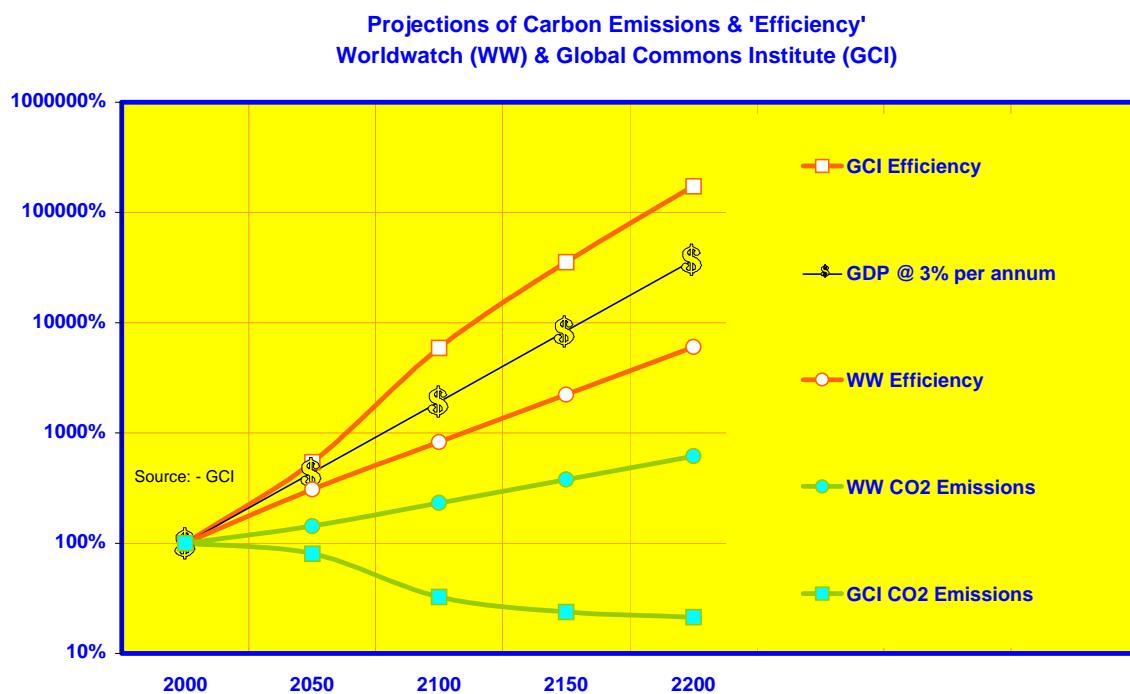
But if the scale of this impending breakdown was better understood, we wouldn't rush to comfort ourselves with such uncritical nonsense. The scale of the issue deserves more serious attention than the World Watch Institute has offered so far. Unfortunately for us all, the emissions of greenhouse gases from fossil fuel burning (principally CO₂) accumulate in the atmosphere. That is, once released they go up and stay there for a very long time. And it is this increasing concentration of the gases, which is causing global temperature to rise and the climate to become less stable.

This means that for rising concentrations to merely stabilize, emissions have to fall not by half a percent or even ten percent. Emissions must fall - indeed they must be cut - by 60 to 80% as soon as possible if citing the 'third party' - stabilizing the Earth's climate system - is to be honest and relevant. The requirement for this emissions cut is absolute and imperative. And moreover, the later this cut happens the hotter the planet will become.

Certainly with regard to the Earth's climate, the ability to grow economically - indeed the desirability of doing this - is utterly contingent on understanding this imperative. If the efficiency goal remains defined as merely increasing growth of global income relative to tonnes of fossil fuel consumed, the rising damages from accelerating climate change will nullify the benefits of this growth.

We need to know where we are headed with climate change. Consequently, it would be sensible to specify on a precautionary basis an upper and stable limit to the amount of CO₂ in the atmosphere. This is after all the objective of the United Nations Framework Convention on Climate Change (UNFCCC). Then we could usefully redefine this climate-related economic efficiency as income per tonne of CO₂ in the global atmosphere. The effect of this would be to provide a tool that over time would show us how well we were slowing the rise of inefficiency in the combined economic and eco-systems.

The bottom chart shows the extent of efficiency gains required to do this (GCI) compared with the World Watch 'good news' repeated year on year (WW). The GCI analysis shows clearly that the growth of these \$:tonne efficiency gains must consistently outperform the rate of GDP growth. That is why the C&C agreement must lead. The World Watch's approach is JAZZ and takes us inexorably to a climate hell on earth.



APPENDIX THREE – Support from key Government Individuals

Jan Pronk, Chairman of COP-6, Environment Minister Netherlands - July 2000

"Contraction and Convergence" ["most equitable . . . easier & cheaper" than alternatives].

" . . . The debate about broadening participation of developing countries in the global effort to stabilize greenhouse concentrations in the atmosphere at sustainable levels has the tendency to focus first on the most advanced developing countries. Suggestions have been made for commitments for those developing countries in the period after 2012 in terms of increased energy or greenhouse gas efficiency. In other words: not an absolute cap, but a relative efficiency improvement in the production structure of developing countries. This strategy would imply that developing countries gradually start participating, as they achieve a certain level of economic development. That is a reasonable and realistic option. However, it can be argued that such gradual participation would only lead to a slow decline of global emissions, even if current industrialized countries would drastically decrease their emissions. As a result global average temperature increase would significantly exceed the 2 degrees centigrade limit that could be seen as the maximum tolerable for our planet.

There are alternatives for this scenario. Some developing countries have argued for an allowance of equal emissions per capita. This would be the most equitable way to determine the contribution of countries to the global effort. If we agree to equal per capita emissions allowances for all countries by 2030 in such a way that global emissions allow us to stay below the 2 degrees global temperature increase (equivalent to about 450 ppmv CO₂), then the assigned amounts for Annex B countries would be drastically reduced. However, due to the fact that all countries would have assigned amounts, maximum use of global emissions trading would strongly reduce the cost of compliance. So, in such a scenario, industrialized countries would have to do more, but it would be cheaper and easier "[July 2000].

Klaus Topfer, Dir. United Nations Environment Programme (UNEP) - June 1999

"Convergence - The review system of Kyoto mechanisms can ensure equity. Currently CO₂ emissions rights are allocated according to existing emissions patterns with a specified reduction percentage for various countries within a certain period of five years (2008-2012). The redistribution through the Kyoto Protocol could be continued until emissions rights are uniformly distributed on a per capita basis. This will be a critical element to ensure the poor also get rights to utilise the world's environment, or in this limited case, the assimilative capacity of the atmosphere, a global commons resource."

Dr Song Jian, Chinese State Councillor Climate Change & Population - Oct 1997

"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."

US Congressman John Porter, Chair GLOBE¹⁵ USA - Nov 1998

"Meaningful progress on confronting the challenge of climate change will only occur when countries from the North and the South are able to collaborate in issues of significant and sustainable development. The GLOBE Equity Protocol - Contraction and Convergence - and its mechanism for financing sustainable development is the only proposal so far which is global, equitable and growth-oriented. It is precisely these issues that were endorsed at the GLOBE International General Assembly in Cape Cod, and form the thrust of our paper (Nov 1998), "Solving Climate Change with Equity and Prosperity." [Viewed at: - <<http://www.globeusa.org>>].

Prof Saifuddin Soz MP. Indian Environment Minister in Kyoto - Dec 1997

"In any discussion, "Contraction and Convergence", the central point is entitlements - equitable per capita entitlements. At Kyoto we had stressed that any discussion on emissions trading ought to be framed in terms of per capita entitlements. Any trading can take place only after the emissions entitlements of the trading partners is defined and legally created - equitably of course. Historical emissions are iniquitous and cannot be the basis of entitlements. Entitlements will define the sharing of the atmosphere on an equitable basis which also brings together all the cooperative mechanisms in the Kyoto Protocol in a common framework."

Jaques Chirac, President of France - COP6 November 2000

"Since 1992, we have fallen too far behind in the fight against global warming. We cannot afford any further delay. That is why, I can confirm to you here, Europe is resolved to act and has mobilized to fight the greenhouse effect. Europe calls upon the other industrialized countries to join with it in this fight. And Europe proposes to the developing countries to join it in a partnership for sustainable development.

Let us start thinking about the post-Kyoto period without further ado. Tomorrow, it will be up to us to set forth the rights and duties of each, and for a long time to come. In order to move forward while respecting individual differences and special circumstances, France proposes that we set as our ultimate objective the convergence of per capita emissions. This principle would durably ensure the effectiveness, equity and solidarity of our efforts."

Sir John Houghton, Chair IPCC WG1 - 2000

"Three widely accepted principles will govern the international agreements needed to meet the threat of climate change. The first is the Precautionary Principle, already clearly embedded in the UNFCCC agreed at the Earth Summit in Rio in 1992. This states that the existence of uncertainty should not preclude the taking an appropriate action. The reason for such action is simply stated as the stabilisation of the concentrations of greenhouse gases (such as CO₂) in the atmosphere in ways that allow for necessary economic development. The second principle is the Polluter Pays Principle, which implies the imposition of measures such as carbon taxes or carbon trading arrangements. The third is the principle of Equity, both intergenerational and international which is the most difficult to apply. However a proposal by the Global Commons Institute that is being widely discussed applies these principles by allowing eventually for the allocation of carbon emissions to nations on an equal per capita basis while also allowing for emissions trading."

¹⁵ GLOBE stands for Global Legislators Organisation for a Balanced Environment. It is an international network of Parliamentarians committed to working in a global non-partisan manner for legislation to protect the environment.

Ambassador Raul Estrada Oyuela, Former Chair Kyoto Negotiations - Feb 2000

"Long before the end of the Framework Convention negotiation, the Global Commons Institute has presented a proposal on contraction and convergence, aimed to reach equality in emissions per capita. We all in this room know the GCI model where contraction is achieved after all governments, for precautionary reasons, collectively agree to be bound by a target of global GHG emissions, making it possible to calculate the diminishing amount of greenhouse gases that the world can release each year in the coming century, subject to annual scientific and political review. The convergence part of the proposal means that each year's global emissions budget gets shared out among the nations of the world so that every country converges on the same allocation per inhabitant by an agreed date. Countries unable to manage within their shares would, be able to buy the unused parts of the allocations of other countries. The entitlement of rights transferred in this trading is legitimised by the per inhabitant criteria.

Level of contraction and timing of convergence should be negotiated on the basis of the precautionary principle. Suggestions for emission reductions are well known and convergence should be achieved at medium term to satisfy legitimacy."

APPENDIX FOUR – Support from key Institutions

IPCC Third Policy Assessment - June 2001

Chapter One, section 3.2: -

"A formulation that carries the rights-based approach to its logical conclusion is that of 'contraction and convergence'.

Chapter Ten, section 4.5: -

"The concept of 'contraction and convergence' is the entitlement of ghg emissions budget in terms of future emissions rights. Such a global future emissions budget is based on a global upper limit to atmospheric concentration of CO₂, for instance 450 ppmv (contraction). This budget is then distributed as entitlements to emit CO₂ in the future, and all countries will agree to converge on a per capita emissions entitlement (convergence). Level of contraction and timing of convergence are subject to negotiations with respect to the precautionary principle."

UNCTAD - Elements of a "Buenos Aires Mandate" - November 1998

". . . meaningful participation by key developing countries" will no doubt loom large in the post-Kyoto period. Much attention will focus on efforts to (a) further define and operationalise the Clean Development Mechanism (CDM) and to (b) agree possible criteria for the participation of developing countries in international emissions trading. Drawing on the Kyoto experience, some possible elements for a mandate regarding participation of developing countries in emissions trading could include the following: -

1. *Participation in emissions trading should be on a voluntary basis. (While the trading system can be designed to benefit all developing countries, it seems that the larger industrially advanced, fast-growing developing countries might be the primary beneficiaries of the system).*
2. *Legally-binding limits (for countries that wish to join the emissions trading system) should be based on emissions growth, not on emissions reductions. The principle was recognised during the Kyoto negotiations. Growth limits would enable the developing countries to continue to pursue their industrialisation but on a more environmentally sustainable basis. (In principle, emissions growth in Non-Annex One countries should be*

compensated for by deeper reductions by Annex One Parties leading to "Contraction and Convergence" of per capita emissions between both sides).

3. *Negotiations could be based on national offers from developing country Parties. Offers by regional groupings such as ASEAN and MERCOSUR should also be considered.*

In addition to existing flexibility mechanisms, developing countries should be allowed to introduce 'partial caps' which, for example, could be based on industrial sector limits and coupled with joint implementation in the uncapped sectors, as a form of progressive restriction towards the imposition of a national cap.

The Royal Commission on Environmental Pollution (RCEP) - June 2000

Chapter Four, "The Need for an International Agreement", "Contraction and Convergence"

*"3. The government should press for a future global climate agreement based on the **contraction and convergence** approach, combined with international trading in emission permits. Together, these offer the best long-term prospect of securing equity, economy and international consensus (4.69)."*

4.47 Continued, vigorous debate is needed, within and between nations, on the best basis for an agreement to follow the Kyoto Protocol. Our view is that an effective, enduring and equitable climate protocol will eventually require emission quotas to be allocated to nations on a simple and equal per capita basis. There will have to be a comprehensive system of monitoring emissions to ensure the quotas are complied with. Adjustment factors could be used to compensate for differences in nations' basic energy needs. Those countries which regularly experience very low or high temperatures might, for instance, be entitled to an extra allocation per capita for space heating or cooling.

4.48 A system of per capita quotas could not be expected to enter into force immediately. At the same time as entitling developing nations to use substantially more fossil fuels than at present (which they might not be able to afford), it would require developed nations to make drastic and immediate cuts in their use of fossil fuels, causing serious damage to their economies.

4.49 A combination of two approaches could avoid this politically and diplomatically unacceptable situation, while enabling a per capita basis to be adhered to. The first approach is to require nations' emission quotas to follow a contraction and convergence trajectory. Over the coming decades each nation's allocation would gradually shift from its current level of emissions towards a level set on a uniform per capita basis. By this means 'grandfather rights' would gradually be removed: the quotas of developed nations would fall, year by year, while those of the poorest developing nations would rise, until all nations had an entitlement to emit an equal quantity of greenhouse gases per head (convergence). From then on, the quotas of all nations would decline together at the same rate (contraction). The combined global total of emissions would follow a profile through the 21st and 22nd centuries which kept the atmospheric concentration of greenhouse gases below a specified limit.

4.50 The upper limit on the concentration of greenhouse gases would be determined by international negotiations, as would the date by which all nations would converge on a uniform per capita basis for their emission quotas, and the inter-mediate steps towards that. It would probably also be necessary to set a cut-off date for national populations: beyond that date, further changes in the size of a country's population would not lead to any increase or decrease in its emission quota.

4.51 In table 4.1 17 we have applied the contraction and convergence approach to carbon dioxide emissions, and calculated what the UK's emissions quotas would be in

2050 and 2100 for four alternative upper limits on atmospheric concentration. We have assumed for this purpose that 2050 would be both the date by which nations would converge on a uniform per capita emissions figure and the cut-off date for national populations.¹⁸ If 550 ppmv is selected as the upper limit, UK carbon dioxide emissions would have to be reduced by almost 60% from their current level by mid-century, and by almost 80% by 2100. Even stabilisation at a very high level of 1,000 ppmv would require the UK to cut emissions by some 40% by 2050.

4.52 The UK-based Global Commons Institute has taken the lead in promoting contraction and convergence, and has developed a computer model which specifies emission allocations under a range of scenarios. The concept has been supported by several national governments and legislators. Some developed nations are very wary of it because it implies drastic reductions in their emissions, but at least one minister in a European government has supported it.²⁰ Commentators on climate diplomacy have identified contraction and convergence as a leading contender among the various proposals for allocating emission quotas to nations in the long term.²¹

4.53 The other ingredient that would make an agreement based on per capita allocations of quotas more feasible is flexibility of the kind already provided in outline in the Kyoto Protocol. Nations most anxious to emit greenhouse gases in excess of their allocation over a given period will be able and willing to purchase unused quota at prices that incline other countries to emit less than their quota, to the benefit of both parties. The clean development mechanism, which allows developed nations to claim emission reductions by sponsoring projects that reduce emissions in developing nations to levels lower than they would otherwise have been, can also be seen as a form of trading.

4.54 In the longer term trading by companies in emission permits, drawn from national emission quotas determined on the basis of a contraction and convergence agreement, could make a valuable contribution to reducing the global costs of stabilising greenhouse gas concentrations while transferring resources from wealthy nations to poorer ones. Trading needs to be transparent, monitored and regulated, and backed by penalties on nations which emit more than they are entitled to. If it became merely a means of enabling wealthy nations to buy up the emission entitlements of poor countries on the cheap, thereby evading taking any action at home, trading would not serve the cause of climate protection. Nor would it if developing countries which had sold quota heavily went on to emit in excess of their revised entitlements.

UK Chartered Insurance Institute (CII) - March 2000

A research report by the Society of Fellows of the CII's report on global climate change describes C&C as: -

"The most realistic way to bring about the required reduction in ghg emissions (which will have the combined effect of reducing the damage imposed on the insurance industry and encouraging the transition to renewable energy) is that proposed in the concept of Contraction and Convergence (C&C). This concept is incredibly simple in its detail. Essentially, everyone has the right to emit an equal amount of pollution (in this case CO₂) to the Global Commons (atmosphere). This would operate in much the same way as the envisaged emissions trading scheme to be set up within the Kyoto Protocol. Since economic progress is dependent on energy, the shortfall from 'Business as usual' energy consumption will need to be met from two directions: efficiency gains, and a rapid growth in renewable energy sources. It is clear from this that emissions trading can only be an intermediate stage, since the total volume of emissions must fall."

The only blockage to this simple system is the absence of political will to ‘step outside the box’ instead of conducting a tortuous round of negotiations of the Kyoto Protocol. One way to unblock this impasse is to amass a large enough consensus of stakeholders behind the concept of contraction and convergence, persuading governments to supersede the Kyoto Protocol. The insurance industry is an obvious place to start such a campaign as it has so much to lose and so much to gain. If society continues down the fossil/Kyoto route, future economic losses are likely to become unsustainable: the current rate of increase in damage from natural hazards is 12% pa and the rate is accelerating. Given that the global sum of such losses was \$100bn in 1999 (Munich Re, 2000), it would outstrip global GDP (growing at 3% pa) by 2065, if the trends persist. If the insurance industry rallies behind C&C, it not only reduces that risk, but it is well placed to invest in the future renewables market. In fact one could argue that as the insurance companies own the oil companies (through equity ownership), insurers form the only industry that has the collateral and the need to adopt the C&C logic.”

USS¹⁶ Research Report No 1 - July 2001

Climate Change, A Risk Management Challenge for Institutional Investors “*Beyond Kyoto - Contraction & Convergence*” (pp 28 29)

“It is important to recognise that any agreement can be only the first step in what will be a major journey. It is clear that even if the Kyoto targets are met, global emissions will continue to rise because of rapidly rising emissions in the developing world. Substantial further steps will have to be taken to curb emissions globally. Such cuts will inevitably begin to involve poor countries and at the same time rich countries are likely to have to commit to much more serious emission reductions themselves. As a result further emission reduction agreements are likely covering the period 2012-20 and beyond. Indeed, the IPCC in its first assessment reports in 1990 recommended emissions cuts of at least 60% to stabilise CO₂ concentrations at 1990 levels and thereby be likely to avoid serious climate disruption. Its subsequent reports have not altered this position.

In the longer term, 'Contraction and Convergence' (C&C) is likely to become increasingly supported as a policy option. C&C was initially advocated by a small UK think tank, the Global Commons Institute (www.gci.org.uk), but has since gained widespread and authoritative support, including that of some poor country governments and also the recent Royal Commission on Environmental Pollution report which recommended that, 'the government should press for a future global climate agreement based on the contraction and convergence approach'. Ironically, while C&C offers a more robust framework than that outlined by Kyoto, and addresses the issue of equity, it also meets the fundamental objection of the US in that it also requires commitments from the developing world. As a global operational framework it also avoids many of the technical problems of Kyoto (such as defining baselines for emissions trading in countries not subject to an overall target, or the extent of international emissions trading that is permissible). However, much will depend on the detail. Done well, C&C could provide a framework for a genuine, equitable, long-term solution to climate change, which reduces political risks and provides businesses and investors with the sort of predictable framework they prefer. But if agreement is hard to reach, C&C might serve to highlight injustices and end up exacerbating tensions. For example, some campaigners have argued for a third 'C': 'compensation' from the rich world for using up the climate's absorptive capacity. Whilst this claim is understandable, such a development could well become an emotive issue that could make agreement far harder to reach.”

¹⁶ Universities Superannuation Scheme

European Parliament¹⁷ - 1998

"Calls on the Commission & Member States to take the lead in brokering an agreement on a set of common principles & negotiating framework beyond COP4 based on:

1. agreement to have a worldwide binding limit on global emissions consistent with a maximum atmospheric concentration of 550 ppmv CO₂ equivalent,
2. initial distribution of emissions rights according to the Kyoto targets,
3. progressive convergence towards an equitable distribution of emissions rights on a per capita basis by an agreed date in the next century,
4. across-the-board reductions in emissions rights thereafter in order to achieve the reduction recommended by the Intergovernmental Panel on Climate Change (IPCC),
5. an agreement to have a quantitative ceiling on the use of flexibility mechanisms that will ensure that the majority of emission reductions are met domestically in accordance with the spirit of articles 6, 12 and 17 of the Kyoto protocol; in this context trading must be subject to proper monitoring, reporting and enforcement;
6. an adequately financed mechanism for promoting technology transfer from Annex I to non-Annex I countries;"

The Africa Group of Nations - August 1997

"As we negotiate the reduction of GHG, the countries of Africa believe that there should be certain principles that need to be clearly defined.

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."

International Federation of Red Cross & Red Crescent Societies - June 2000

World Disasters Report 2000 Box 7.2 A Climate of Debt" <http://www.ifrc.org/>

"No one owns the atmosphere, yet we all need it. So we can assume that we all have an equal right to its services – an equal right to pollute. On the basis of the minimum cuts in total carbon dioxide pollution needed to stabilize the climate, estimated by the Intergovernmental Panel on Climate Change to be between 60 to 80 per cent of the pollution levels reached in 1990, and assuming that we all have an equal right to pollute, rich countries are running up a massive climate or 'carbon' debt. By using fossil fuels at a level far above a threshold for sustainable consumption, year after year the carbon debts of rich countries get bigger.

Any political solution to climate change will need to be based on reductions in emissions, otherwise known as contraction. As the climate is owned by no one and needed by everyone, we will also have to move towards equally sharing the atmosphere, known as convergence. Our collective survival could depend on addressing both."

¹⁷ This is a formulation of C&C by the Parliament that was carried by 90% of the vote. It reflects inter alia that nearly all European Environment Ministers have also publicly endorsed C&C.

APPENDIX FIVE

Contraction Formula

The path of the global emissions curve is established by fixing five conditions:

1. Start date for the contraction period;
2. Target date of emissions stabilisation;
3. Rate of change to be zero in target year (i.e. stable emissions);
4. Initial rate of change to be equal to the actual rate of change at that time;
5. The total level of emissions to be set in accordance with a chosen level of atmospheric concentration stabilisation.

These criteria can be satisfied by a quartic equation of the form

$$Y = k + lx + mx^2 + nx^3 + px^4$$

where Y equals the annual global emissions budget, x is the time variable and the parameters k, l, m, n, p are determined by the five criteria above by a series of multiple equations.

$$k = y_0$$

$$l = r$$

$$m = 30A - 18y_0 - 12y_1 - 4.5r$$

$$n = -60A + 32y_0 + 28y_1 + 6r$$

$$p = 30A - 15y_0 - 15y_1 - 2.5r$$

where y_0 and y_1 are the emission levels at the beginning and end of the contraction period respectively, r is the annual increase in emissions at time 0 and A is the cumulative emissions over the contraction period divided by the length of the period in years.

Convergence Formula

The variables for a convergence formula are set by three conditions:

1. Start from actual shares at the beginning of the convergence period;
2. All countries to converge to equal per capita shares by the target date;
3. Arithmetic to rely only on actual population data (potentially subject to a cap).

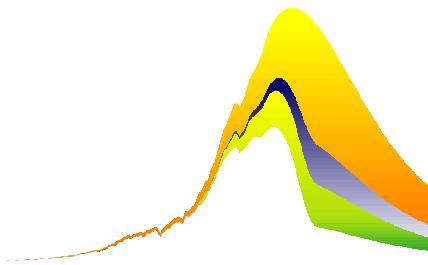
The third point is to avoid complications over controversial population projections. In order to counter the argument of per capita allocations promoting population growth, the population figures can be frozen at any time for the purposes of emissions allocations.

GCI has proposed two alternative formulas:

$$s_{y+1} = s_y - (s_y - p_{y+1})^{-a(1-x)} \quad (\text{Exponential convergence})$$

$$s_{y+1} = s_y - x(s_y - p_{y+1}) \quad (\text{Linear convergence})$$

APPENDIX SIX - References



Global Commons Institute (GCI) (see below)

Technical support and information about "*Contraction & Convergence*" and the planning model itself (CCOptions) are available at: -

<http://www.gci.org.uk>

“Contraction and Convergence – the Global Solution to Climate Change”

Schumacher Briefing No. 5

Published during and launched at COP-6, November 2000.

Available Now from Green Books price £5: -

<http://www.greenbooks.co.uk/cac/cacorder.htm>

Describes C&C, its history, reactions to it and possible futures.

Global Commons Network (GCN): -

<http://www.topica.com/lists/GCN@igc.topica.com/read>

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