Edited by David Cromwell and Mark Levene

SURVIVING CLIMATE CHANGE

The Struggle to Avert Global Catastrophe

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Pluto Press
LONDON • ANN ARBOR, MI

in association with

Crisis Forum

First published 2007 by Pluto Press
345 Archway Road, London N6 5AA
and 839 Greene Street, Ann Arbor, MI 48106

www.plutobooks.com

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Hardback
ISBN-13 978 0 7453 2568 2
ISBN-10 0 7453 2568 8

Paperback
ISBN-13 978 0 7453 2567 5
ISBN-10 0 7453 2567 X

Library of Congress Cataloging in Publication Data applied for

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources. Logging, pulping and manufacturing processes are expected to conform to the environmental regulations of the country of origin.

10 9 8 7 6 5 4 3 2 1

Designed and produced for Pluto Press by
Chase Publishing Services Ltd, Fortescue, Sidmouth, EX10 9QG, England
Typeset from disk by Stanford DTP Services, Northampton, England
Printed and bound in the European Union by
CPI Antony Rowe Ltd, Chippenham and Eastbourne, England

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The Case for Contraction and Convergence

Aubrey Meyer

I was born in the UK in 1947. I grew up in South Africa in the 'apartheid era' after the Second World War. 'Unity is Strength' was the motto of the then White Nationalist government of the country, yet 'Separate Development' was their decreed strategy. Even to a child, the segregation – or 'apartheid' – under this unity was a political oxymoron. This divided and asymmetric state made the Beloved Country weak for the lack of unity. This lesson now applies to our beloved but divided planet. Change is inevitable. May it be moderated for the better, even as we integrate cost and benefits of 'development' in the struggle to avoid the worst of global warming and climate change.

Early on my interest was focused by music. By the time I was 21, I was making my living playing and writing music in Europe. Still under this influence by the age of 40, I had become a parent and also very scared by the deeply asymmetric politics of global warming and climate change. There was nowhere to escape this. I became involved in efforts to correct these trends and 20 years on I am still.[1]

To musicians integration is everything. How music and musicians fit together, how we make the shared energy work to make music, is all about intelligent time measurement and design. Though creatively alive, music is very precise about counting. Timing and tuning to shared reference points are fundamental to the power of live music. It was not obvious to me when I was younger that principle precedes practice, and that this has both timeless stability and political relevance.

A current example of this is the East West Diwan Orchestra.[2] It was started in 1999 by the late Edward Said and Daniel Barenboim for children of Arab and Jewish families in the conflicts of the Middle East. The young players' attraction to music makes it possible for them to come together as equals from two sides of a conflict into the shared framework of music making. The Diwan Orchestra sets a global

standard of peaceful cooperation, based on the musical principles of measuring and common reference points, and of working together despite differences, to produce something beautiful.

CONTRACTION AND CONVERGENCE LEADS PRACTICE WITH PRINCIPLE

The contemporary example of the East West Diwan Orchestra actually suggests a model for a global framework of reconciliation and ecological recovery in the years ahead. If, as a species, we are to avoid dangerous climate change and survive, we need to start counting from fundamentals with the core resonance of reconciliation. In practice this means keeping within the precautionary limits and using the pragmatic rationale of counting people's rights under these limits as equal.

This does not mean we are all equal. It means that to survive, we are all equally and collectively rationed by the limits that preserve us. The resonance of this in the text of the United Nations Framework Convention on Climate Change (UNFCCC) is 'common but differentiated responsibilities'.

Thus, the objective of the UNFCCC is to stabilise rising greenhouse gas concentration in the atmosphere at a value that is safe, based on principles of both precaution and *equity*. The UNFCCC necessarily adheres to contraction and convergence, first proposed by the London-based Global Commons Institute (GCI) in 1990 (see below). Contraction and Convergence is a policy framework that combines the precautionary principle and the principle of equity. The framework was explicitly approved by the UNFCCC Secretariat in 2003 with the statement that 'the objective of the UNFCCC inevitably requires Contraction and Convergence'.

We can restate the above key clauses of the UNFCCC as follows. Let us regard humanity, crudely, as being composed of two groups: high-energy users and low-energy users. The use of energy is directly related to carbon dioxide emissions (and that of other greenhouse gases, or GHGs). All of us share the common goal of atmospheric stabilisation, but some of us need to do more than others. Hence 'common but differentiated responsibilities'. Since the low carbon emitting nations can still increase their emissions before they reach the sustainable average, 'the share of global emissions originating in developing countries will grow to meet their social and development needs'. By implication, then, the high carbon emitting nations must contract fastest and greatest: 'the developed country Parties must

Key Clauses in the United Nations Framework Convention on Climate Change

Parties to the UNFCCC, 'acknowledge that change in the Earth's climate and its adverse effects are a common concern of humankind'. They are 'concerned that human activities have been substantially increasing the atmospheric concentrations of greenhouse gases, that these increases enhance the natural greenhouse effect, and that this will result on average in an additional warming of the Earth's surface and atmosphere and may adversely affect natural ecosystems and humankind'. (Preamble)

The Convention's objective – The Convention 'is to achieve … stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (Article 2). In other words, greenhouse emissions have to contract.

The Principle of Global Equity – The Parties 'should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity' (Article 3.1). They note that, 'the largest share of historical and current global emissions of greenhouse gases has originated in developed countries and that per capita emissions in developing countries are still relatively low' (Preamble). They therefore conclude 'that in accordance with their common but differentiated responsibilities and respective capabilities the developed country Parties must take the lead in combating climate change and the adverse effects thereof' (Article 3.1), while 'the share of global emissions originating in developing countries will grow to meet their social and development needs' (Article 3.3). In short, the Convention covers Convergence and a system of emissions allocation.

The Precautionary Principle – The Parties 'should take precautionary measures to anticipate, prevent or minimise the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures' (Article 3.3).

Achieving global efficiency – 'taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at lowest possible cost' (Article 3.3). In the past, cost-effective measures have been used to target pollutants, notably CFCs, in the form of trading via markets under a global maximum limit or 'cap'. More generally, the point to note here is that the idea of a framework based on precaution and equity had been established, with efficiency introduced in a subsidiary role purely to assist it.

take the lead in combating climate change'. Obviously the goal is sustainable emissions levels – so these two sides of the discussion inevitably lead to convergence. The lock opens and the water rushes out until both sides are level.

Many individuals, organisations and, indeed, nations have concurred that Contraction and Convergence (C&C) is the necessary policy framework that stems from the UNFCCC agreement, structured so that we are all in tune with each other, and in time to save the planet. What exactly then does C&C propose?

THE PRINCIPLE OF CONTRACTION AND CONVERGENCE

C&C is a global climate policy framework, formulated on the basis of equal rights, and has been proposed to the United Nations ever since 1990 by the GCI, as a means to achieving the UNFCCC climate change objectives.

C&C calculates a global carbon budget for what is deemed a 'safe' climate, e.g. limiting global temperature rise by 2° C. This enables greenhouse gas reduction scenarios to be calculated in the process of contraction. The global carbon budget can be shared by international negotiation, along a timeline with the final goal of achieving equal rights: this is the process of convergence. The commitment to a global treaty based on this negotiation can enable policies and measures to be organised at rates that avoid dangerous global climate change (see Figure 1).

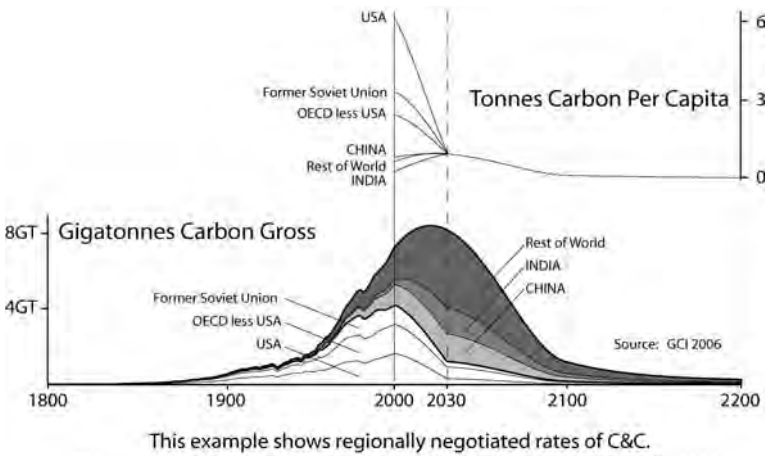


Figure 1 Contraction and Convergence

Rates of contraction (Figure 2) and convergence (Figure 3) may be revised periodically as scientific understanding of the relationship between rising concentrations and their impacts on our world develops.

To get agreement to arrive at this juncture we need to concur with what Tony Blair has correctly called 'a rational science-based unity rather than more rounds of division'.[3] With the C&C definition closely based on the text of the UNFCCC which formalises into international law what must by definition be a numerate process,

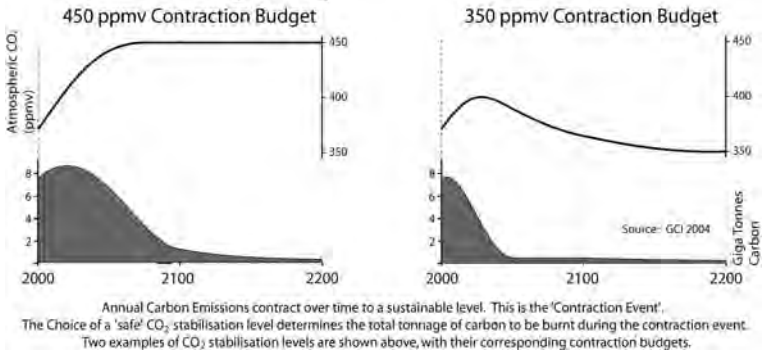


Figure 2 Negotiating Rates of Contraction

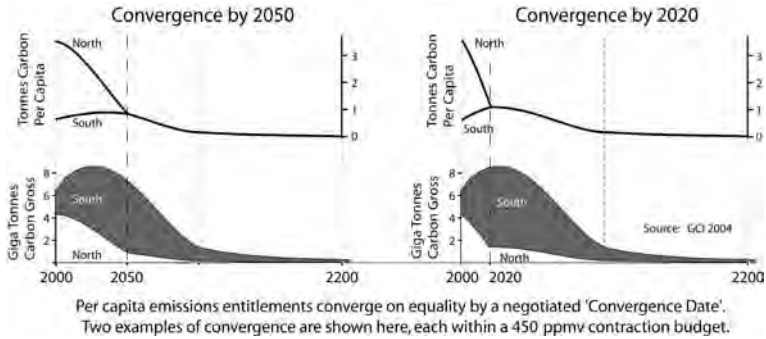


Figure 3 Negotiating Rates of Convergence

The Contraction and Convergence framework proposes:

(a) A full-term contraction budget for global emissions consistent with stabilising atmospheric concentrations of GHGs at a concentration maximum deemed safe by the UNFCCC.
(b) The international sharing of this budget as a pre-distribution of entitlements that result from a negotiable rate of convergence to equal shares per person globally by an agreed date (for example, 2030).
These entitlements will be internationally tradable.

the issue thus unavoidably turns on the global measurement of GHG concentrations.

The C&C approach enables the UNFCCC process to be constitutionally numerate. It makes it possible to define a budget

from a GHG concentration target and a convergence date by when per capita entitlements to emit have become equal, whatever rates of C&C are negotiated. Its calculus is first and foremost tied to the carbon limit and the people consuming within it; that is, before it is tied to any gain or loss of money or Gross World Product (GWP) arising. The tradability of the entitlements predistributed this way creates equilibrium between future carbon consumption and future climate.

'DOUBLE JEOPARDY' – ASYMMETRIC GROWTH AND CLIMATE DAMAGES

In stark contrast, the world at large is increasingly now haunted by the growth, divisions and conflicts of separate development. Money and power pursue each other and in this 'expansion and divergence' the 'disconnects' are discordant and dangerous. On the left side of Figure 5, we see the global asymmetry of dollar-based purchasing power: two-thirds of moneyless people routinely share 6 per cent while the other third spend the remaining 94 per cent, thus primarily causing the GHG emissions accumulating in the global atmosphere and driving climate changes.[4]

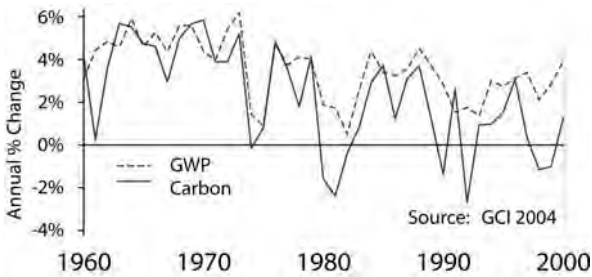
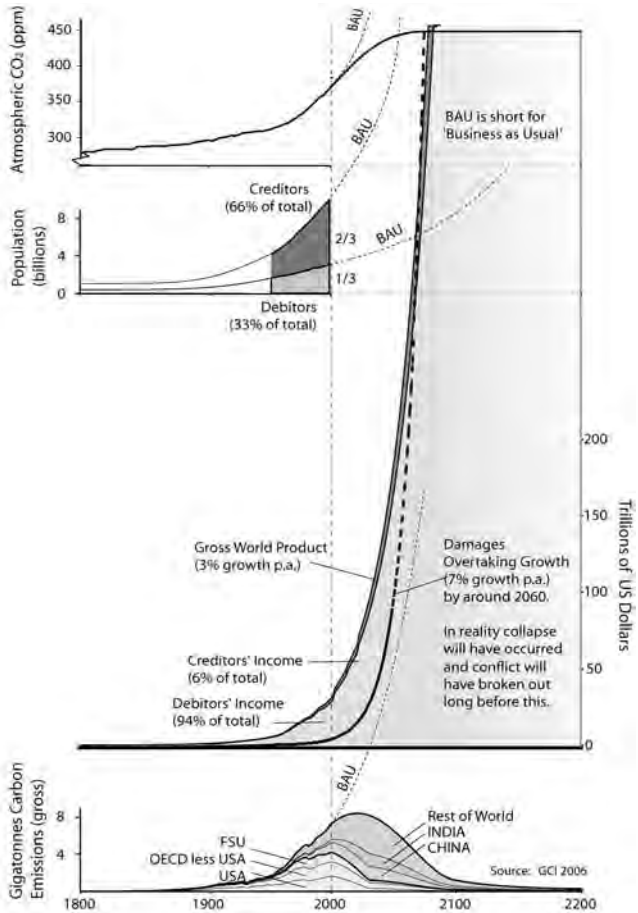


Figure 4 GWP, Carbon Lockstep

As Figure 4 shows, this money – or Gross World Product – is a close proxy for pollution, namely global carbon emissions. The growth of these emissions over the last 200 years of fossil fuel dependency has raised global temperature by one degree Celsius and triggered a rate of damages from an increasingly unstable climate that is twice the rate of growth in the economy (shown in Figure 5). The situation is critical. These trends are worsening and the poorest, particularly in small islands and Africa, are most vulnerable to the impacts of climate change.



A 3% per annum exponent in the path integral of growth is starkly asymmetric and unsustainable. Adhering to economic prognosis based on this is a measure of an increasingly dangerous economic 'growth illusion'.

When climate damages are added, it is already clear that the growth is *un*-economic. When damages are subtracted from this growth, it is clear the net growth is increasingly negative.

Asymmetric and damaging net-negative growth is a recipe for conflict. The bottom line is that there is no sustainable energy source that can realistically support this 'Expansion and Divergence'.

Contraction and Convergence can help cope with the limits to growth and structure and stabilise the transition to an equilibrium state based on:

(1) resource conservation,
(2) global rights,
(3) renewable energy and
(4) ecological recovery.

Figure 5 Asymmetric Growth and Climate Damages 'Double-Jeopardy'

The injustice is acute. Many suffer great hunger or thirst. Many are forced to migrate as their lives are threatened. Many already die. This climate change induced mortality of innocent third parties is largely ignored; the poor and disadvantaged are discarded at the margins of the current system of expansion and divergence.

And while the monetary economy is compulsively force-focused on the 'benefits of growth', it is de-linked from the 'costs of climate damages'. As the right-hand side of Figure 5 indicates, climate-related damages increasing at a yearly rate of 7 per cent will overtake economic growth of 3 per cent per annum by the year 2060.

But, as the damage costs are subtracted from the benefit of economic growth, the benefits of growth are thus relentlessly deleted. For now, the accounts still disguise this as the necessarily cost-free discards of 'progress'.

THE RELATIONSHIP BETWEEN THE EMISSIONS AND ATMOSPHERIC CONCENTRATIONS OF GREENHOUSE GAS ON A GEOLOGICAL TIMESCALE OF 400,000 YEARS

Thanks to ice-core sampling, data for atmospheric concentration of CO_2 and temperature go back about half a million years before the present.[5] Throughout the ice-core record, up until the Industrial Revolution, temperature and greenhouse gas concentration moved up and down closely in step as shown in Figure 6. They oscillated because of natural change processes, between clearly defined upper and lower limits, but never went outside these boundaries. For CO_2, those limits were 180 and 280 parts per million by volume (ppmv); for methane (CH_4), 300 and 700 parts per billion by volume (ppbv); and for temperature, 5 and 15 degrees Celsius.

The leap in CO_2 concentration from 280 to 380 ppmv and CH_4 concentration from 700 to 1,700 ppbv in the last 200 years is faster and higher than anywhere in the geological record and has been accompanied by a one degree rise in global average temperature.

The rates of change in the human economy, since industrialisation began in the West around 1800, have had an impact on the atmosphere that is very different from the geological record. The ice-core records suggest very strongly that further global warming is to come.

Understanding this is fundamental to devising and being guided by a rational and strategic framework of GHG emissions for the purpose of restraining dangerous human-induced rates of climate change on the biosphere.

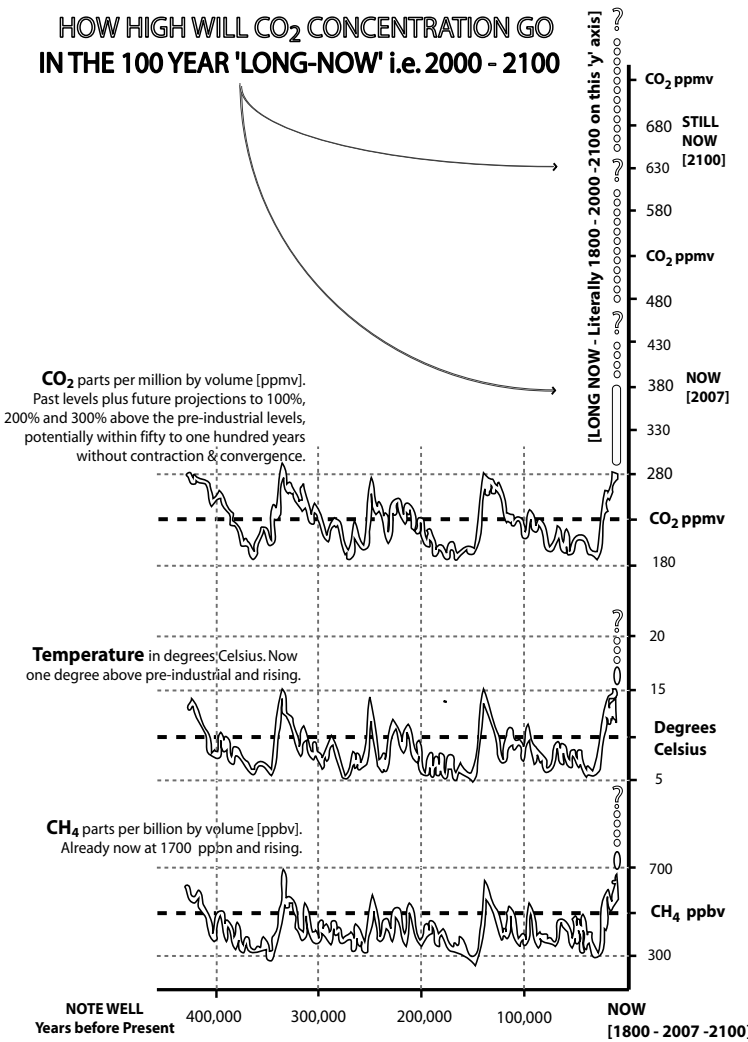


Figure 6 How high will CO_2 concentration go?

This chapter, and indeed this book, offers some insights into this, guided by the notion that to solve a problem you have to solve it faster than you create it. This is 'the battle of the rates' and we have to win it to survive.

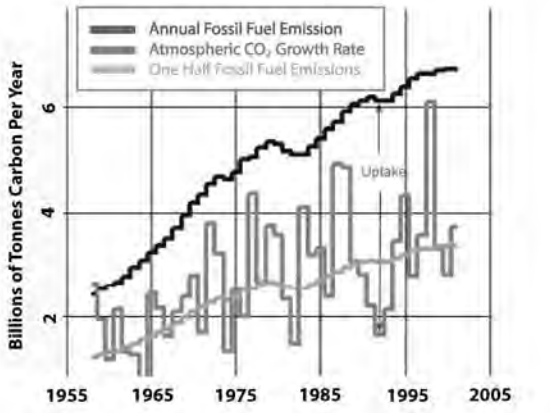


Figure 7 Atmospheric Growth Rate of CO_2

THE RELATIONSHIP BETWEEN THE EMISSIONS AND ATMOSPHERIC CONCENTRATIONS OF GREENHOUSE GAS EMISSIONS FROM 1800 TO NOW AND BEYOND

The battle of the rates

Over the last 200 years, human behaviour has disturbed the equilibrium of the natural carbon cycle and the balance of climate stability. CO_2 emissions from fossil fuel burning have raised atmospheric concentration by 40 per cent (see left half of curves plotted in Figure 9) until now, resulting in close to a one degree Celsius rise in global temperature.

Yet, in spite of the clear and present danger of increasingly dangerous rates of climate change beginning to take hold, uncertainty still surrounds the policy debate around how much to modify this behaviour in future. Over the next 200 years (see the right half of Figure 9), the uncertainties about what the overall systemic reaction to this 'policy' will be can be reduced to 'the battle of the rates'.

The questions are: what will the rate of atmospheric accumulation of greenhouse gas emissions from now on actually be, or how high will atmospheric greenhouse gas concentration be allowed to rise? In other words what does it really take to solve this problem faster than we are creating it?

To answer this it is necessary to look at the relationship between human source GHG emissions to the global atmosphere and the

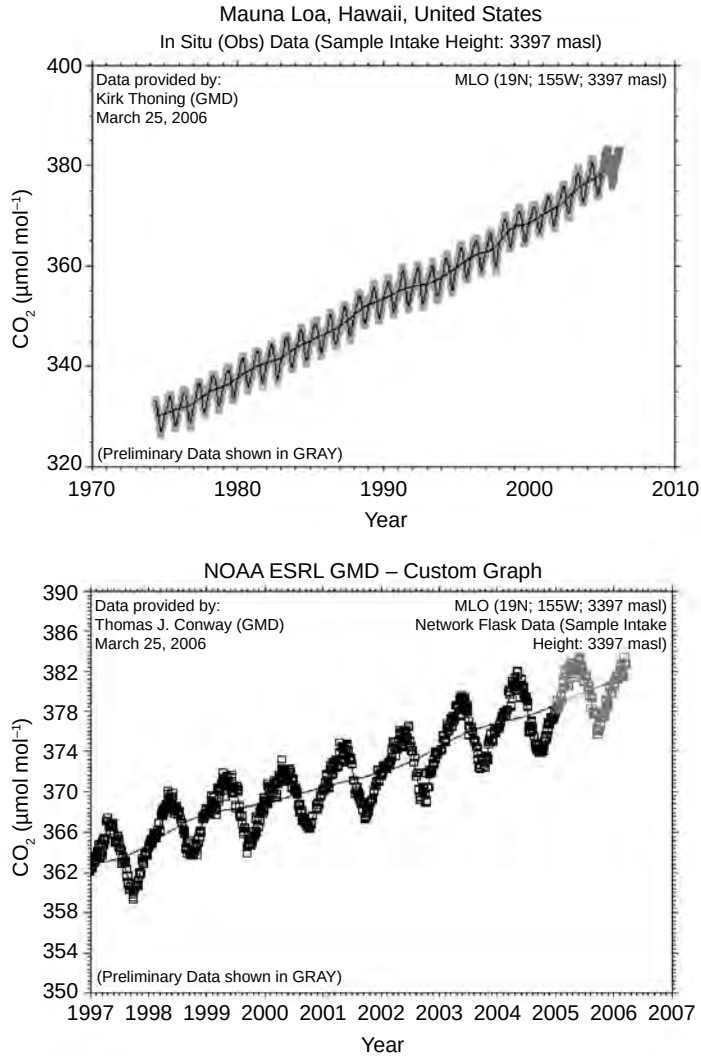
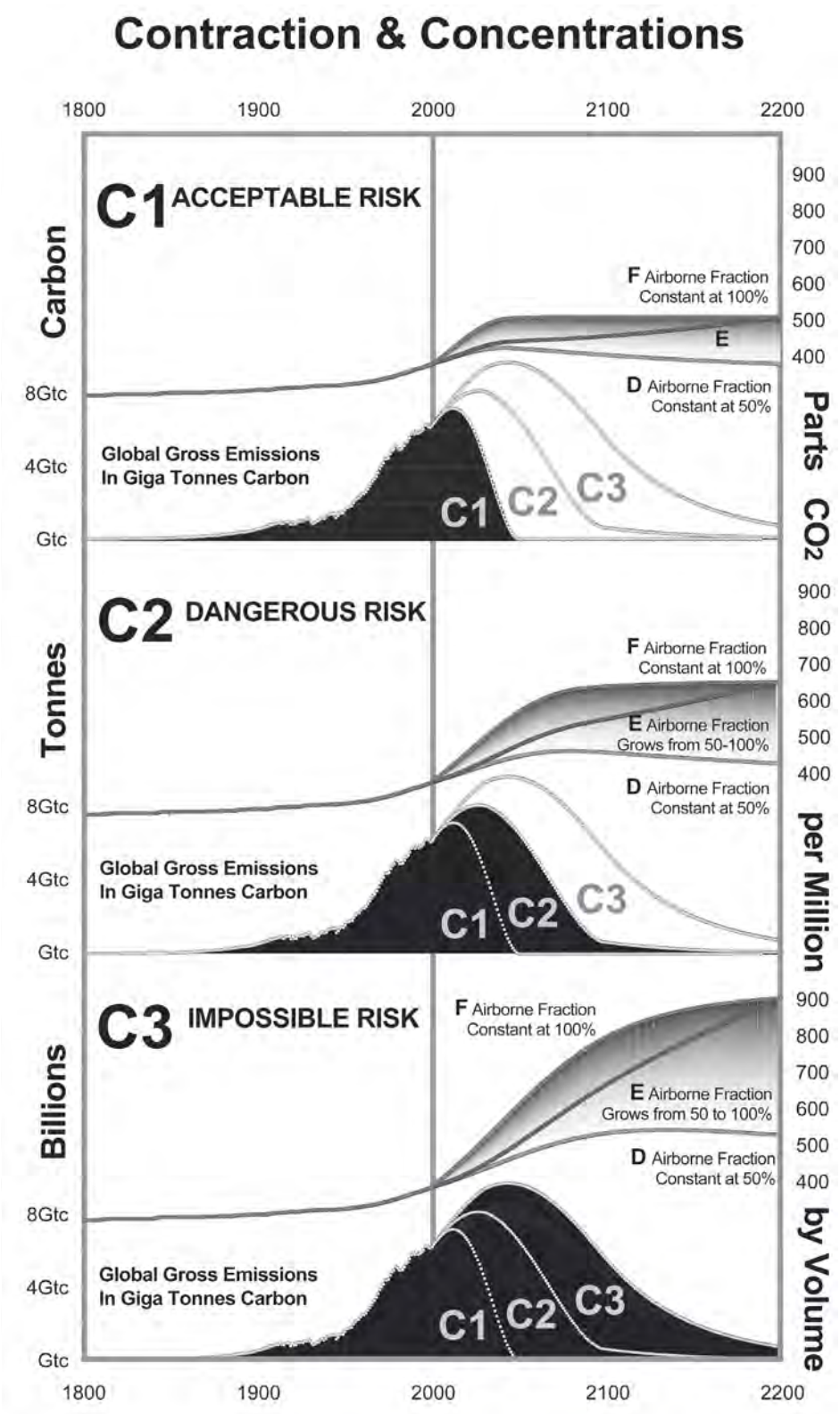
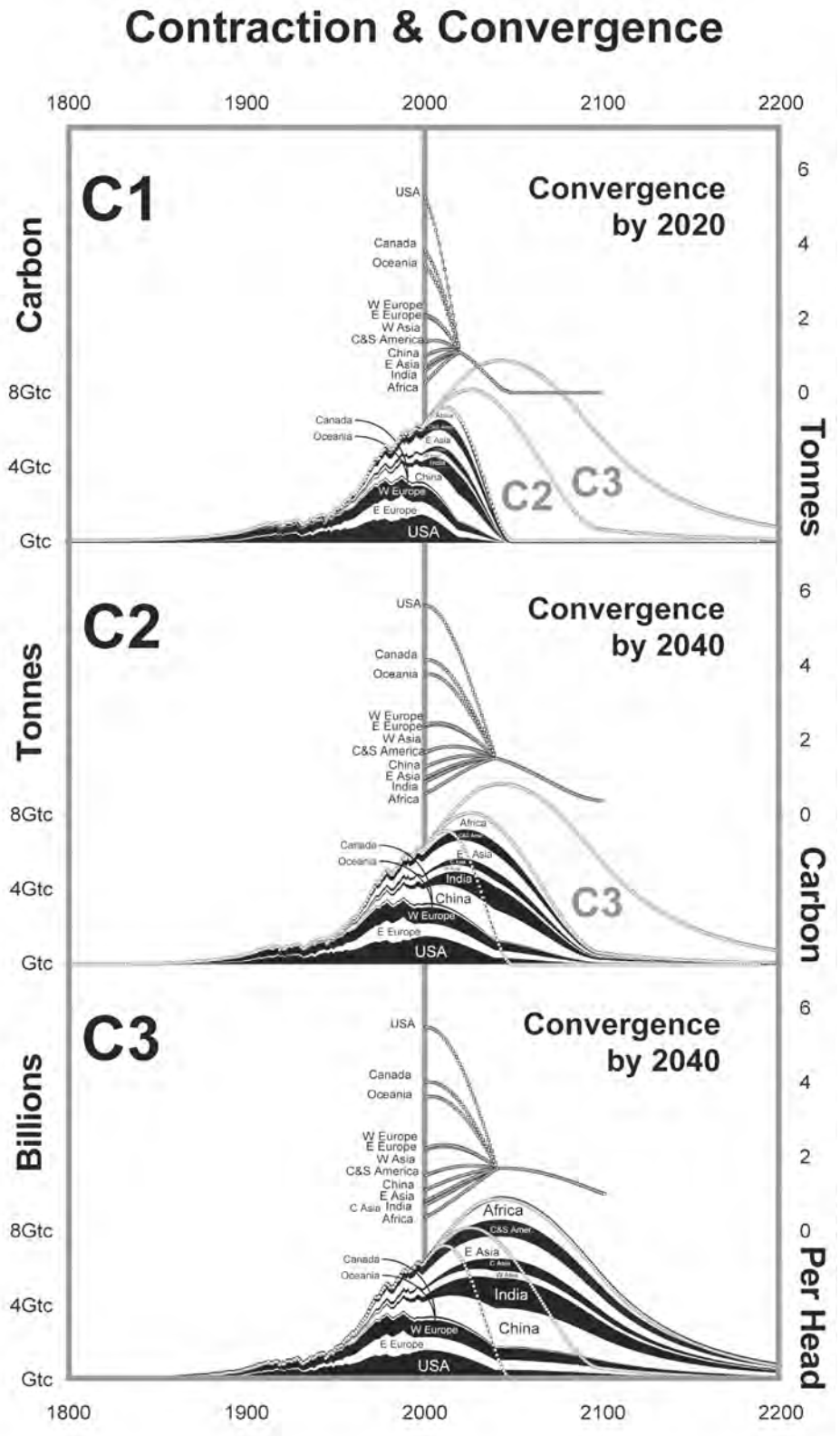


Figure 8 CO_2 Measured at Mauna Loa Observatory

now varying extent to which these are increasingly retained there. The relationship between emissions and atmospheric concentration over this period has seen on average a constant fraction of each year's emissions remaining airborne. This so-called 'Constant Airborne Fraction' has until recently, been 50 per cent; i.e. 50 per cent of


Contraction & Concentrations
1800
1900
2000
2100
2200
C1 ACCEPTABLE RISK
Carbon
8Gtc
4Gtc
Gtc
F Airborne Fraction Constant at 100%
E
D Airborne Fraction Constant at 50%
Global Gross Emissions In Giga Tonnes Carbon
C1
C2
C3
900
800
700
600
500
400
Parts CO2
C2 DANGEROUS RISK
Tonnes
F Airborne Fraction Constant at 100%
E Airborne Fraction Grows from 50-100%
D Airborne Fraction Constant at 50%
per Million
C3 IMPOSSIBLE RISK
Billions
E Airborne Fraction Grows from 50 to 100%
by Volume


Contraction & Convergence
1800
1900
2000
2100
2200
C1
Convergence by 2020
Carbon
8Gtc
4Gtc
Gtc
Tonnes
6
4
2
0
USA
Canada
Oceania
W Europe
E Europe
W Asia
C&S America
China
E Asia
India
Africa
C2
C3
C2
Convergence by 2040
Tonnes
Carbon
C3
Convergence by 2040
Billions
Per Head

each year's emissions has been retained in the atmosphere, and 50 per cent has been returned to apparently enlarging 'sinks' for the gas in the biosphere.

A tap flowing into a bath provides a familiar analogy for this all-important relationship.

'Bath–tap' analogy

The dominant greenhouse gas from human sources is CO_2. The relationship between atmospheric CO_2 concentrations and the emissions of CO_2 from human sources is a 'stock-flow' relationship and can be thought of as a 'bath–tap' analogy. Just as the bath accumulates the flow of water to it from the tap, the atmosphere accumulates the flow of emissions to it from sources such as the burning of fossil fuels. Emissions are the short-term flow to the atmosphere which slowly accumulates a fraction of these as long-term stock.

On the flow side, the bath–tap analogy extends further by introducing the 'plug hole' through which water is drained away. The tap represents the various sources of carbon emissions in the real world; the plug hole represents their natural 'sinks'. Sinks in the real world are, for example, oceans and forests in which some of the 'extra' CO_2 in the atmosphere is 're-absorbed'.

If the plug hole is open while the tap is on, the level of water in the bath (the stock) may only slowly rise. In other words, the water level of the bath is the net balance of the rates of flow into the bath through the tap and out of the bath through the plug hole. If the tap water runs in at twice the rate that it drains away through the plug hole, the net rate of water accumulating in the bath is 50 per cent, or half the rate, of the flow from the tap into the bath.

If the bath approaches the point of overflowing, the tap needs to be turned off completely to avoid overflow. The bath level, however, continues to rise even while the tap is being turned off and at least until it is turned off. That is, it takes time to turn the tap off, and during that process there is a risk that the bath could spill over. The analogy refers here, in the real world, to the possibility of climate runaway, where we would no longer have any control over global warming, as positive feedbacks (self-reinforcing effects) would take over from human impacts.

In the case of the present atmosphere the danger of the overflow is increasing, not decreasing. Emissions are increasing, while sinks are failing due to increased forest combustion, warming and acidification

of the oceans. Consequently the airborne fraction of emissions is increasing too.

In the analogy, the tap is opening wider, the pressure behind it is increasing, the plughole is blocking up, the rate at which the bath is filling is accelerating and there are more and more people in the bath wanting to fill it. The likelihood of the bath overflowing is itself rapidly growing.

PRESENT CO_2 'PATH INTEGRALS' – EVIDENCE OF 'AGGRAVATED RATES OF ACCUMULATION' OF ATMOSPHERIC CO_2

Covering the last 200 years, good data exist for both CO_2 emissions from burning fossil fuel and atmospheric CO_2 accumulation, or concentrations in parts per million by volume (ppmv) and weight in gigatonnes (GTC). One part per million by volume of CO_2 in the global atmosphere equates to a weight in carbon of 2.13 billion tonnes (gigatonnes).

Observed data from the Mauna Loa Observatory (MLO) of the US government[6] shows that the 'Constant Airborne Fraction' (CAF) of emissions now appears to be changing.

On average the fraction of emissions from fossil fuel burning being retained in the atmosphere is growing, as is shown in Figure 7. The more recent trend in the raw data are shown in the two panels of Figure 8.

These data make it possible to determine the effect of having the higher – or 'aggravated' – rates of atmospheric CO_2 retention persist into the future. These are shown in the projections from the C&C model in the charts C1 (convergence by 2020), C2 (convergence by 2040) and C3 (convergence by 2040) that are in Figure 9. The rate of increase in atmospheric CO_2 until recently has been 1.5 ppmv per annum: the carbon weight of this annual increase is therefore approximately 3.3 GTC. This is around half the weight of annual emissions which is currently about 6.5 GTC.

The point of great concern here is that over the period 2003–05, the rate of atmospheric increase has jumped to nearer 3 ppmv per annum. This gives a loading of the atmosphere by weight that is roughly equal to, not half, but all the emissions from fossil fuel burning. This suggests that roughly the equivalent of 100 per cent of emissions were retained in the atmosphere in these years. This is 'aggravated accumulation'.

This was not foreseen in the carbon cycle modelling within the Intergovernmental Panel on Climate Change (IPCC) in the first three of its assessment reports between 1990 and 2001. These reports on the science of climate change, and the carbon contraction budgeting linked to different levels of GHG stabilisation in the atmosphere, did not as a result engage with the issue of 'aggravated accumulation'.

FUTURE CO_2 'PATH INTEGRALS'

The charts in Figure 9 project three scenarios for future rates of CO_2 stabilisation in the atmosphere. These 'path-integrals' are carbon consumption added up over time.

They project the contraction budgets for carbon emissions published by the IPCC in the 1995 Second and 2001 Third Assessments, for: (1) 350 parts per million by volume (ppmv), (2) 450 ppmv and (3) 550 ppmv. These IPCC reference curves are shown by path 'D' in each case against the emissions contraction budgets also quoted by IPCC.

In each of these three reference cases, the curves for atmospheric accumulation are projected using the C&C model to show the aggravated path integrals of rates of CO_2 accumulation in the atmosphere into the future at:

(a) 50 per cent CAF, as given with the original IPCC determined rates and integrals of emissions contraction budgets (path 'D' in the three examples shown);
(b) 100 per cent CAF, in other words the theoretical maximum rate of atmospheric retention of GHG emissions from human sources (path 'F' in the examples shown); and
(c) a rate of GHG retention in the atmosphere that gradually increases from 50 per cent to 100 per cent over the next two centuries (path 'E' in the three examples shown).

The scenarios shown are 'pairs' of emissions budgets and atmospheric concentrations that should have been stable at IPCC given values, but can rise faster along path 'E' (combined in first chart of Figure 9):

C1. An emissions budget for 350 ppmv as determined by IPCC, may well rise through 500 ppmv (here called 'acceptable risk').
C2. An emissions budget for 450 ppmv as determined by IPCC, may well rise through 650 ppmv (here called a 'dangerous risk').

C3. An emissions budget for 550 ppmv as determined by IPCC, may well rise through 900 ppmv (here called an 'impossible risk').

The justification for doing this relies on the data already returned (and quoted above) showing that the aggravated rate of emissions accumulation in the atmosphere is already occurring intermittently. The purpose of doing this is to highlight the much greater extent of risk with which we are already confronted as the likelihood of aggravated rates of accumulation persisting into the future is real. The point of concern is that conditions of runaway climate change will take hold if preventive action is not urgently taken.

These 'aggravated rates of accumulation' are a fundamental strategic consideration as we try and determine a stable future over the next few decades since:

- governments are still caught in poor understanding and indecision about 'policy' to modify human fossil fuel consumption beyond 2012 when the Kyoto Protocol to the UNFCCC expires;
- politicians are operating under the increasingly challengeable assumption that there is still time to stop dangerous rates of climate change from taking hold.

Some commentators, notably scientist James Lovelock, already take the position that it is all too late; in the 'bath–tap' analogy, the bath is inevitably now going to overflow. The priority test to keep in mind for policy to prevent this catastrophe is to compare path integrals for:

(a) the rate at which we cause the problem with our global emissions total where this rate is understood as the possible and likely rates of atmospheric accumulation and,
(b) these rates against the rates at which we are organising globally to stop triggering dangerous rates of climate change by contracting our global emissions total fast enough to avoid catastrophe.

We can reasonably measure the rate at which we presently still continue to cause the problem much faster than we act to avoid it by reference to the Kyoto Protocol. In its given time period of 2008–12, the Kyoto Protocol will theoretically and at best have avoided emitting a few hundred million tonnes of CO_2 (measured

as carbon) into the atmosphere. During the same period we will have added several billion tonnes of carbon to the atmosphere from emissions: virtually business as usual. As soon as we factor aggravated accumulation into this it is clear that the end result will be that by 2012 we will be more, not less, deeply committed to the accelerating rate at which we are causing the problem than the response rates of C&C that are necessary to avoid it.

CAN WE SOLVE THE PROBLEM FASTER THAN WE ARE CAUSING IT?

As comparison of the three scenarios laid out here demonstrates, the risks of GHG concentrations rising faster and higher than has been suggested, and potentially completely beyond the ability of human decision taking to mitigate, are already clearly great and worsening. What is shown in the graphics of Figure 9 narrows and compares the ranges of uncertainty about concentrations to being between paths D (lowest) and F (highest) in each case.

This makes it possible to draw some very obvious conclusions about (1) the risks of acceleration in what we face and (2) what the accelerated rates of C&C are that it may take to avert these risks, in other words to solve the problem faster than we are causing it.

If the bath is not to overflow we need to be working more for scenario type C1, not giving in to C3 as is the case with Sir David King, the government's chief scientist.[7]

King, with an eye on the unresolved tension between the world's major GHG polluters – the US, India and China – has taken the view that the *realpolitik* driving this expansion of consumption now overshadowing the entire global community, is to aim for a cap of 550 ppmv CO_2 atmospheric concentrations. This, said King, was a 'reasonable' target. Anything less would be 'politically unreasonable'. Indeed, if King recommended a lower limit 'he would lose credibility with the government'.[8] But setting such a high limit means that the likelihood of preventing more than a two degree rise in global temperature is just 10–20 per cent. As *Guardian* columnist and green campaigner, George Monbiot, noted: 'Two degrees is the point beyond which most climate scientists predict catastrophe: several key ecosystems are likely to flip into runaway feedback; the biosphere becomes a net source of carbon; global food production is clobbered, and 2 billion people face the risk of drought. All very reasonable, I'm sure.'[9]

The truly alarming implication of King's stance is that his understanding of the contraction requirement to stay below this 550 ppmv maximum is based on IPCC carbon cycle modelling where the airborne fraction of emissions was assumed constant at around 50 per cent. When we allow for the aggravated rates of accumulation discussed above, King's 550 ppmv CO_2 prognosis is more probably headed to 1,000 ppmv and, hence, a runaway acceleration towards climate catastrophe. King, like many of the experts, appears either not to have understood the implications of aggravated accumulation in the C2 and especially the C3 scenarios. Or, perhaps for political reasons, he is ignoring this for now.

This is more than alarming. King has posed climate change as a greater threat than terrorism. But by saying, in effect, that the politically acceptable solution is to aim for 550 ppmv CO_2, his use of the word 'threat' is wholly misleading. It is certainly possible and almost inevitable that the aggravated rates of retention will increasingly become the norm if we persist with emissions control as envisaged in the Kyoto model. There is a point beyond which they certainly will become the norm, and on our present trajectory we are closing on it dangerously.

Avoiding this outcome means the underlying programme of global carbon emissions C&C must be agreed and internationally implemented at rates faster than those shown for 550 ppmv CO_2. The alternative is the slope of atmospheric concentration of CO_2 and other greenhouse gases, and temperature, running away out of control. To make the relevant comparison, contrast 'Acceptable Risk' C1,E with 'Impossible Risk' C3,D.

The contraction profile for C3 is three times the 'weight' (i.e. the total area under the curve) of C1, but the concentration trajectories cited are virtually the same.

WAR ON ERROR: TRANSCENDING FALSE DICHOTOMIES

The circumstances in which the next few decades of human development take place are inevitably going to be profoundly reflexive. The implications of failing to prevent dangerous rates of global climate change are almost too dreadful to contemplate. As argued by palaeontologist Michael Benton, mass extinction events such as the Permian 251 million years ago were almost certainly the result of rapid non-linear climate changes, triggered by sudden greenhouse gas loading of the atmosphere and temperature increases.[10] The

difference is that then there were no human beings; now there are – us. Against this background, political integration of people on the left and on the right into a consensus-backed rationale for action is urgently required and already long overdue.

The economics of 'expansion and divergence' brings 'omnicide'

This globally 'separate development', just as in South Africa, is neither moral nor, since it has triggered a global security crisis, is it sustainable. Indeed a creeping madness inhabits this 'economic growth' and dealing with this is now fundamental to resolving our global dilemma. The very future of humanity as a whole is relentlessly deleted, when one-third of people are unwittingly attached to a false accounting which, in the words of Colin Challen, the Chairman of the all-party climate group of UK MPs, operates like the Third Reich as 'the economics of genocide'.[11] Uncorrected, this future increasingly warms to become how the rich finally commit suicide by continuing to rob the poor. As the historian Mark Levene puts it, this is the 'economics of omnicide' as all are inevitably vulnerable to the effects of climate changing out of control.[12]

In 1995 the IPCC Second Assessment Report was published. After bitter battles over the 'value of life' during its preparation, this intergovernmental 'consensus' report openly repudiated the global cost-benefit analysis of climate change carried out by economists who claimed to have demonstrated that it was cheaper or more cost-effective to adapt to climate change than to mitigate and prevent it. It was not the procedure *per se* that was condemned, it was the assumptions behind the valuation of the assets at risk. These said valuation was proportional to income, so the climate-caused death of a poor person was one-fifteenth the value of a dead rich person. When the climate mortality was summed globally, the net effect was to demonstrate that adaptation to climate change was the 'efficient' or cheaper option.[13]

It is this which demands a change in the accounting. Thus, we need a war on error, on the fixation with 'efficiency' and what former World Bank economist Herman Daly has called 'uneconomic growth'. It requires amnesty with the actuality of ecological limits and with each other as people. Success is possible if 'efficiency' is understood as at best a derivative of the principles of the UNFCCC, namely 'precaution' and 'equity'. Success is governed by the safe and stable limits that preserve us all and the global constitutional norm that values the right to life, regardless of income, as equal. This is a security

proposition, more than any ethical construct. The alternative: to share the proceeds of unsustainable growth unequally, with conflict and failure the inevitable consequence.

SEQUENCING PRINCIPLE AND PRACTICE IN THE BATTLE OF THE RATES

The 'ultimate objective' of the UNFCCC (see box on p. 31) is to stabilise the rising atmospheric concentration of greenhouse gases at a level that prevents dangerous anthropogenic interference with the earth's climate system. The Convention declares 'qualitatively' that this must be done based on the principles of precaution and equity. Quantitative guidance, however, remains vague. It is expressed as aversion to danger by noting the per capita emissions differentials and 'differentiated responsibilities' of 'parties' for the historic contributions to the atmospheric build-up of GHGs. Subject to the limit that saves us, a quantitative methodology is required to reconcile the process to the limit. Without this there is the real danger of global failure swallowing local success.

It is said that principle without practice is useless, while practice without principle is dangerous. If ever the latter were true it is now and principle must precede and inform practice if we are to have any chance of avoiding dangerous rates of climate change. Specifically, this means that we have to solve the problem of climate change faster than we cause it. So consistency with a principled methodology for measuring the rate at which we cause the problem, against which we can demonstrate the faster rate at which we cause the solution, is a *sine qua non* for success.

The Convention uses the words 'ultimate objective'. As it stands, this does not sequence principle and practice. So some choose to limit the meaning of the word 'ultimate' to 'eventual', where the words mean merely the eventual future outcome of UNFCCC. Others recognise in 'ultimate' the sense of 'fundamental'. Here, the fundamental, perpetual and pervasive purpose of the Convention, before, during and throughout the process is recognised. It is in this sense that quantitatively principled methodology precedes process. Increasing momentum of human emissions on the atmosphere is already evident. Dangerous rates of climate change and its catastrophic damage effects will occur unless we stop this momentum by rapidly contracting these emissions. For this contraction to be globally effective and sufficient, it must be guided by an international C&C agreement with its practice quantitatively structured on that principle.

As the UN, through the vast majority of its members who were party to the Convention, are still legally committed to its achievement, the claim here, thus, is that the UNFCCC *is*, by definition, the 'United Nations Framework Convention for Contraction and Convergence' (UNFCC&C).

PRACTICE WITHOUT PRINCIPLE LEADS TO GLOBAL TRIAGE

The 'Berlin Mandate' was agreed at the first Conference of the Parties (COP-1) to the UNFCCC in Berlin April 1995, to establish a Protocol to the UNFCCC. Between 1995 and 1997, the 'ad hoc group on the Berlin Mandate' (AGBM) was chaired to this purpose by Raul Estrada Oyuela, a distinguished career diplomat from Argentina. In August 1997 the AGBM met for the seventh time, a few months before COP-3 in Kyoto, in December 1997 and the creation of what would become known as the 'Kyoto Protocol'.

During this meeting of the AGBM, Chairman Estrada appeared at a very large conference for the press and the NGOs to report on progress and take questions. Emission trading had come into play and everyone knew that the political argument had come to centre on one question above all others: 'How would the multilateral commitments on emissions control be defined and quantified?' A new word had resulted from the acronym of the point at issue, namely 'Quantified Emissions Limitation Reduction Options' or 'QELROS': or put more bluntly, who got how much and why.

By this stage, GCI had established two clear benchmarks in the debate. The first was C&C as the meta-concept for calculating QELROS in a scientific and constitutional manner. The second – considered notorious – was that the so-called Byrd-Hagel Resolution (BHR) of the US Senate, in July 1997,[14] amounted, in fact, to C&C.[15] The BHR was all or nothing. It embraced QELROS globally, as *quantified reductions* alongside *quantified limitations* of emissions for all of the developed and the developing countries all on the same account. GCI took the view that C&C was the only way to negotiate what the resolution called for, as anything devoid of a concentration target and more complicated than C&C would be rich in contested assumptions and recreate the arbitrary sub-global conditions that the US had been objecting to all along. In other words, the US rejects the notion that only part of the world, the developed nations (listed in Annex I of the Kyoto Protocol), should be made responsible for acting on

climate change. Why, for instance, should the US have obligations to act but not China?

Indeed, whether the Senate had intended it or not, BHR was tentatively seen, by the US climate delegation *inter alia*, as C&C by definition. At a special series of meetings in Washington in July 1997, officials of the US government asked GCI to raise support for this understanding, particularly in India and in China. We did this on visits to those countries during July and when reporting back in August we also secured a collective statement to the UNFCCC from the Africa Group of Nations affirming the need for C&C. As the record shows, all this would feature clearly at the end of COP-3.

As he reported to the AGBM 7 press conference, Chairman Estrada was familiar with all these developments. His news, however, was desultory. The US continued objecting to the one-sided nature of the negotiations and the commitments on offer; the European governments and NGOs were effectively hostage to this BHR demand for a global solution. At the end of the session I publicly asked Estrada if the QELROS were seen as a function of an atmospheric greenhouse gas concentration target or whether it was the other way around, that the concentration value was simply seen as the result of whatever haggling had taken place in the QELROS negotiation. To much laughter from Greenpeace and its cohorts in the Climate Action Network, who had wrongly interpreted GCI's support for a global solution as support for the US position per se, he said, 'Aubrey in this process what happens in practice is what happens and you make up the principles afterwards to explain what happened in practice.' In other words, while Estrada afterwards apologised for the rebuff, what he was actually saying amounted to a case of 'make it up as you go along'.

A few years later Estrada published a paper in which he recalled the exchange thus:

> In a meeting with NGOs during the Kyoto Protocol negotiations, Aubrey Meyer asked me which differentiation criteria were being used in the process. As negotiations were very flexible, I answered that at the end of negotiations I would explain those criteria, and that allowed me to get out of the situation among the laughs of the audience. When the negotiation ended and the Protocol was adopted, Aubrey Meyer asked me again which were the criteria, and since I didn't know the answer, I simply said that with QELROS agreed criteria were no longer relevant.[16]

Candid as he was, the blunt truth is that what Estrada had revealed was an example of aleatory – a term used in music for elements chosen at random – at the highest level of climate change politics, even more farcical than gesture politics. It is as if someone who waves their arms around believes that by doing so this makes them the equal of a great virtuoso violinist, say, of the ilk of Jascha Heifetz. The simile is harmless but what it illustrates is not. The UN climate negotiations are fundamentally flawed by the evolutionist folly that just plucking 'promising' numbers for QELROS out of a hat will do. The hope is that everyone will fail to notice the difference between the signal of what is required and the noise of what is actually happening. In the final hours of COP-3 the global allocation of tradable emission permits was debated. The US accepted in principle the C&C signal led by the Africa Group, India and China.[17] But while the UK remained silent, Estrada suspended the meeting saying that all the work done was in danger of being lost. The remnant noise became the Kyoto Protocol.[18]

Even 'evolutionists' could see by the end of 1997, however, that dangerous rates of climate change would not be averted by this aleatoric approach. Instead, it would collectively lead us to a kind of global triage – the sorting of the priority order of patients waiting for medical treatment – leaving us increasingly unfit to survive. Indeed, as matters are currently unfolding, such a process of triage has already begun.

A further insight into how this has been happening is provided through the person of James Cameron, an architect of Kyoto and emissions trading and a UK government adviser turned 'carbon trader'. In 1990 Cameron's 'Centre for International Environmental Law' (CIEL), in association with Greenpeace, encouraged the vulnerable Small Island States of the South Pacific and the Caribbean to form the Association of Small Island States (AOSIS). As the islands are mostly low-lying and very vulnerable to sea-level rise, the group took on the status of 'canary-in-the-mine', a *memento mori* for us all, if dangerous rates of climate change are not avoided.

By 1995, however, Greenpeace and CIEL had persuaded their clients that salvation lay in them presenting what became known as the 'AOSIS Protocol' to COP-1. Refuting the need for 'globality' defined by common sense and the US government, this stated that the developed countries should only tighten their emission reduction 'commitments', as in the UNFCCC, in exchange for no control of emissions by anyone else. At COP-2, in 1996, the US rejected this as 'unrealistic'. When the US presented their Byrd-Hagel Resolution

a year later, Greenpeace attacked it as 'Byrd-brained'[19] whilst also arguing that global emissions must be reduced to zero by 2050 to avert a global climate disaster.[20] This was the same as the C1 scenario of 'Acceptable Risk' as defined above, a position GCI had argued since introducing C&C at COP-2 in 1996. As anyone could see that C&C was obviously required to achieve this, from that day to this it remains a mystery why Greenpeace and Mr Cameron have routinely denounced all calls for C&C. All the more peculiar, one might add, given that Greenpeace and others have described the paltry outcome of the COP-3 as 'a farce' and recognised that AOSIS have shifted from being an endangered species to being a certain discard in the emerging reality of triage. Moreover, since then Greenpeace has repositioned itself and the NGOs at the margins of the triage in a process now nearer the C3 scenario of 'Impossible Risk', and with Mr Cameron now operating as 'Carbon Capitalist' and trader par excellence at these lucrative margins. Indeed, Cameron has recently added Africa to the growing pile of discards that the C3 scenario inevitably causes and the economics of genocide inevitably requires:

> The Africans are in a perilous position. They will not be rescued by 20 years of debate about C&C. Nor will they be rescued by the Carbon Market [or] beneficiaries of [it]. They're going to have to really look to the possibilities that do exist in altering their economies to cope with very high fossil fuel prices and Climate Change at the same time . . . some combination of looking at land use and land use change issues; of coping more effectively with the water resources which are there; of growing biocrops; of ensuring that renewable energy technology is made available at low cost.[21]

C&C IS 'QUANTUM' AND IT COUNTERS DESPAIR WITH THE MOMENTUM OF HOPE

It is neither sane nor sanguine to defend the notion of unequal rights and simply discard vulnerable third parties. If we continue this, a growing global apartheid increasingly separates us from each other, sanity and the planet. If, and only if, we correct this 'in-time' and 'in-tune', can the really violent and potentially terminal 'corrections' of a changing global climate still be avoided.

The challenge is organising a C&C framework in preference to being further disorganised by structureless commerce of 'expansion and divergence', triage, conflict and chaos. It is simply not enough

to rely just on more guesswork and patchwork and end up doing 'too little too late'.

Against this, counsels of despair are increasingly being voiced by eminent scientists such as James Lovelock, the creator of the *Gaia* theory.[22] He now suggests that it is already all too late. Although he has good reason to because of the 'aggravated rates' of GHG accumulation, this is nonetheless the 'victim's perception'. This must be weirdly amusing to the people who have said that there is no climate problem, only now to convert to saying that there *is* but there is no solution: it is all just too vast for the intelligence of humanity.

C&C says there still is time to define the goal-driven framework for solutions. However, for this to work, the international politics needs urgently to be freed from the stalemate by division that explains the failure of the Kyoto Protocol. For the last 15 years one half of the world has felt that it is being asked to do too much too soon in exchange for the other half of the world doing (or what is seen as doing) 'too little too late'. When the US oil industry took the position that 'there isn't a problem and you can't solve it without developing countries' (sic), this was simply the obverse of the juvenile 'green' organisations who took the position that 'there is a problem and you can solve it without developing countries'. The measurement challenges in this daft stalemate made effective negotiation of the UNFCCC impossible. The Kyoto Protocol was the result. Worse, the European Trading Scheme, seen as a gold standard by its 'free market' advocates, recently descended into bathos as European governments effectively took to bribing polluters to join it. Enron's fraud was mild by comparison but the pork-barrel basis of GHGs permits pre-allocation is the problem.

This hastens the danger of runaway climate change. To stop this requires measures that are congruent with the context of what is already an acute time-dependency. Survival for the human species is now a race against time. We have to solve this problem understanding that the 'we' involved is 'global', with all of us fitting into the available space-time that is left.[23] With a clear implication derived from 'do unto others', the context is almost biblical but it also raises fundamental questions of identity and culture as to:

- 'What' is being measured?
- 'How' are we measuring what is being measured?
- 'What' is the time-dependent unit of measurement?

- 'How' is value being assigned?
- 'Who' is doing the measurement?

As in love and quantum mechanics, the measurer and the measured are interactive; the observer's observation affects the observed. The strongest reason to deconstruct the inequality in the cost-benefit of expansion and divergence is simply that the economic science of inequality breeds climate failure. Kyoto's defenders unwittingly underwrite this. Though they reject the goalless model, or guesswork, of pure laissez-faire, they also reject the goal-focus of the C&C framework as somehow worse. Interestingly, it is for this reason that even transnational corporate leaders have taken to calling the Protocol an 'ineffective patchwork'. In the absence of a global GHG concentration target, they say they cannot address the drift into climate chaos.[24]

CONCLUSION: C&C DEFENDS ONLY TWO ASSUMPTIONS

The political equivalent of the quantum particle/wave dichotomy has Kyoto knowing where it is but not what its effect is or where it is going. C&C knows what its effect is and where it is going, because it defends only two core assumptions of numeracy (limits and equal rights), it is simple and simply says so. This science-based rationale gets increasing traction while Kyoto loses it to the goal-free poker-economics of 'multi-criteria trade-offs' and third party discards.

Consider again Einstein's vexed riddle as to whether God 'plays dice'. The game could not be played unless the dice existed. Principle simply precedes practice and so informs it. The dice are structured so and the game is programmed by the dice. Avoiding dangerous rates of climate change is the dice game we now play. Only in unity can we be determined not to lose. Contraction and convergence counters despair with the momentum of hope. Without such vision, much of humanity will simply perish.

FURTHER INFORMATION ON CONTRACTION AND CONVERGENCE

C&C definition statement and Bill:
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Zoom-able global past/future C&C 'map':
http://www.gci.org.uk/images/C&C_Bubbles.pdf
Animated C&C demonstration:

http://www.gci.org.uk/images/CC_Demo(pc).exe
C&C pledge statement:
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