

**Limiting Global Greenhouse Gas Emissions
- An Urgent and Overdue Ecological Economics Measure on Climate Change**

**Submission for ANZSEE 2007 Program Committee –
Draft Paper for Peer Review**

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Abstract

Scientists have been warning about the danger from global warming for almost 20 years and our national and international governance systems have failed to deliver policies to effectively address this planetary emergency. After reviewing the reasons for the failure of our political, social and economic systems to make an effective response, it discusses why it is critical that we limit average global warming to less than 2°C above pre-industrial levels. Given that this will require ensuring that greenhouse gas emissions peak by 2015 and are then significantly reduced to 25% of 2000 levels by 2050, this is an enormous challenge. It is a challenge, however, that needs to be urgently addressed, as the risks to the future of humanity of allowing warming to exceed 2°C are potentially enormous and disastrous.

Key words: climate change, carbon rationing, international governance

“ For fifteen years now, some small percentage of the world’s scientists and diplomats and activists has inhabited one of those strange dreams where the dreamer desperately needs to warn someone about something bad and imminent; but somehow, no matter how hard he shouts, the other person in the dream - standing smiling, perhaps, with his back to an oncoming train - can’t hear him. This group, this small percentage, knows that the world is about to change more profoundly than at any time in the history of human civilisation. And yet, so far, all they have achieved is to add another line to the long list of human problems- people think about ‘global warming’ in the way they think about ‘violence on television’ or ‘growing trade deficits’, as a marginal concern to them, if a concern at all. Enlightened governments make smallish noises and negotiate smallish treaties; enlightened people look down on America for its blind piggishness. Hardly anyone, however, has fear in their guts.” (McKibben, 2003)

Background and Introduction

In 1988, the Toronto Conference on the Global Atmosphere, hosted by the Canadian Government and attended by many eminent climate scientists and concluded “humanity is conducting an unintended, uncontrolled and globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war” and that States should “reduce CO₂ emissions by approximately 20% of 1988 levels by 2005 as an initial goal” and establish a “World Atmosphere Fund” to be financed in part by a levy of fossil fuel consumption in the industrialised countries (Bodansky, 1994, p15).

In 1990, the Intergovernmental Panel on Climate Change (IPCC) published its First Assessment Report which “predicted that if states continue to pursue “business as usual,” the global average surface temperature will rise by 0.3C per decade...a rate of change unprecedented in human history” (Bodansky, 1994, p57) This was despite successful attempts encouraged by the fossil fuel industry through the US, Saudi and Soviet delegations “watering down the sense of the alarm in the wording, beefing up the aura of uncertainty” (Leggett, 2001, p15).

The first section discusses why so little progress has been made given in the almost 20 years since the Toronto Conference identified the magnitude of the global warming problem and identified initial goals of emission reductions to address it. All the IPCC reports since 1990 have confirmed the climate change problem with increasing certainty and the need to take urgent action to address it. This lack of progress on addressing the climate change problem has also occurred despite the fact that scientists have demonstrated that we can power our current and future global economy from renewable energy sources with minimal greenhouse gas emissions (Sorensen, 2004).

The second section of the report is mainly based on the 2007 IPCC Report of Working Group 3 on Mitigation of Climate Change (IPCC, 2007). This IPCC Report and other reports identify what level of emission reductions is needed to limit the risk to the planet of dangerous climate change. It briefly discusses some of the mounting evidence that global average warming in excess of 2°C will represent dangerous climate change. The third section then discusses a possible approach to achieving the level of emission reductions that the IPCC Report and other research indicates are necessary to limit the risk of exceeding average global warming of 2°C.

No Agreement to Substantial Reductions

Negotiation of the UN Framework Convention on Climate Change (UNFCCC) concluded in 1992. This Convention had as its ultimate objective to achieve “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (UNFCCC, 1992, Article 2). It also included an agreed precautionary principle in relation to climate change. 189 countries, including all the major developed and developing countries, have ratified the UNFCCC.

Its objective of preventing dangerous anthropogenic interference with the climate system is, however, not being achieved. One of the major reasons for this was the successful resistance by the US of the inclusion of targets and timetables for reductions of greenhouse gases in the UNFCCC. In the view of William Nitze – who led the US delegation to the UNFCCC International Negotiating Committee during the negotiations – “the Bush Administration’s climate change policy was not based on a rational assessment of the national interest...It was based on a volatile mixture of ideology and politics. Key US Presidential advisors led by former Chief of Staff, John Sununu believed that the climate change issue was being used by environmentalists to impose their “anti-growth” agenda on the US economy” (Nitze, 1994, p189). “The Bush Administration felt the need to accommodate the wishes of industrial interests dependent on the production and use of coal and oil by opposing any targets and timetables for CO2 reductions as long as possible (Nitze, 1994, p190)”. Given that the US was by far the largest emitter of greenhouse gases and the world’s largest economy,

it was unlikely that other countries from the OECD or the developing world would sign a climate change agreement without the participation of the US. The US therefore “achieved its major negotiating goals in the final agreed text” of the UNFCCC (Nitze, 1994. p188).

In 1994, at the 9th meeting of the International Negotiating Committee of the UNFCCC, the majority of countries agreed that commitments by industrialised nations to cut greenhouse gas emissions were inadequate to meet the treaty’s objectives (Business Editors, 1994; Oberthur & Ott, 1999). This was followed by efforts by the fossil fuel industry led by the Global Climate Coalition (GCC) and its allies, particularly the Climate Council, to ensure that there was no international agreement that the commitments were inadequate and to ensure a blocking role for their OPEC allies in the international negotiation process by requiring consensus on all matters of substance (Oberthur & Ott, 1999).

The election of President Clinton and Vice President Al Gore in 1992, particularly given the latter’s environmental and climate change credentials, had given hope that the US would take a more progressive position in the climate change negotiations (Moltke, 1997; Oberthur & Ott, 1999). Clinton had been forced to rule out a carbon tax during his 1992 election campaign, due to a Republican attacks claiming it would cost over 280,000 of jobs in the state of Ohio (Ohio was a key state in the election) and that he supported such a carbon tax as Vice Presidential candidate, Al Gore, had advocated one in his book *Earth in the Balance* (Berke, 1992).

The fossil fuel lobby, particularly through the Global Climate Coalition (GCC) continued to provide substantial opposition to any US commitment to targets and timetables for greenhouse gas reductions. It also sought to highlight the uncertainties that arise in dealing with such a complex chaotic system as the earth’s climate and use climate skeptics to strongly promote the uncertainty. The GCC actively promoted the views of climate skeptics such as Patrick Michaels, Fred Singer, and Richard Lindzen in its literature, press releases, and congressional testimony, and would direct press inquiries to these people (Leggett, 2001; Levy & Egan, 1999).

The GCC and its fossil fuel industry allies successfully lobbied to defeat in Congress in 1993 the Clinton Administration’s proposed energy tax (BTU Tax) which was to be levied at a higher rate of petroleum fuels (Hoerner & Muller, 1996). By 1995, a landslide victory by the Republicans in both houses of the US Congress in 1994 buried any hope of Congressional support for stringent measures to reduce greenhouse gases.

In response to a 1995 report by the US National Climatic Data Center (NCDC) that documented an increase in severe weather events, the fossil fuel lobby through the GCC commissioned a study by a private weather forecasting firm, Accu-Weather, denying any such changes. The Accu-Weather report received significant media coverage, as it was released in the lead up to the 11th and final meeting of the UNFCCC International Negotiating Committee (INC) in 1995 in New York. This was despite the fact that the fossil fuel industry sponsored study was a laughingstock in the scientific community. It turns out that the NCDC study was based on all the weather data in the US collected since the beginning of instrumentation. By contrast, the Accu-Weather study drew on data from three towns – Augusta, Georgia, State College,

Pennsylvania and Des Moines, Iowa (Accu-Weather, 1995; Gelbspan, 1999; Leggett, 2001)

At the INC meeting itself, the allies of the fossil fuel industry were ruthless (by diplomatic standards) in preventing international agreement on the inadequacy of commitments under the UNFCCC and on decision-making procedures.

“At that New York meeting, the adequacy-of-commitments debate ended in acrimony. The EU, the United States, and most of the other JUSCANZ¹ members agreed that the commitments were inadequate. Russia, the OPEC nations, and several other countries, however, maintained that they were adequate. Australia, among others, expressed reservations. The true cause of the acrimony, however, was a series of disruptive tactics instigated by the OPEC nations. Led by Saudi Arabia and Kuwait, these nations attempted to undermine the forthcoming Berlin conference by blocking agreement on the rules of procedure for the meeting. Many states' representatives were particularly upset by the flood of messages passed by the Global Climate Coalition to the Saudi and Kuwaiti delegations during the final, late night discussion about the rules of procedure. The meeting broke up with bad feelings between many delegations, no decision on either the adequacy of the commitments in the UNFCCC or the rules of procedure for Berlin, and a ban on the presence of all nongovernmental organizations on the floor during debates (Lanchbery, 1997, p8).”

An interviewee indicated that it was Don Pearlman of the Climate Council (a close Global Climate Coalition ally - also mainly funded by the fossil fuel industry) that was the main source of the messages and the cause of the ban (UNFCCC Interviewee 1, 2006).

On the other side of the international climate change policy debate, the Alliance of Small Island States (AOSIS), supported by a range of non-governmental Environmental Organisations, submitted a draft Protocol for the first Conference of the Parties (COP) of the UNFCCC in Berlin in 1995. This draft protocol called for a 20% reduction of CO₂ emissions of industrialised countries by 2005 in line with the target and timetable proposed by the Toronto Conference in 1988. This draft Protocol could have under the UNFCCC's rules been adopted by the COP in Berlin in 1995 and would have represented a significant step forward in combating climate change. This significant step forward was not taken, however, as even the European Union (EU), which had supported targets and timetables in the negotiation of the UNFCCC, was having difficulty getting several of its member governments to support stringent action on climate change (Leggett, 2001; Oberthur & Ott, 1999).

An agreement was reached at the first COP on the Berlin Mandate which agreed to a process based on analysis and assessment to set quantified emission limitation and reduction objectives within specified timeframes. Some concessions were made to the US and other laggard countries in terms of the wording of the Berlin Mandate. The Mandate process was to be completed by COP 3 in 1997 which Japan had agreed to host in Kyoto (Leggett, 2001; Oberthur & Ott, 1999).

¹ JUSCANZ – an acronym for Japan, US, Canada, Australia and New Zealand

The GCC on behalf of the US fossil fuel lobby was immediately on the offensive, criticising the fact that developing countries were not included in those countries committing to objectives under the Berlin Mandate (PR Newswire, 1995). This was despite the fact that it had been agreed under the original UNFCCC that the Annex 1 countries (mainly the industrialised OECD, Russia and Eastern European countries), which had emitted most of the greenhouse gases into the atmosphere, would be first to take action. Almost all of these countries had much higher per capita emissions than any developing country although total greenhouse gas emissions from India and China were becoming more significant.

Later in 1995, the IPCC finalised its Second Assessment Report. It was at the working group plenary to finalise the IPCC Summary for Policymakers: The Science of Climate Change - IPCC Working Group 1 that the GCC, the Climate Council and its allies, particularly Mohammed Al-Sabban, a Saudi Oil Ministry Official used crude but effective tactics to weaken the conclusions in the Summary and thereby have the full IPCC scientific report changed to match the Summary. At a late stage of the proceedings, when many scientists had left and NGOs had been asked to stop making interventions and leave the floor for governments, Don Pearlman from the Climate Council would ferry written notes to Al-Sabban who would then intervene to again weaken the scientists' conclusions (Leggett, 2001).

Despite the success of GCC and its allies in weakening IPCC Scientific Report's language some of which was then reflected in the IPCC Synthesis Report (eg "Emerging evidence points to a detectable human influence on climate" (Leggett, 2001, p227) became "the balance of evidence suggests a discernible human influence on global climate" (IPCC, 1995, p22). The IPCC Report stated that "using technologies that presently yield the highest output of energy services for a given input of energy, efficiency gains of 50–60% would be technically feasible in many countries" over the next two to three decades (IPCC, 1995, p37). The Clinton Administration in the US accepted and publicly supported the findings of the IPCC, which had drawn heavily on US research results (Oberthur & Ott, 1999)

An Agreement on Limited Reductions

The offensive by what Leggett (2001, p15) and the other environmentalists called the "Carbon Club" intensified in the period preceding and following the agreement on the Kyoto Protocol in December 1997. The Kyoto Protocol agreed a reduction target of 5.2% of greenhouse gas emissions from 1990 levels for the Annex 1 countries averaged over the period 2008-2012, with some countries such as Australia negotiating an increase. The EU committed to an overall reduction of 8% and the US committed to a 7% reduction from 1990 levels of greenhouse gases, well short of the 20% by 2005 target proposed by the Toronto Conference in 1988 and included in the draft AOSIS Protocol submitted to the Berlin COP in 1995.

In the two years from the Berlin COP of 2005 till the Kyoto COP of 2007, the GCC was a key member of a wide coalition of US Business Interest NGOs and major fossil fuel and auto industry corporations opposing US commitment to what became the Kyoto Protocol. The GCC and their allies sought to turn the precautionary principle on its head, comparing the supposed uncertainty of the science of climate change to the alleged certainty of large economic costs and job losses that would occur in the US if

carbon dioxide emissions were significantly reduced (WEFA Group, Zinder & Associates, 1996).

In 1997, members of this carbon coalition funded a \$13 million public advertising campaign claiming that the risk to the US economy of signing Kyoto Protocol was too great. The American Petroleum Institute, a leading GCC member (William O'Keefe, was a senior executive at API and Chairman of the Global Climate Coalition at the time) was a major funder of the campaign and sought funding from other GCC members. "Public opinion did shift (following the campaign) while it was concerned about climate change, it was also concerned about economic impacts (GCC Interviewee 1, 2005)". An image of one of the press advertisements with the headline "The UN Climate Treaty is not Global – It's not Global and it won't work" is shown in Appendix 1. This reflected the theme initiated in 1992 by the GCC and its allies of focusing on the growing emissions of developing countries, particularly China and India and the adverse impact that they claimed that emission reduction targets would have on the US economy (GCC, 1996).

An opinion survey in the U.S. tried to measure the effects of this campaign and the intense newspaper debate at the time. It concluded that the debate led to a higher exposure of the American public while still 44% of respondents had not remarked any story on the climate change issue. The media campaign succeeded inasmuch as the percentage of respondents stating that scientists disagreed on the climate change issue doubled from 38% to 67%. This shows the success of the GCC and its allies in promoting the climate sceptics to try to undermine the peer reviewed science of the IPCC. Overall, about 3/4 of respondents thought that temperatures had risen during the last century and would continue rising in absence of climate policy."(Michaelowa, 1998, p255)

Despite this advertising campaign and the claimed shift in public opinion, the majority of the US public remained convinced on the need for urgent action to reduce greenhouse gas emissions. The New York Times conducted a large public opinion survey on global warming just prior to the Kyoto COP. Sixty five per cent of those polled felt that the USA should take steps to cut its own emissions immediately, irrespective of what others did. The margin of error on this figure was just 3 per cent. It seemed, as the Times put it, that 'the American people are far more willing than their government to take early, unilateral, steps'. As for the public's response to oil and coal-industry arguments that emissions reductions would be economically ruinous, 'they appear to be unimpressed', the Times concluded (Leggett, 2001).

The GCC and its allies were, however, more successful in gaining support of the US Senate in a resolution opposing the US agreeing to the proposed Kyoto Protocol. In Spring of 1997, Senator Byrd, a strong advocate of the coal industry from a major coal mining state, West Virginia, (Lee, Cochran & Roy, 2001) approached the a senior GCC official to seek advice in regard to a proposed Senate resolution opposing the Kyoto Protocol (GCC Interviewee 1, 2005). Senator Byrd also sought support from the GCC and its members in lobbying Senators to support the resolution. During the weeks following the meeting, fossil fuel and automobile industry lobbyists were briefed and successfully lobbied Senators to support the resolution that had over 60 co-sponsors was passed 95-0. The Clinton Administration did not seem to react to the proposed resolution either because "not fully aware of it or did not think much of it and therefore

never mounted a major challenge to it” (GCC Interviewee 1, 2005; Lee, Cochran & Roy, 2001).

Given the level of opposition in the US Senate and that it requires a two-thirds majority in the Senate to ratify a treaty, President Clinton never sent the Kyoto Protocol that was signed by the US to the Senate for ratification. The problem of getting Senate support was compounded by the power of the fossil fuel industry which not only has many well funded lobbyists but also made almost US\$40 million in political campaign contributions in 2000 (www.opensecrets.org, 2006a, 2006b) and traditionally has been a major contributor to US Presidential and Congressional election campaigns.

In March 2001, President GW Bush announced that the US had abandoned ratification of the Kyoto Protocol. The US fossil fuel lobby’s efforts to undermine the US commitment to participate in international action on global warming had succeeded. Just after that in a briefing paper given to President GW Bush’s under-secretary of state, Paula Dobriansky, before a meeting with the Global Climate Coalition, states that POTUS [President of the United States] rejected Kyoto in part based on input from you [the Global Climate Coalition]" (US State Department & Brill, 2001, p3). Other papers suggest that Ms Dobriansky should sound out Exxon executives and other anti-Kyoto business groups on potential alternatives to Kyoto. The papers further state that the White House considered Exxon "among the companies most actively and prominently opposed to binding approaches [like Kyoto] to cut greenhouse gas emissions" (Vidal, 2005). In addition, Phil Cooney former American Petroleum Institute lobbyist was hired as Chief of Staff of White House Environment Office (Gore, 2006).

Implementation of the Kyoto Protocol without US participation

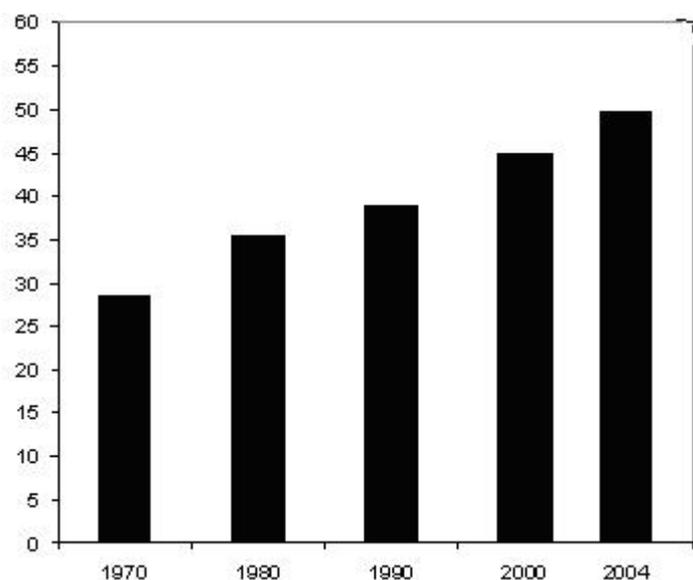
Even before the US withdrew from the Kyoto Protocol, major disagreements had arisen on the detailed arrangements for its implementation, particularly at COP 6 in the Hague in 2000 (Grubb & Yamin, 2000). Subsequent negotiations have weakened the Kyoto Protocol’s targets and its likely performance and effectiveness. The EU by offering concessions at the negotiations of the detailed implementation of the Protocol to Canada, Japan and Russia and other incentives to Russia managed to get the required level of ratification for the Protocol to come into force (Christoff, 2006). This required ratification by countries that represented 55% of emissions from Annex 1 countries, which given that the US represented 36% of emissions required that all other major Annex 1 countries ratified.

Given that the Kyoto Protocol was the major instrument to achieve the objective of the UNFCCC - the stabilization of atmospheric greenhouse gasses at ecologically safe levels - is likely to achieve a reduction of less than 1% of total global emissions of Annex 1 countries in the 2008-12 commitment period, it has not been effective (Christoff, 2006).

The refusal of the US (the world’s largest national emitter) to ratify the Protocol has also made it more difficult to get the major developing countries emitters, such as China and India which now rank 2nd and 4th in terms of their national emissions, to accept targets and timetables as part of the post-2012 international climate regime.

The recent IPCC Report (2007) shows that global greenhouse gas emissions continue to increase (as shown Figure 1 below) and have increased by 28% from 1990 levels by 2004 to total 49 gigatonnes of CO₂e² (equivalent).

Figure 1: Global Greenhouse Gas Emission 1970-2004 (IPCC, 2007)



Total greenhouse gas emissions in gigatonnes of CO₂e

It also concluded that “with current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades” forecasting an increase of between 25% to 90% of greenhouse gas emissions by 2030 compared to 2000 levels.

Despite, the increasing warnings that we are overheating the planet which started with the Toronto Conference Declaration in 1988 and the subsequent UNFCCC and Kyoto Protocol, we have made no progress in significantly reducing growth of global greenhouse gas emissions, far less actually reducing emissions. The US, the world’s largest emitter in total and along with Australia, the largest national emitter on a per capita basis both continue to increase their emissions (Christoff, 2006). Both have refused to ratify the Kyoto Protocol partly due to pressure from the fossil fuel lobby, as outlined above for US. Clive Hamilton (2007) recently documented a similar process in Australia. Neither the final UNFCCC or the Kyoto Protocol were particularly strong agreements compared with the magnitude of the problem and both were weakened by US and Australian negotiating tactics (Mintzer & Leonard, 1994; Oberthur & Ott, 1999).

The Kyoto Protocol was further weakened by the concessions discussed previously to Russia, Japan and Canada in order to ensure ratification. Alden Meyer from the Union of Concerned Scientists described the reductions in the original Kyoto Protocol as being "not as large as we believe is demanded by the science and is possible ... but it's important to get the foundation laid" (Hanley, 1997). Since then the US and Australia have withdrawn from the weakened Protocol and no significant progress has been made

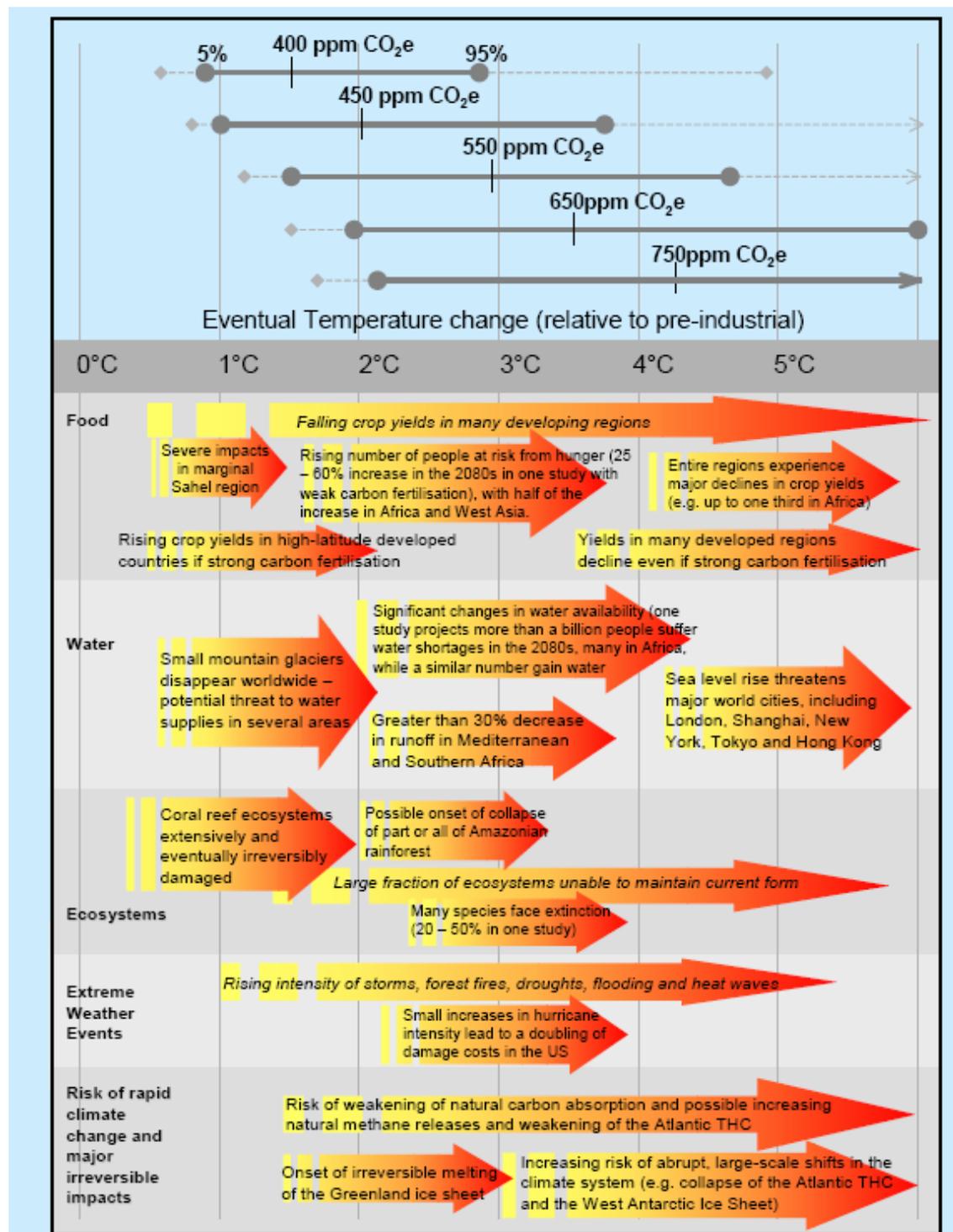
² CO₂e: Measure of all greenhouse gases in equivalent amount of CO₂

on a post-2012 international climate change agreement (Sterk et al., 2007). This demonstrates that there has been a major failure over the period from 1988 to 2007 of the international policy process to effectively address the climate change issue.

What needs to be done to Reduce the Risk of Dangerous Climate Change?

Given the lack of progress, it is unlikely that we can avoid potentially dangerous climate change – the target that is now being mainly discussed is limiting average global warming to 2°C. It is widely considered that warming should be kept below 2°C to avoid triggering irreversible, dangerous climate change, but that figure is now very difficult to avoid. At 450 ppm CO₂e (equivalent), which will be achieved in less than ten years, there is an 26-78% chance of exceeding 2°C and a minimum 3% chance of triggering runaway greenhouse heating. At 550 ppm CO₂e, which is the Stern Review target, there is a minimum 24% chance of triggering runaway greenhouse heating. “The 2°C level is far from "safe" and a political compromise because, practically speaking, it is going to require great effort to avoid it.” (Spratt, 2007, p1) The following diagram from the Stern Review shows the level of CO₂e in the atmosphere and the likely level of global warming from the pre-industrial era.

Figure 2: Stabilisation levels and probability ranges for temperature increases



From: (Stern, 2006) – Executive Summary

This diagram shows the enormous risks we face if average global warming exceeds 2°C with possible onset of irreversible melting of the Greenland ice sheet and other ecological disasters.

The IPCC (2007, p22) Report also indicates that to limit average global warming to 2-2.4°C, will require limiting atmospheric concentrations of CO₂ to 350-400ppm (and total greenhouse gases to 445-490ppm CO₂ equivalent). In order to achieve this it

indicates that total global greenhouse gases need to peak not much above current levels no later than 2015 at the latest and then need to be reduced to 50-85% below 2000 levels global CO₂ emissions by 2050. Compounding the problem, these reductions must occur right when the world's poorest countries are making the transition to modernity—in other words, at the very moment when global energy demand is about to skyrocket.

Given that to limit average global warming to 2°C requires emissions to start falling by 2015, which is only 8 years away; this indicates the urgency of the international policy problem. Given the IPCC forecasts, emissions by 2015 are likely to be 15-45% above 2000 levels and have already reached emission of 49 gigatonnes of CO₂e by 2004, it is likely by 2015 globally we will have annual emissions between 55-65 gigatonnes of CO₂ equivalents. Given a global population forecast for 2015 of 7.3 billion (UN Department of Economic and Social Affairs, 2006) and an estimated 60 gigatonnes of CO₂e emissions, this equates to an emission level of approximately 8 tonnes of CO₂e for every person on the planet.

The IPCC Report (2007) estimates that a 50%-85% reduction from 2000 of levels of 40 gigatonnes is required to stabilize greenhouse gas emissions at a level to limit warming to 2-2.4°C. Using a 75% reduction (not the maximum in the IPCC report – but above mid-point to reduce risk of overshooting the 2°C target) – this equates to 10 gigatonnes of emissions by 2050. Given a population forecast of 2050 of 9.2 billion (UN Department of Economic and Social Affairs, 2006) this equates to just over 1 tonne of CO₂e emissions for every person on the planet at that time.

Therefore, in order to effectively reduce emissions to a level that bring the risk of overshooting the potentially dangerous 2°C, emissions per capita therefore have to be reduced by 1 tonne per capita every 5 years for the 35 years from 2015 to 2050 (0.2 tonne per capita per year). This would achieve an 87.5% reduction from 8 tonnes per capita to 1 tonne per capita of CO₂e in per capita emission and approximately a 75% reduction in overall emissions from 2000 levels.

Table 1: Reductions needed per capita and total to minimise risk of 2°C+

Year	CO ₂ e per capita Tonnes	Global Population billion	Total CO ₂ e emissions Gigatonnes
2015	8	7.30	58.4
2020	7	7.67	53.7
2025	6	8.01	48.1
2030	5	8.32	41.6
2035	4	8.59	34.3
2040	3	8.82	26.5
2045	2	9.03	18.1
2050	1	9.19	9.2

It could be argued that using a straight line reduction of reducing allowable per capita emissions of 1 tonne every 5 years is rather simplistic, however, given the alternative technologies particularly in the energy sector are likely to rapidly improve over the period, given a requirement to move away from fossil fuels, achieving large percentage

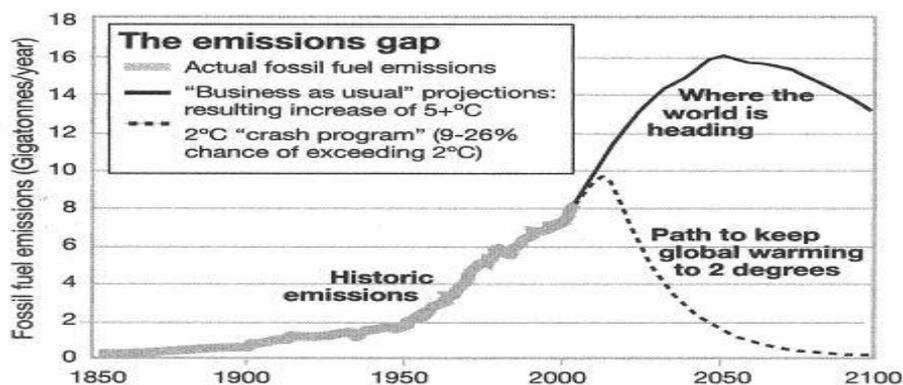
per capita reductions (eg reducing by 50% from 2045 – 2050 from 2 tonnes to 1 tonne per capita should be feasible) and probably more achievable (though less desirable) than achieving higher per capita reductions earlier.

In 2004, the US, Australia and Canada all emitted more than 20 tonnes of CO₂e per capita in 2004 (UNFCCC, 2006a) therefore to require a reduction of over 60% to meet a 8 tonnes per capita target by 2015. Using International Emissions Trading, it is likely they could buy some per capita emissions allowances from developing majority world countries which will not use all of their 8 tonnes per capita limit. US, Canada and Australia would need to reduce per capita emissions by over 95% to meet the 2050 requirement of limiting emissions to 1 tonne CO₂e per capita.

Focusing on emissions from fossil fuel emissions, which represent over half of the total global greenhouse gas emissions shows the dramatic change that is necessary. Current emissions from fossil fuel use are following the trajectory of the IPCC Special Report on Emission Scenarios (2000) "AIB" scenario (a globalized, technologically advanced world in which energy production includes a broad portfolio of fossil-fuel and non-fossil-fuel sources). Emissions are growing much faster than required for stabilisation at either 445-490ppm CO₂e or even at 650ppm.

Other research concludes, based on a reasonable set of assumptions, that to have a ‘very low to low risk’ (calculated as a 9%-26% chance) of exceeding the 2°C threshold, global emissions of carbon dioxide (CO₂) would need to peak in 2010, achieve a maximum annual rate of decline 5% pa 2015, and fall by over 80% below 2000 levels by 2050. This would need to be matched by similarly stringent reductions in the other greenhouse gases emitted to the atmosphere (Baer & Mastrandrea, 2006).

Figure 3: The emissions gap for fossil fuel use



Adapted from: (Carbon Equity Project, 2007)

Figure 3 shows emission in terms of gigatonnes of carbon used in fossil fuels - 1 tonne carbon burned represents 3.65 tonnes carbon dioxide in the atmosphere.

It will, in other words, take heroic efforts to achieve the level of reductions necessary, but a precautionary trajectory to limit warming to 2°C is still possible. Already existing technologies – if implemented and disseminated with Marshall Plan effectiveness and Manhattan Project urgency – can very quickly win us huge emissions reductions, and buy us time to develop new technologies and adopt lower consumption lifestyles. We cannot, however, afford the delay associated with “incremental decision making” as we know it today, when each increment must be made to appear economically unthreatening and politically palatable (Athanasίου, Kartha & Baer, 2006).

If we burn all the available fossil fuels, global warming would exceed that of the Pliocene era, three million years ago, when sea level was 25 metres higher than today. Consequences of such a sea level rise would be too severe to manage: a quarter of a billion Chinese live within 25 metres of sea level, there are many major cities on the East Coast of the United States below this level and about one billion people worldwide. The profound implication, which must be learnt by politicians and the public, is that we cannot burn all the fossil fuels. To do so would create a totally different planet, one without ice in the Arctic, with extreme heat and drought in the Mediterranean region, the American West and parts of Africa, and most important, with the sea level beginning to rise uncontrollably (Hansen, 2007).

A Modern Marshall Plan to Reduce Global Greenhouse Gas Emissions and prevent Global Warming of more than 2°C

The Greenhouse Development Rights (GDRs) approach proposed by Athanasίου et al (2006) or something like it is needed in order break the global impasse over developmental equity in a climate constrained world. The GDRs approach takes climate protection to mean a scientifically grounded precautionary approach. It recognizes the uncertainties, and aims to preserve a high probability of avoiding catastrophic climate disruption. This therefore implies an extraordinarily stringent global emission path.

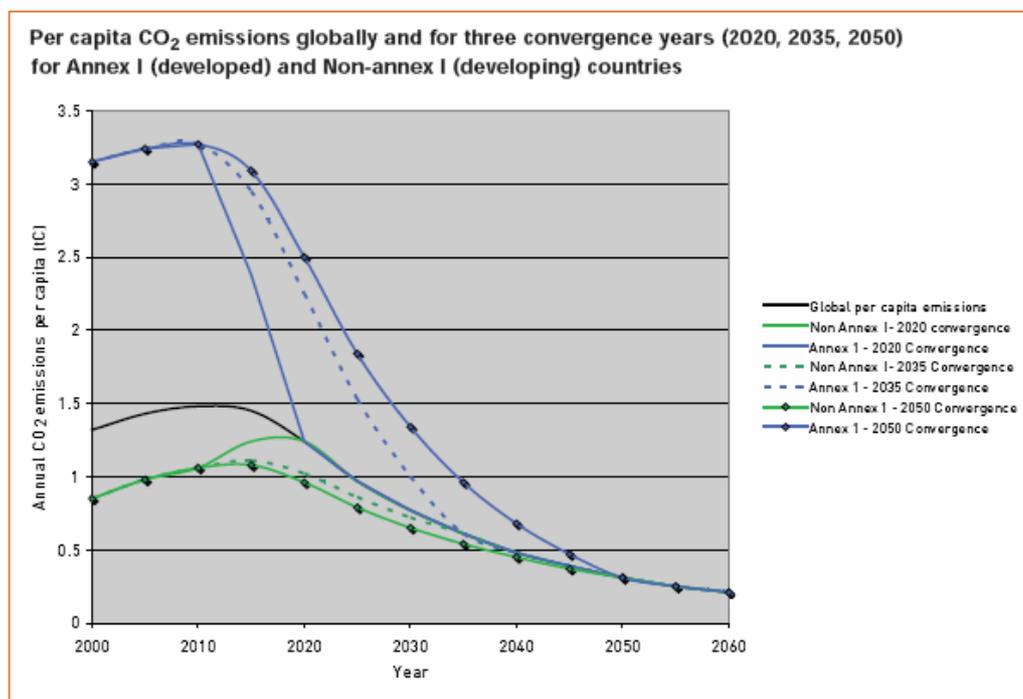
The GDR approach proposes a mitigation shortfall target for each nation, representing the level to which emissions have to be reduced below its “no regrets” emission level. The mitigation shortfall is defined as the amount of mitigation that is needed in order to adequately decarbonize the global economy and keep us within the precautionary global emissions budget, above and beyond the mitigation that nations can be expected to accomplish by means of no-regrets activities. Although, this then leads to a more sophisticated approach of allocating emission based historical responsibility and development level, the simpler per capita approach has, in my view, more chance of being supported in the international negotiations needed to bring it into place.

Even with the impending climate crisis, the majority world is dealing with a crisis of its own: the crisis of poverty that still afflicts the vast majority of its citizens. This includes scandalously high infant mortality rates, preventable or curable disease as a fact of life, the continuing onslaught of AIDS, malnutrition in a world of plenty and crushing daily physical insecurity (Athanasίου, Kartha & Baer, 2006).

The following figure shows the level of reductions required to achieve contraction and convergence of CO₂ emission between Annex 1 (developed countries) and non-Annex 1 (developing) countries in 2020, 2035 and 2050 with 4% per annum maximum rate of reduction occurring in 2020 from peak emissions in 2014. In order to have a very low

to low risk of exceeding 2°C it will be necessary to reduce emissions at a higher maximum rate of 5% pa rather than the 4% pa on which Figure 4 is based (Baer & Mastrandrea, 2006)

Figure 4 – Contraction and Convergence in 2020, 2035 and 2050



From: (Baer & Mastrandrea, 2006, p29) Figure 4 uses tonnes of Carbon as measure.

As discussed previously, it is necessary to reduce global emissions to 1 tonne of CO₂e per capita emissions by 2050 as the target necessary to reduce the risk of average global warming exceeding 2°C to low or very low. As 60% of emissions currently come from burning fossil fuels (IPCC, 2007), this will require a reduction to 0.6tonne per capita of CO₂ from fossil fuels used and based on the 3.65 tonnes of CO₂ emitted per tonne of carbon burnt, this represents approximately 0.16 tonne of carbon burnt per capita in 2050. The level of reductions therefore needed is shown in the Table 2 below.

Table 2: Reductions in fossil fuel used needed per capita and total to minimise risk of 2°C+ (assumes fossil fuel emissions continue to represent 60% of emissions)

Year	Global Population billion	Total CO ₂ e emissions Gigatonnes	Fossil Fuel Emissions Gigatonnes CO ₂	Per Capita Fossil Fuel Emissions Tonnes CO ₂	Per Capita Fossil Fuel Use Tonnes - Carbon
2015	7.30	58.4	35.0	4.8	1.32
2020	7.67	53.7	32.2	4.2	1.15
2025	8.01	48.1	28.8	3.6	0.99
2030	8.32	41.6	25.0	3.0	0.82
2035	8.59	34.3	20.6	2.4	0.66
2040	8.82	26.5	15.9	1.8	0.49
2045	9.03	18.1	10.8	1.2	0.33
2050	9.19	9.2	5.5	0.6	0.16

As discussed earlier, the straight-line reduction in per capita emissions does create ambitious targets for reductions in the later period; however, by that time vast improvements in technology providing non-carbon energy sources would be expected.

The International Political Economy of reducing Greenhouse Gas Emissions

Given the failure of the international governance process to achieve significant greenhouse gas reductions that was discussed in the first section of this paper, how is agreement on the much larger reductions now needed going to be achieved?

It certainly will not be easy to achieve agreement, given the current intransigence of high emission countries such as the US and Australia and their refusal even to ratify the limited reductions agreed in the Kyoto Protocol. The IPCC (2007) and other reports (Baer & Mastrandrea, 2006) outline the level of greenhouse gas emission reductions that need to be achieved to limit the risk of global warming to 2°C or less. This is for emissions to peak by 2015 at the latest and substantial reductions from then for the rest of the 21st century with reductions of at least 75% by 2050. (The IPCC give a range of 50%-85% but the modeling by Baer & Mastreandrea (2006) indicates that reductions of at least 75% below 2000 emission levels by 2050 are needed to avoid significant risk of exceeding the 2°C target.)

An international protocol based on a decreasing per capita allowance to be implemented as soon as possible could be negotiated under the UNFCCC. If implemented as a global cap and trade scheme with a global market being created in the emission allowances, it would allow the over emitters in the developed countries in the minority world to buy emission allowances from the many majority world developing countries with lower levels of emissions and thereby provide funds for their development, including development using low emission energy sources.

This would provide incentives for countries like China, which have high national CO₂e emissions of over 4 billion tonnes - last reported to UNFCCC in 1994 (UNFCCC, 2006b). As China's GDP has more than doubled since 1994 (Srinivasan, 2006), it is likely that emissions may have increased by 75% by 2007 (assuming some level of reduction in energy/carbon intensity of the Chinese economy over the period) so that China could be close to the 7 billion tonnes of CO₂e (a similar total national level as the US). Given a maximum per capita allowance of 8 tonnes per capita in 2015 which would fall steadily and China's anticipated population of 1.39 billion in 2015 (UN Department of Economic and Social Affairs, 2006), this would give China an incentive to limit emissions. Similar incentives would apply to Brazil and India that have relatively high national greenhouse gas emissions (UNFCCC, 2006b) but on a per-capita basis are well below most developed, Annex 1 countries.

This per-capita emissions scheme could be implemented as a global cap-and-trade system, with each country given allowances in an amount corresponding to its population multiplied by the target global per capita emissions for that year. This would result for many developed countries in shortfall versus their actual emissions that they would be obligated to reduce. Countries with emissions in excess of their allowances would be required to either reduce them domestically or, alternatively, to buy additional allowances on the global market, at a price that might indeed be quite high and increase steadily, reflecting as it does the stringency of the global adequacy trajectory based on

continual reductions of allowable per capita emissions. Any country that exceeded its total emissions target for a year would have a reduced emissions allowance for the following year. A country that came in below its emission allowance would be able to carry the credit forward to subsequent years (as weather factors – eg mild winters may affect emission levels). The country could also sell the allowance on the global emissions trading market to other countries for a subsequent year, if the country is on a trajectory of successfully reducing emission levels below its allowance level.

Based on the latest IPCC Report, the average Annex 1 country has 16.1 tonnes CO₂e per capita emissions, with the US, Canada and Australia being well above this average and European countries being below this average (IPCC, 2007). With an 8 tonne per capita cap on emissions from 2015, Annex 1 countries with high per capita emissions would need to purchase emission permits from low per capita emission countries as well as taking action to dramatically reduce their emissions. One major challenge will be getting the high emitting countries Annex 1 countries such as US, Canada and Australia to agree to this in any internationally negotiated agreement.

The average non-Annex 1 country has 4.2 tonnes per capita emissions (IPCC, 2007) so although they may also have some reservations about agreeing to limit emissions, many countries will be able to benefit from selling emission allowances as their per capita emissions would be below the initial per capita allowance level.

The IPCC (2007) Report estimates that the range of GDP reductions required to substantially reduce emission levels to limit CO₂e in the atmosphere to between 445-535ppm as less than 3% of GDP between now and 2030 which is less than 0.12%pa. An atmospheric concentration of 445ppm of CO₂e would incur substantial risk of global average warming in excess of 2°C and 530ppm would make global average warming in excess of 2°C almost certain (Baer & Mastrandrea, 2006). The developed world can easily afford 3% or more of GDP over the next 25 years and its need to purchase per capita emission allowance from the developing majority world should allow these countries to develop. Overall, the substantial investment and infrastructure required to make the necessary and rapid transition from a fossil fuel driven global economy should start to add rather than detract from overall global economic activity.

Given the problems encountered in the last 17 years, since negotiation on an international treaty on climate change first began and the lack of progress in achieving the objective of the UNFCCC that in 1992 agreed the objective of preventing dangerous interference with the atmosphere, the prospects for agreeing and implementing the urgent actions needed to limit warming to 2°C are not promising.

Australia is also not exactly leading the charge to require urgent action based on the most recent IPCC Report, federal Environment Minister Malcolm Turnbull responded with a statement saying that "imposing unilateral and savage cuts to Australian emissions will just export our emissions and jobs to other countries". Dr Fisher, the Head of Australia's delegation to the recent IPCC Forum commenting on the IPCC Report said, "if you look at the table showing the peaking times for carbon dioxide for low level concentrations in 2015 - frankly that is exceedingly unlikely to occur. That's only eight years away and . . . global emissions are growing very strongly. So already from a practical point of view we are breaching those low levels. That doesn't mean you don't do anything, or that you can't overshoot and come back. But as soon as you go

over it, it becomes much harder. On the current trajectories you would have to say plus 3 degrees is looking more likely." (Minchin, 2007)

Conclusion

Urgent and major international action is required to stop the currently steadily increasing levels on global greenhouse gas emissions so that they peak within 8 years and are reduced quickly and substantially from that level so we can limit the risk of average global warming exceeding 2°C. Urgent internationally agreed action and national action by all countries but particularly the developed, minority Annex 1 countries and China, India and Brazil as the leading countries in the majority developing world with substantial national greenhouse gas emissions.

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