

RECKLESS GAMBLERS

HOW POLITICIANS' INACTION IS RAMPING UP THE RISK OF DANGEROUS CLIMATE CHANGE

“This report is uncomfortable but essential reading for all policy makers. It demonstrates the remaining global carbon budget for even a 2°C temperature rise is small and diminishing fast and that unprecedented reductions in emissions are now required across the globe. It is a refreshing wake-up call for all those with a stake in our global future.”

Professor Kevin Anderson, Director of the UK's Tyndall Centre for Climate Change Research at The University of Manchester and University of East Anglia.

A REPORT FOR POLICY MAKERS BY FRIENDS OF THE EARTH ENGLAND, WALES & NORTHERN IRELAND



Friends of the Earth

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ABOUT THIS REPORT

This report is for the policy community involved in negotiating and agreeing carbon budgets at national, regional or international level. It summarises findings on the size of a global carbon budget consistent with the United Nations Framework Convention on Climate Change objective to “prevent dangerous anthropogenic interference with the climate system”. The report provides illustrations of how this global carbon budget can be apportioned to different countries. Its aim is to provoke a public debate about what constitutes an acceptable risk of dangerous climate change; a debate which to date has been confined to politicians.

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“This report is uncomfortable but essential reading for all policy makers. To have even a small chance of meeting the UK, EU and Global commitment to avoid ‘dangerous climate change’ demands courageous and candid political leadership. As this report admirably demonstrates the remaining global carbon budget for even a 2°C temperature rise is small and diminishing fast and that unprecedented reductions in emissions are now required across the globe. At a time when scientific assessments of the impacts of climate change underpin increasing pressure for a more stringent temperature target of 1.5°C, this report represents a refreshing wake-up call for all those with a stake in our global future.”

Professor Kevin Anderson, Director of the UK's Tyndall Centre for Climate Change Research at The University of Manchester and University of East Anglia.

MAIN REPORT FINDINGS

- Recent climate science and risk analysis show that there is now a very small remaining safe level of greenhouse gas emissions compatible with preventing dangerous climate change.
- A 2 degrees temperature rise can no longer be considered “safe”; even 1.5 degrees carries with it major risks.
- Even a Global Carbon Budget of 1100 Gigatonnes of CO₂ equivalent from now to 2050, which would give a 75% chance of exceeding 1.5 degrees, and a 30% chance of exceeding 2 degrees, would require unprecedented emissions reductions which go far beyond those currently contemplated by politicians. Reducing risks further would require even tougher action.
- If dangerous climate change is to be averted it will require immediate and significant changes to how we fuel our economies in virtually all countries, it will require systemic action across all sectors of the economies of all countries.
- As leaders of countries with large historical and current emissions, politicians in developed countries must shoulder the blame for increasing the risk of dangerous climate change. They will need to make deep emissions reductions and provide hundreds of billions of dollars for developing countries to grow without carbon-intensive energy.
- Living within the small remaining global carbon budget, if shared out on an equal per capita basis between 2010 and 2050, would require reductions in emissions in developed countries of around 8-15 per cent per annum, immediate emissions reductions in some developing countries, an early peak and decline in emissions in others, and some countries would be able to continue to increase emissions from their very low baseline. These are just illustrative figures, not prescriptions but if one group of countries emits more than these amounts, it would require corresponding reductions in what other countries emit and the scope for this is now very limited. Achieving cuts in developing countries will require substantial financial and technology transfers from developed countries.
- Urgent research and debate needs to be carried out - alongside urgent action to reduce emissions - to identify exactly how to share out the remaining global carbon budget and whether these reductions are technically possible and, if not, whether approaches using negative emissions or even geo-engineering are possible or acceptable.

SUMMARY OF REPORT

Almost 20 years ago the UNFCCC was agreed and subsequently ratified by over 190 countries. Its objective is to “prevent dangerous anthropogenic interference with the climate system” (dangerous climate change). The UNFCCC treaty recognised that due to historical emissions, per capita current emissions and their greater economic wealth, developed countries should lead the way by reducing their emissions and should assist developing countries to deal with climate change through the provision of finance and technology. It acknowledged that developing countries had pressing development needs which required them to grow their emissions.

Since the UNFCCC was agreed politicians have done little to stem the growth of emissions which, as this report shows, constitutes a reckless gamble that has substantially increased the likelihood of the planet entering a prolonged period of dangerous climate change.

Many developed country governments have stated that a rise of 2 degrees centigrade above pre-industrial levels is the global average temperature target we have to stay below to avoid dangerous climate change. More than 100 developing countries have stated that the goal should be to stay below a 1.5 degree rise, while some have called for a 1 degree limit, because a global average temperature above these will lead to very significant negative impacts on their populations who are on the front-line of climate change impacts (e.g. fisherfolk and subsistence farmers).

More recent science suggests that a 2 degree target is far more dangerous than previously believed. Scientists suggest that it would lead to more severe and frequent

direct impacts, such as floods and droughts, with some suggesting much higher risks of what are variously called “tipping points” or “large-scale discontinuities”. This new evidence supports the position of the developing countries for a target lower than 2 degrees.

Uncertainty, risk and the need for caution

The complexity of the climate system also means there are many uncertainties in predicting what emissions reductions are necessary to avoid dangerous climate change. For example, it is not possible to identify an emissions-reductions pathway that with certainty leads to a particular temperature change.

Instead, computer models are able to identify probabilities arising from a particular pathway. For example, the UK emissions reductions target of 42 per cent cuts by 2020 and 80 per cent by 2050 from a 1990 baseline gives more than a 50 per cent chance of exceeding 2 degrees. This appears to be a very high risk to take for something which politicians say must be prevented. Politicians should be aiming to at least make the chance of exceeding 2 degrees “unlikely” or “very unlikely” which, in the terms of the Intergovernmental Panel on Climate Change (IPCC), means aiming for a less than 33 per cent or less than 10 per cent chance of exceeding 2 degrees.

New research findings

Climate science is clear that it is the cumulative amount of greenhouse gas emissions (global carbon budgets) over the next two decades which is the prime determinant of

whether dangerous climate change can be averted. This report uses the C-ROADS model of Climate Interactive to assess the probability of exceeding particular temperature targets for particular global carbon budgets.

This Friends of the Earth research shows that to have a less than 33 per cent chance of exceeding two degrees (which corresponds to a 75 per cent chance of exceeding 1.5 degrees) implies a global carbon budget of at most 1,100 Gigatonnes of CO₂ equivalent (GtCO₂e) between now and 2050. Such a budget still carries major risks.

The research also illustrates what these global carbon budgets may mean for particular countries. The analysis shows that if historical emissions are counted (i.e. the carbon budget is shared out fairly from, e.g., 1850 to 2050 or even 1970 to 2050) the United States and EU have already used more than their share (based on equal per capita allocations) of a global carbon budget. Emissions in these countries would need to cease immediately. So this report presents what countries’ equal share of the remaining global carbon budget would be on a per capita basis ignoring historical emissions - with an understanding that favouring developed countries in this way must be balanced by them paying developing countries to take a greater share of the burden. This way of allocating emissions also ignores emissions associated with the making of products that are consumed in developed countries (embedded emissions). Including embedded emissions would also make reductions required of developed countries significantly greater than those given in this report.

Using this approach, and assuming no use of negative emissions or other forms of geo-engineering would require emissions reductions in developed countries of 8-15 per cent per annum starting immediately. Some developing countries would need to make deep reductions immediately (for example Saudi Arabia), whereas other developing countries would need to peak their emissions and decline within the next five years (for example, China). The poorest developing countries, such as many in Africa and Asia, would be able to continue to grow their emissions, in order to bring large numbers of their people out of poverty.

Such cuts go far beyond what has been considered to date, and some may say they are not feasible. Yet the consequence of not making these combined reductions is a much greater risk of abrupt or irreversible catastrophic climate change.

Therefore urgent research needs to be carried out, alongside urgent action to reduce emissions, to identify whether these reductions are technically possible. If such cuts are impossible there needs to be a global societal debate to consider

either

a) whether re-allocations between groups of countries are possible – some taking on smaller cuts, if others are able to deliver greater action. If it were for developed countries at the expense of developing countries this is a very unfair position given that historical emissions and embedded emissions are already excluded, requiring further financial transfers.

or

b) whether negative emissions or other geo-engineering techniques, which carry their own significant risks, are acceptable (there is currently a

UN moratorium on geo-engineering).

Anything much less than these cuts, or slower reductions, will make dangerous climate change very likely or virtually certain. It would also increase the risk of substantial and severe risks of abrupt and/or irreversible climate change (tipping points or large-scale discontinuities). And this is for a global carbon budget with a still high - and for many people, especially within developing countries - unacceptable risk of dangerous climate change. Less risky strategies would require tougher action still.

Because of the legacy of historical emissions, plus the carbon footprint associated with embedded emissions, Friends of the Earth says that, in addition to unprecedented emissions cuts in their own countries, developed countries also need to provide hundreds of billions dollars of finance and technical support to developing countries each year to enable them to achieve emissions reductions (in addition to an adaptation fund). This is in line with the UNFCCC agreement. Developed countries are the only countries able to raise the necessary finance to enable developing countries to develop without recourse to carbon-intensive energy, for example through introducing a financial transaction tax, carbon taxes, and other measures.

What this research does demonstrate is that if dangerous climate change is to be averted it will require immediate and significant changes to how we fuel our economies in virtually all countries. In other words, instead of countries seeking to get the lowest possible emissions reductions targets within international negotiations and

attempting to push responsibility on other nations, they all need to rapidly accelerate the transition to a low-carbon sustainable economy.

The research also demonstrates that the risks of dangerous climate change are already very high and therefore in addition to urgent emissions reductions a high priority must be given to adaptation.

INTRODUCTION

When in 2008/09 parts of the banking sector brought the world economy close to collapse politicians used colourful language to describe their reckless behaviour. President Barack Obama lashed out at “fat cat bankers”¹ and Gordon Brown (then UK Prime Minister) accused bankers of operating “outside” of everyday human values and principles.² However, it is increasingly clear that world leaders are taking a huge gamble with the global climate upon which all of us depend. How big a gamble isn’t commonly understood by the public because politicians are not open about it.

As politicians seek to avoid significant emissions reductions, and global emissions of greenhouse gases continue to increase, so the risk of abrupt and/or irreversible climate change increases. We are already seeing increases in catastrophic events – such as this year’s floods in Pakistan and fires in Russia. This research suggests that politicians are recklessly gambling with the stability of the climate - with the potential for devastating impacts which would dwarf the recent financial crisis.

The purpose of this research by Friends of the Earth is to open up this issue of risk to public debate. What the research does is illustrate that if society wants even a small chance of avoiding dangerous climate change it will require a huge change in the level of political response. Preventing dangerous climate change requires immediate, systemic action across all sectors of the economies of all countries.

As the report makes clear, because of the complexity of the climate system it is impossible to be precise about the likely physical, social, environmental and economic impacts

from a particular global average temperature increase. It is also not possible to say with absolute certainty that a particular global carbon budget will yield a particular global average temperature increase. For these reasons the report is focused on the risks involved; for example, a particular global carbon budget gives a high or low risk of exceeding a particular global average temperature, which in turn gives a high or low risk of abrupt or irreversible climate impacts. We all deal with risk in our daily lives, for example when crossing the road, or choosing to insure our homes against the risk of burglary, or in the case of the bankers in their daily work as they gamble on stocks and shares. We rarely consider risks that involve the lives and livelihoods of billions of people.

This report aims to create a public debate about what level of risk society is willing to accept regarding the impact associated with climate change. In particular the report assesses:

- **What is dangerous climate change?**
- **What size of global carbon budget offers what chance of avoiding dangerous climate change?**
- **What would a global carbon budget commensurate with at least a limited chance of avoiding dangerous climate change mean for different countries?**

WHAT IS DANGEROUS CLIMATE CHANGE?

More than 190 countries have ratified the United Nations Framework Convention on Climate Change (UNFCCC). Its objective is to “prevent dangerous anthropogenic interference with the climate system”. The treaty did not set a target for global average temperature increase to be avoided, nor did it suggest an upper limit on the concentration of greenhouse gases in the atmosphere. The IPCC, set up to provide scientific advice to Governments, has not suggested a target because it states that “Defining what is dangerous interference with the climate system is a complex task that can only be partially supported by science, as it inherently involves normative judgements”³.

To determine the size of global carbon budgets to prevent dangerous climate change there are two significant decisions. The first is identifying the maximum global average temperature increase. The second is the degree of certainty desired for staying within the chosen temperature increase.

Temperature target

The G8 countries (EU countries + United States, Russia, Japan, and Canada) and those championing the Copenhagen Accord have suggested a global average temperature increase of 2 degrees should be the target to stay within (see Box 1). Recently more than 100 developing countries have suggested that the target should be 1.5 degrees while many others, including many developing country NGOs and movements, have called for the target to be 1 degree.⁴ This is because of the greater risks faced by people in developing countries due to greater exposure to extreme weather impacts and less capacity to adapt and rebound from catastrophes.

Developing scientific research has also amended the analysis of the scale of risk we face. In the 2001 IPCC Third Assessment Report, five classes of impact – “reasons for concern”- were identified and, together with their risk of occurrence, plotted against rising global average temperature. This work has been recently updated.⁵ The diagrammatic presentation of the updated research, the so-called burning embers diagram, graphically demonstrates the changes in understanding of risks due to increased scientific understanding between 2001 and 2009 (Diagram 1).

What is clear from the earlier burning embers diagram is that by adopting the 2 degree target the EU and G8 had in fact accepted, without widespread public debate, “substantial impacts or risks” to ecosystems (e.g. loss of coral reefs), “negative impacts or more significant risks” of extreme weather events and some populations and regions facing much greater harm than others. However, they (EU and G8) also wanted “neutral or low risk” of net aggregate impacts (i.e.

net financial impacts), and certainly “neutral or low risk” of large-scale discontinuities (e.g. irreversible deglaciations of the West Antarctic or Greenland Ice Sheets or major changes to Earth’s climatic system through, for example, substantial reduction or collapse of the Gulf Stream). This is why they deemed 2 degrees acceptable.

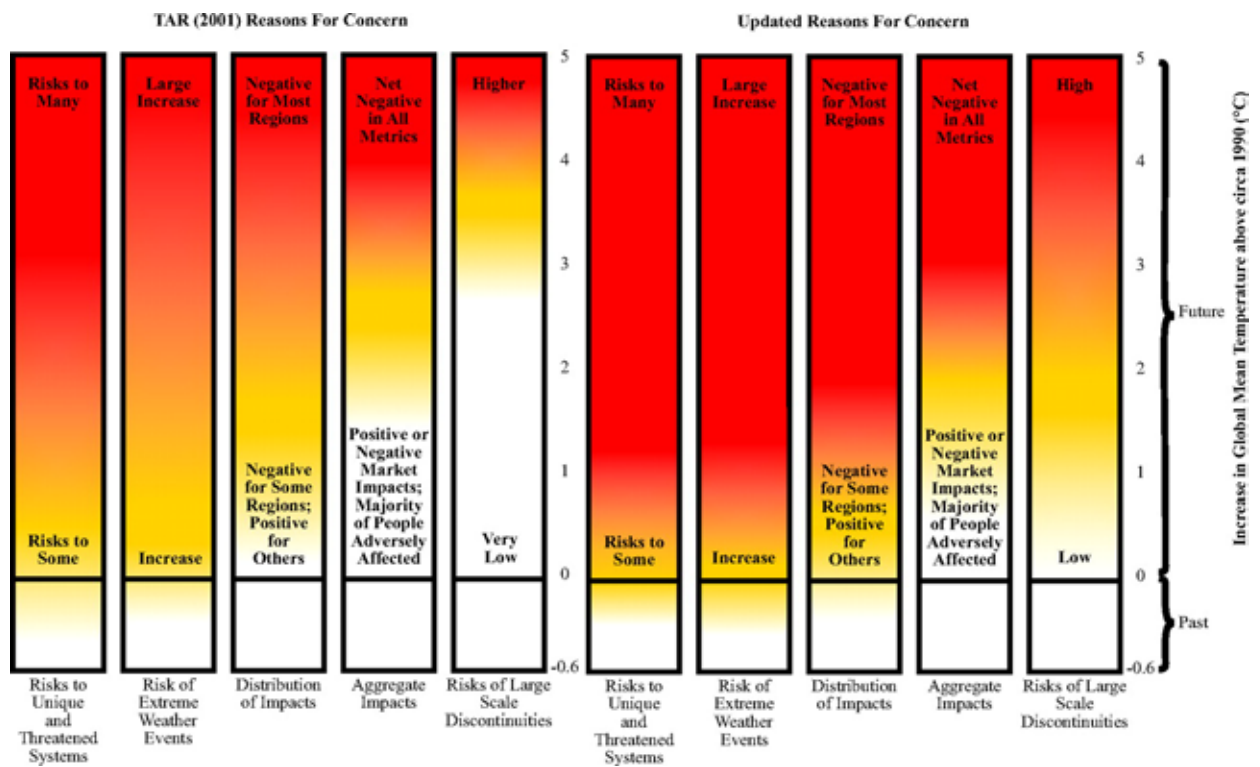
The updated burning embers diagram makes clear that for 2 degree there are now substantial negative impacts associated with extreme weather events and that there are now “moderately significant” risks of large-scale discontinuities – risks which were thought to be “very low” in 2001. This reassessment makes it clear that the EU, which set its 2 degree target 14 years ago, should either update its temperature target to a global average of not higher than 1.5 degrees above pre-industrial levels, or it should tell its electorate that it now consider it appropriate to accept much greater risks of dangerous climate change than it previously had asserted was acceptable.

Many countries and their populations, especially developing countries on the front-line of climate change, are less willing to accept the impacts on their livelihoods and security that the EU and G8 are implicitly accepting. An examination of the updated burning embers diagram suggests a safer position might involve, at least theoretically, setting a global average temperature target of not greater than 0.5 degrees above pre-industrial levels because at this level there are “neutral or low risks” for all five reasons for concern. A 1.5 degree target would be commensurate with the start of the “substantial negative” red areas.

The UK’s Committee on Climate

Diagram 1 – the Burning Embers diagram. White = neutral or no risk, Yellow = negative impacts for some systems or more significant risks, Red = substantial negative impacts or risks that are more widespread and/or severe

RISKS FROM CLIMATE CHANGE, BY REASON FOR CONCERN – 2001 COMPARED WITH UPDATED DATA.



Smith J B et al. PNAS 2009;106:4133–4137

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PNAS

Change, the UK Government's advisory body, has made an interesting contribution to the debate by suggesting that in addition to a target temperature to avoid "dangerous" climate change the risk of "extremely dangerous" climate change should be kept to very low levels (e.g. less than 1 per cent chance).⁶ In its 2008 report the Committee suggested that "extremely dangerous" climate change was a global average temperature increase that is "so dangerous that it must be avoided with very high probability"; they then go on to suggest that this is 4 degrees above pre-industrial levels and therefore a carbon budget should be set that only gave a less than 1 per cent chance of exceeding this temperature. The implication of the 2009 updated burning embers diagram is that the Committee on Climate Change's definition of "extremely dangerous" climate change should be revised downwards. A 2010 paper from the Tyndall Centre also notes that if the call for policy to be evidenced-based is to be meaningful, then "2 degree C now represents a threshold, not between 'acceptable' and 'dangerous' climate change, but between 'dangerous' and 'extremely dangerous' climate change."⁷

2.2 Risk

The probability and risk of avoiding dangerous climate change is not discussed widely. For example, despite frequent EU and UK political pronouncements that the goal is that "temperatures **must** rise no more than 2 degrees C" or "temperatures **do not** exceed 2 degrees" (our emphasis) the reality is that the higher conditional targets set by the EU and UK (30 per cent and 42 per cent respectively) are based on more than a 50:50 chance of exceeding 2 degrees. Even these targets are undermined by offsetting provisions that significantly reduce the quantity of emissions reductions and thereby further increase the risks of exceeding 2 degrees.

It's clear that there is a large disconnect between bold political statements of the importance of avoiding certain temperature increases and the high level of risk of exceeding these through the emissions reduction targets set. The IPCC formally defines 33 per cent or less as "unlikely", 10 per cent as "very unlikely".⁸ It would seem that, as an absolute minimum, if politicians' goal is to not exceed a particular temperature target it should aim at a probability of exceeding it of at least "unlikely".

Because developed country governments have yet to respond to updates in science they have not yet said what they think is an acceptable level of risk for exceeding 1.5 degrees. But it is very possible that the public would be more risk averse with regards to avoiding dangerous climate change. (see box 2)

To conclude this section of the report:

- **More recent science suggests that if the G8 and the EU follow the logic of their previous choices they would now define "dangerous climate change" as a global average temperature rise of no greater than 1.5 degrees.**
- **An examination of the burning embers diagram shows even a global average temperature increase of 1.5 degrees is far from risk free.**
- **A public debate about the acceptable level of risk is needed, but Friends of the Earth contends that 50:50 chances are a far higher risk than could be deemed acceptable.**

BOX 1 – 2 DEGREES IS MUCH MORE DANGEROUS

In Luxembourg on 25 June 1996 the EU Council (Heads of State) agreed a target of keeping global average temperature increases to below 2 degrees. In 2005 the EU recognised that “Significant impacts on ecosystems and water resources are likely even with a temperature increase between 1-2°C. But once the global temperature increase exceeds 2°C, climate impacts on ecosystems, food production and water supply are projected to increase significantly and unexpected response of the climate becomes more likely and irreversible catastrophic events may occur.” In 2008 the G8 also agreed to limit global average temperature increases to below 2 degrees.

We should understand however that a global average 2 degree increase will result in higher temperatures in some places than others. For example, temperature increases over land will be higher than over oceans, and some land masses will be warmed more than others (e.g. average global 2 degrees increase could result in 4 degree increase in southern Africa).

Two degrees is also now a much more dangerous level. Ahead of the 2009 Copenhagen UNFCCC climate negotiation a synthesis of the latest science said that:

“temperature rises above 2 degrees will be difficult for contemporary societies to cope with, and are likely to cause major societal and environmental disruptions through the rest of the century and beyond.

A 2 degree rise could cause 5-20% reductions of cereal grain yields in South Asia, South East Asia and Sub-Saharan Africa, significantly exacerbating under-nutrition and adverse health outcomes (especially child physical and intellectual development).

Even with effective adaptation, the impacts on water resources in many parts of the world will be severe with climate change associated with only 1.0 to 1.5 degree rises in temperature.

The risks of large scale discontinuities were considered to be very low in 2001 for a 2 degree C increase but are now considered to be moderate for the same increase.

BOX 2 – UNDERSTANDING THE RISK OF CLIMATE CHANGE

The risk of precipitating dangerous or irreversible climate change is shared by all the population of the planet, and unborn generations, but those in developing countries are at greatest risk. Most will have no inkling of that risk, and most in the developing world will have contributed almost nothing to its creation. How much do we – governments, decision makers, and citizens – understand of the nature and scale of this risk, and how should we all participate in a collective and urgent effort to manage and reduce it?

So when Lord Turner, chair of the UK Committee on Climate Change talked recently about “the small probability of catastrophic losses” as a result of a global policy aimed at roughly a 50:50 chance of avoiding 2 degrees temperature increase and a less than 1 per cent chance of exceeding 4 degrees was this position fully informed and up to date on the latest science of the consequences of 1.5, 2, 3 or 4 degrees temperature increases? The UK Government 2010 National Risk Register does not consider the risks of abrupt or irreversible climate change nor major changes to food supply or migration as a response to climate change. It does suggest that severe weather events are likely but

relatively low in impact, compared to major industrial accidents or terrorist attacks. The risk register potentially indicates a misplaced confidence in the UK Government of its ability to adapt to climate change as it unfolds and a failure to consider adequately longer-term risks.

What about the perceptions and attitudes of the general public? The public are the subject of too much conflicting information and too great a range of personal contexts to be able easily to make an informed judgment about risk; all this contributes to the low salience of climate change relative to other priorities.

It is likely, however, the public are more risk adverse than politicians in this matter. A report by the UK Department of Health identified the factors that make the public less accepting of risks, including whether they are incurred involuntarily (e.g. exposure to pollution) rather than voluntarily; result from man-made, rather than natural sources; cause irreversible damage; and pose danger to future generations. This report assumes that a fully informed public would want policies that deliver a low risk of dangerous climate change.

SECTION 3

GLOBAL CARBON BUDGETS

There is no certainty that a given global carbon budget (box 3) will lead precisely to a global average temperature increase. This section therefore identifies a number of global carbon budgets and presents the risks of temperature increase associated with these. The global carbon budgets and risks of exceeding 2 degrees are derived from a model developed by US organisation Climate Interactive (appendix). Table 1 shows global carbon budgets for different risks of exceeding 2 degrees. Corresponding risks of exceeding 1.5 degrees are shown where possible.

The global carbon budgets shown in table 1 are small and diminishing. This is because of a lack of action to

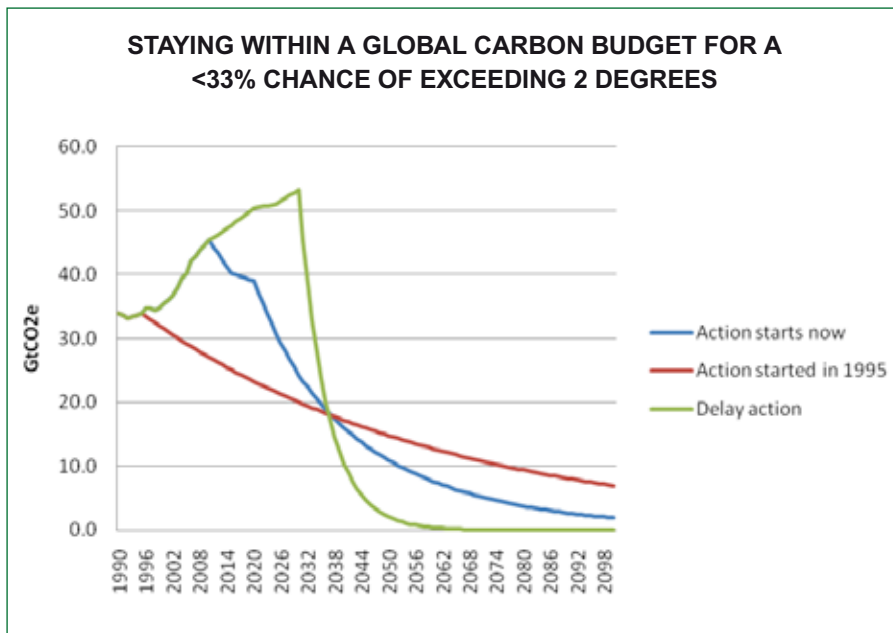
reduce carbon emissions over the past 20 years and the high and still growing current global emissions. If in 1990 the world had agreed to a global plan to stay within budget for a less than 33 per cent chance of exceeding 2 degrees, all they would have needed to do was to have kept emissions steady for five years, and then cut at a gentle 1.5 per cent a year. The following graph (graph 1) shows then that we've made it so much harder because of 20 years of delay. If we delay any further, it becomes almost impossibly difficult. The graph clearly demonstrates that the best time to have started cutting emissions was 20 years ago, but the next best time is now.

BOX 3 – WHAT ARE GLOBAL CARBON BUDGETS?

A global carbon budget is a forecast of the total amount of greenhouse gases – measured in GtCO₂e - that could be emitted by all countries during a particular period (e.g. 2010 to 2050). Alongside assumptions about land-use change it will give a probability of exceeding a given temperature threshold. From a climate perspective, it is cumulative emissions – i.e. budgets – that matter, not end dates.

In the UK the Government has set a series of three five-year carbon budgets up until 2022. These carbon budgets set legal limits on how much greenhouse gases the UK can release within these three five-year periods. A global carbon budget is the same idea in that it sets limits on how much greenhouse gas can be released globally over a given period of time.

Global greenhouse gas emissions between 2000 and 2009 were 400 GtCO₂e. This has already considerably depleted the total global carbon budget available through to 2050, and the trend is for emissions to accelerate upwards.



Graph 1

Scenario No.	2010 to 2049 Global carbon budget	% chance of exceeding 1.5 degrees ⁹	% chance of exceeding 2 degrees (range)
1	1,070 GtCO ₂ e + tougher action on deforestation	75	29 (12 - 45)
2	1,070 GtCO ₂ e		34 (16 - 52)
3	1,275 GtCO ₂ e		44 (24 - 63)
4	1,333 GtCO ₂ e	95	47 (27 - 67)
5	1,537 GtCO ₂ e		57 (37 - 77)
6	1,595 GtCO ₂ e		61 (41 - 81)

Table 1: Global carbon budgets and risks of exceeding global average temperatures increases of 1.5 and 2 degrees above pre-industrial levels

Note: The figures assume current levels of deforestation unless stated otherwise. See appendix for technical detail. They also exclude international aviation and shipping emissions. If emissions from these sources continue to grow then the global carbon budgets presented here would need to be smaller to achieve same probabilities of exceeding 1.5 or 2 degrees.

As can be seen from Table 1 only scenarios 1-4 provide a central estimate of greater than 50 per cent of avoiding 2 degrees. Scenarios 5 and 6 give a less than 50 per cent chance of avoiding 2 degrees. In comparison it has been estimated by the Institute of Physics that the Copenhagen Accord emissions could lead to a global average temperature increase of over 4 degrees, despite its stated aim to avoid 2 degrees.¹⁰ The chance of avoiding 1.5 degrees decreases from 25 per cent in scenario 1 to around 5 per cent in scenario 4. Given that more recent science suggests 1.5 degrees or lower is the threshold between acceptable and dangerous climate change, this research has focussed its analysis on scenario 1. Other scenarios present, in Friends of the Earth's view, too high a risk of dangerous climate change. This is also the only scenario which makes exceeding 2 degrees "unlikely". Although a much greater chance of avoiding 1.5 degrees is desirable, even scenario 1 is exceptionally challenging. Given that the emissions between 2000-09 were 400 GtCO₂e, scenario 1's total 40 year budget

of just 1,100 GtCO₂e (rounding to nearest 100) would require very steep and unprecedented declines in global emissions.

To conclude this section of the report:

- **A global carbon budget of 1,100 GtCO₂e (Scenario 1) will require a very steep and unprecedented decline in global emissions. Even this has a 75 per cent risk of exceeding 1.5 degrees and a 30 per cent chance of exceeding 2 degrees. Even this budget is, in Friends of the Earth's view, far more risky than is desirable. We consider such a budget to be an absolute maximum. Higher global carbon budgets give, in Friends of the Earth's view, an unacceptable risk of dangerous climate change.**

SECTION 4

GLOBAL CARBON BUDGETS: IMPLICATIONS FOR INDIVIDUAL COUNTRIES

How a global carbon budget is shared between nations is an intensely political issue and is one of the major reasons why global climate change negotiations are moving extremely slowly. This section discusses some of the principles and factors involved, and it illustrates how the global carbon budget could be shared out.

The UN Convention on Climate Change agreed on the principle of “common but differentiated responsibility”, namely that developed countries should do the most to reduce emissions (although all countries need to take action), because:

- the largest share of historical and current global emissions of greenhouse gases originated in developed countries;
- per capita emissions in developing countries are still relatively low;
- the share of global emissions originating in developing countries will grow to meet social and development needs.

Yet almost 20 years since this principle was agreed, reduction targets have not been agreed. Debates are continuing on how emissions reductions trajectories should be allocated (see box 4). If historical emissions are included in the calculations of allocations then, as table 2 shows, it would require emissions reductions in Europe, the United States and other developed countries of greater than 100 per cent immediately because they consumed much more than their fair share from 1850. This means developed countries have accumulated a very large ‘carbon debt’ which they will need to pay back to developing countries through financial and technology

	USA (GtCO ₂ e)	EU (GtCO ₂ e)	China (GtCO ₂ e)
Divided by 2010-2049 population	49	67	193
Historical emissions: start 1850	-305	-135	432
Historical emissions: start 1970	-146	-52	284
Historical emissions: start 1990	-60	20	223

Table 2: Share of a 1,100 GtCO₂e budget 2010-2049, different allocation methods

transfers. This will enable - but only if sufficient funds and technologies are provided - developing countries to grow their economies and lift their people out of poverty without recourse to carbon intensive energy.

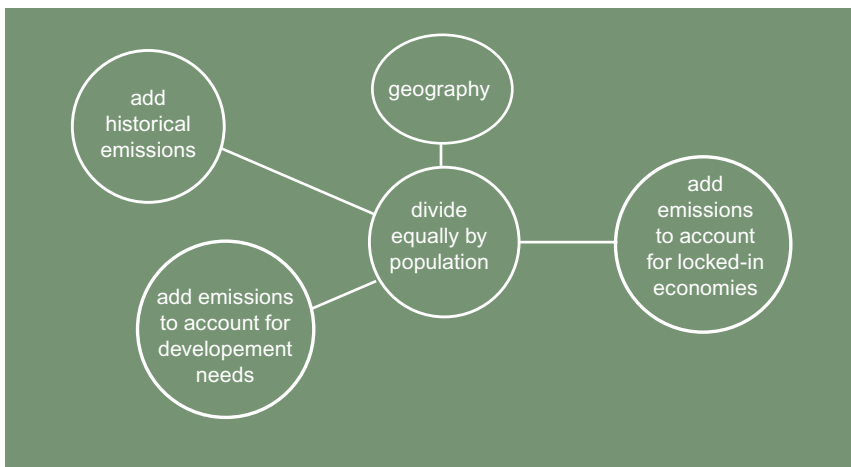
To illustrate the challenge of living within the remaining global carbon budget, this research uses an approach of dividing a 1,100GtCO₂e (Scenario 1, rounded up) budget between countries on an equal per capita emissions basis for their average population between 2010 and 2050 (Table 3). This division of the remaining budget would favour the developed countries that have emitted most pollution in the past (e.g. United States, UK). To compensate for over allocation to developed countries they need to pay for the extra effort that developing countries will need to make to live within their under allocations. The cost of this, together with the costs of adaptation, would not be insubstantial since this extra effort by developing countries is likely to be the more expensive carbon-reduction technologies. Estimates of the finances vary from \$100bn a year by 2020 pledged by developed countries within the Copenhagen Accord to \$2,000 billion per year by African

nations. As well as an ethical position this is also a pragmatic position as only developed countries can raise the scale of monies needed to enable developing countries to develop without recourse to cheaper carbon-intensive energy production. Recent Friends of the Earth research has identified that a Financial Transaction tax, plus redirecting fossil fuel subsidies and other measures such as carbon and energy taxes could raise over \$400 billion a year.¹¹

The analysis, in table 3, assumes significant progress in preventing deforestation with emissions falling from around 6 GtCO₂ a year currently to less than 2 GtCO₂ by 2040 (if forestry emissions are not reduced by this amount then reduction trajectories in countries would need to be steeper). The individual carbon budgets therefore exclude emissions from forestry (favouring developing countries) as well as international aviation and shipping emissions, plus embedded emissions in imports (favouring developed countries).

BOX 4 – DIFFERENT WAYS OF ALLOCATING GLOBAL CARBON BUDGETS TO COUNTRIES

Starting with dividing the remaining global carbon budget equally by population, there are broadly four main ways advocated for adjusting this, depending on different definitions of fairness:



<- Gives more to developing countries = Gives more to developed countries >

The arguments for the four ways of adjusting an equal-per-capita allocation are, briefly:

- **account for historical emissions** (i.e., the United State and EU have already used far more than an equal share of the global carbon budget, which starts in 1850, not 2010).
- **account for development needs** (i.e., some countries have exceptionally pressing needs for more energy use).
- **account for geography** (some countries need a greater allocation as they need more energy for heating or cooling).
- **account for lock-in** (some countries are locked in to high carbon economies, and need time to unlock themselves).

Table 3: Emissions reductions for individual countries based upon an equal sharing of a 1100GtCO₂e 2010-2049 global budget, assuming no negative emissions

Country	Carbon budget 2010-2049 (GtCO ₂ e)	Peak year	Trajectory – annual percentage change in emissions
Very high per capita emitting countries			
United States	49.2	2010	> -15a year
Saudi Arabia	4.8	2010	> -15 a year
Russia	17.4	2010	> -15 a year
Australia	3.4	2010	> -15 a year
Canada	5.3	2010	-15 a year
Japan	15.7	2010	-10 a year
High per capita emitting countries			
South Korea	6.5	2010	-10 a year
Czech Republic	1.4	2010	-10 a year
Germany	10.4	2010	-9.5 a year
Poland	4.8	2010	-8 a year
EU	67.5	2010	-8 a year
UK	9.1	2010	-7.5 a year
Eire	0.7	2010	-7 a year
Medium per capita emitting countries			
Slovakia	0.7	2010	-6 a year
Hungary	1.3	2010	-5 a year
Italy	8.0	2010	-5 a year
Sweden	1.3	2010	-4.5 a year
Mexico	16.7	2013	+5 a year to 2013, then -5 a year afterwards
China	193.1	2013	+5 a year to 2013, then -5 a year afterwards
Chile	2.6	2014	+5 a year to 2014, then -5 a year afterwards
Thailand	9.7	2014	+5 a year to 2014, then -5 a year afterwards
South Africa	7.3	2015	+5 a year to 2015, then -5 a year afterwards
Syria	4.0	2016	+5 a year to 2016, then -5 a year afterwards
Low per capita emitting countries			
Tunisia	1.6	2020	+5 a year to 2020, then -5 a year afterwards
Brazil	28.7	2025	+5 a year to 2025, then -5 a year afterwards
Egypt	14.7	2025	+5 a year to 2025, then -5 a year afterwards
Indonesia	35.9	2028	+5 a year to 2028, then -5 a year afterwards
Peru	4.8	2032	+5 a year to 2032, then -5 a year afterwards
Very low per capita emitting countries			
India	195.8	2034	+5 a year to 2034, then -5 a year afterwards
Vietnam	13.9	2035	+5 a year to 2035, then -5 a year afterwards
El Salvador	1.0	2040	+5 a year to 2040, then -5 a year afterwards
Bolivia	1.7	After 2050	+5 a year
Pakistan	35.2	After 2050	+6 a year
Ghana	4.7	After 2050	+10 a year to 2035, then +5 a year afterwards
Sudan	8.1	After 2050	+10 a year to 2035, then +5 a year afterwards
Bangladesh	26.7	After 2050	+10 a year to 2041, then +5 a year afterwards
Uganda	8.2	After 2050	+15 a year to 2045, then +5 a year afterwards

	UK ¹²	USA	EU	Global
2020	-56%	-74%	-60%	+2%
2030	-80%	-95%	-83%	-16%
2050	-96%	-100%	-100%	-68%

Table 4: UK/EU/United States/global cuts on 1990 levels - This sharing of a 1,100 GtCO₂e global budget implies the following % reductions on 1990 levels

The emissions reduction rates for countries to live within an equal share of a global carbon budget of 1,100 GtCO₂e are incredibly stark. Annex 1 countries, such as the United States, Russia, and Australia need to reduce emissions by more than 15 per cent per year whilst the EU would need to reduce emissions by around 8 per cent per year because of higher current per capita emissions. These reduction rates translate to the targets in table 4 for 2020, 2030 and 2050 compared to 1990 baseline.

For developing countries the situation is more complex. Some countries are high emitters already - for example, under this scenario Saudi Arabia would need cuts greater than 15 per cent per year and South Korea 10 per cent per year. Other developing countries would need to peak their emissions by 2015 and then reduce them by around 5 per cent each year (for example China, South Africa, Mexico). Countries such as Peru, India, and Vietnam could continue to increase their emissions by around 5 per cent per year until the 2030s.

Countries such as Pakistan, Bangladesh, Ghana and Bolivia could increase their emissions beyond 2050, as shown in Table 3 (from a very low base). Although some developing countries do increase emissions for some time under this scenario, their per capita emissions remain far lower

than the current per capita emissions in developed countries.

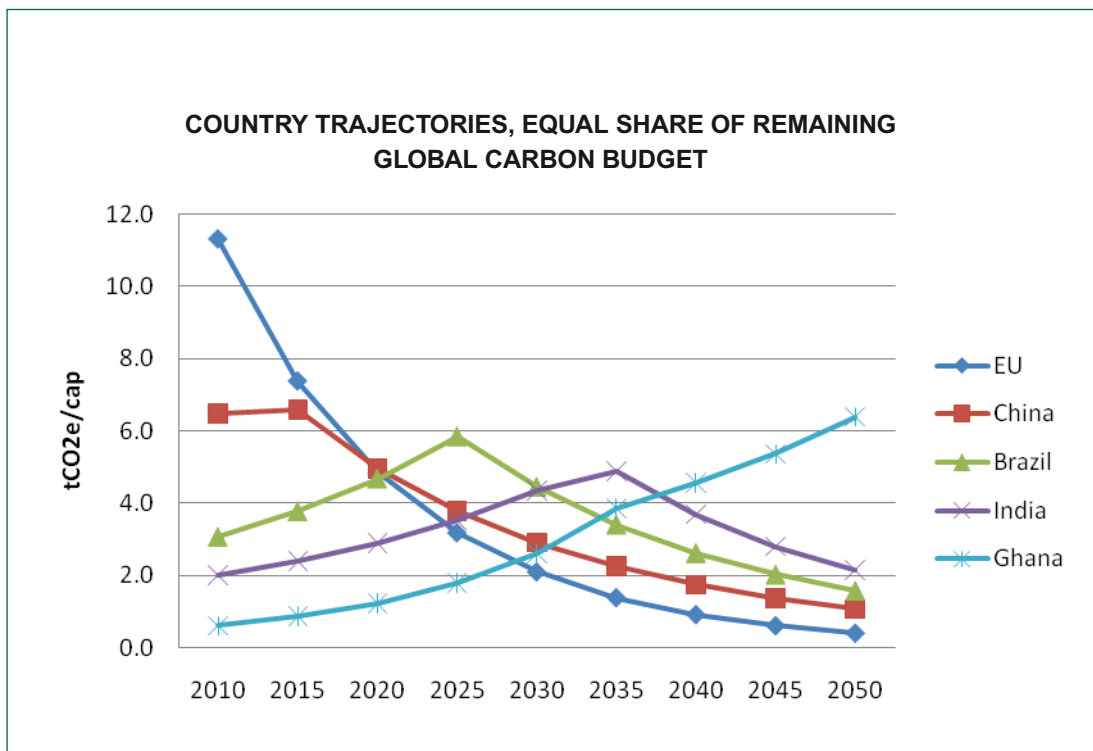
Although these emissions reductions go far beyond what have been considered to date, and some may say they are not feasible, the consequences of not making these reductions are a much greater risk of abrupt or irreversible catastrophic climate change. Research to date on how to reduce emissions within individual or groups of countries has on the whole, at least within Europe, adopted a back-casting approach, which involves setting reduction targets in the future and working backwards to see how they may be met. These have largely worked backwards from 80 per cent cuts by 2050. Only one research report that Friends of the Earth knows of looks at emissions reductions of the scale presented in this report.¹³ What is clear is that there is an urgent need for research to identify what emissions cuts may be technically possible if the transition to a low-carbon economy is driven as fast as possible (i.e. forecasting not back-casting), alongside urgent action in all areas where much greater reductions are known to be possible. If research shows that this scale of emissions reductions is technically possible - and in developing countries the funds and technologies have been made available by developed countries -

then politicians need to work with others to convince electorates that these reductions must be made. If research suggests these cuts are not technically possible, or populations reject the changes involved, then there will need to be a global societal debate on whether negative emissions or other geo-engineering techniques, which bring their own significant risks, are acceptable (box 5). The alternative to not making these cuts is to take a continuing colossal gamble with the fate of billions of people.

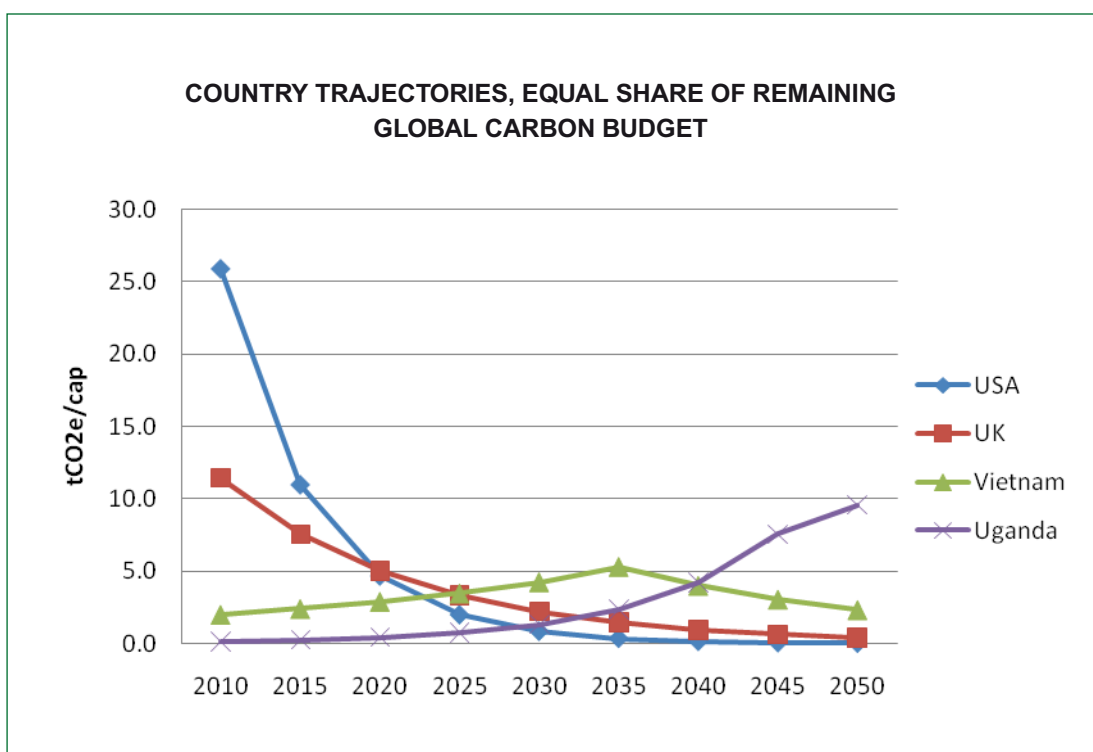
To illustrate the limited scope from deviating away from the emissions reductions illustrated in this report it is worth consider what the result would be if the least-developed countries would choose not to use all of their equal emissions entitlements if financial and technological support enables them to meet their development needs using low-carbon technologies (and if they do so it should be their choice not a choice foisted upon them). The spare carbon this makes available is very limited. A high-end estimate of the extra carbon space is 30 GtCO₂e, assuming that no country would go beyond 5 tCO₂e per capita beyond 2030. It would make only minor changes to the reduction rates required by, for example, the EU, Russia, China and the United States (see Table 4). This is because the total emissions by

Graphs 2 and 3 below show the relative trajectories of per capita emissions for a range of developing and developed countries:

Graph 2



Graph 3



BOX 5 – NEGATIVE EMISSIONS

Negative emissions include burning biomass and capturing the carbon released to store it underground (a technology not yet proven on a commercial scale), large-scale afforestation (which has potentially very significant impacts on food supply), increasing the carbon content of soil through bio-char, and capturing carbon from the air and storing it underground. The recent UN Convention on Biological Diversity agreed a de-facto moratorium on large-scale geoengineering activities that could negatively impact on biodiversity until more is understood about the risks and governance programmes are established. This moratorium includes large-scale biomass with carbon capture and storage, large-

scale reforestation and large-scale production of bio-char for adding to soil. Many climate scientists believe that very large negative emissions are necessary to prevent dangerous climate change. Some NGOs have suggested that a substantial reduction in meat consumption could free up land for biomass production and enhance biodiversity (<http://www.zerocarbonbritain.com/>).

Negative emissions are different to other forms of geoengineering such as increasing the reflectiveness of clouds, injecting aerosols in the stratosphere or building mirrors in space; all these technologies, known as solar radiation management (SRM), are designed to reflect energy back to space and do not reduce carbon

emissions. The Royal Society, the UK's top scientific institution, warned that greenhouse gas emissions reduction efforts should not be reduced and that that SRM could introduce new risks into the climate system. It stated "too little is understood about their potential future effectiveness, risks and uncertainties to justify reducing present and future efforts to reduce greenhouse gas emissions" and "Prior to undertaking large scale SRM experiments or deployment, unintended environmental effects should be carefully assessed. It would be risky to embark on major implementation of SRM methods without a clear and credible exit strategy."

these countries are very high due to high per capita emissions and large populations. It therefore demonstrates the extremely limited scope for developed countries to do much less than the illustrated emissions reductions in the report as the amount of carbon emissions available for offsetting over the 40 year period is less than 3 per cent of the total carbon budget. This in effect rules out carbon trading as an effective tool to reduce emissions reductions obligations by developed countries.

A more unfair allocation of emissions is theoretically possible but is extremely unjust, would be almost certainly unacceptable to developing countries, and probably would leave hundreds of millions of people living in abject poverty. For example, the following allocation is within the 1,100 GtCO₂e global carbon budget:

- the United States and all developed countries reducing emissions by 5% per year from now;
- China/Indonesia/Mexico/Indonesia/Brazil/S Africa/S Korea all peak in 2015 and reduce emissions by 5% per year from then; and
- India and poorer developing countries peak in 2020 and reduce emissions by 5% per year from then.

Such an allocation would see the USA using three times an equal share of the remaining global carbon budget, in addition to its heavy over-use of the historical global carbon budget.

There are two countries in particular whose emissions trajectories are critical:

The very high level of **United States** current per capita emissions plus their relatively large population mean that any delay to very steep annual cuts has major implications

for global carbon budgets. A five-year delay in implementing 15 per cent cuts would almost double the United States' use of the total global carbon budget. Alternatively, a one-year delay and then only reducing at 5 per cent a year would almost triple the United States' budget use.

Although **China** is in many ways leading the way in fighting climate change through its technological investments, regulations and renewable power development it also has already quite high and rising per capita emissions (compared to many other developing countries) and very large population. Even though much of these emissions are for productions of goods for consumption in the United States and Europe, and even though its pre-1990 emissions were low, its emissions trajectory from now on is critical. A 5 per cent annual increase

to a 2013 peak date and then 5 per cent annual decreases after gives a budget use of 200 GtCO_{2e} - an equal per capita share. But if the peak date is 2015, 2020 or 2025 budget use is 235 GtCO_{2e}, 335 GtCO_{2e} and 454 GtCO_{2e} respectively (ie 21, 30 and 41 per cent respectively of the total global carbon budget). If China does not peak until 2025 it will consume around 40 per cent of the global carbon budget with around 20 per cent of the global population. China has pressing development needs and it is essential that China is provided the assistance it needs to live within its equal share of a global carbon budget (see Box 6).

Any country using more than an equal share would mean that other countries would need to do more to keep within budget. But for the United States and China, because of sheer size, if they use more than an equal share, this has highly disruptive implications for other countries if an overall global carbon budget is to be met. For example, a peak year for 2020 not 2013 for China uses extra carbon budget double the entire EU 2010-2049 budget. Delaying 15 per

cent a year cuts for 10 years for the United States is double the entire combined Mexico and Brazil 2010-2049 budget.

The **EU** is an important player because of its historical emissions and because it's current emissions are close to those of the United States and China. It is also important because it can, and should provide political leadership. It was the bloc that first set a temperature target to avoid dangerous climate change. It has consistently put the issue of climate change on the global political agenda. However, in recent years its leadership has faded away through: failing to set and deliver emission reductions commensurate with even its own aim to avoid 2 degrees temperature increases; failing to update its temperature target in line with updated science; and consistently aligning itself with the positions of the US government rather than with scientific understanding, the security of its own citizens and the citizens in developing countries most at risk from dangerous climate change. Its approach of 'we will move when the United States and

everyone-else does' is a recipe for a collective disaster.

What is clear from this analysis, politically, is that countries cannot wait for a global agreement to begin significant emissions reductions and that in international climate negotiations there is no time to deconstruct past agreements and forge new ones. Instead Kyoto Protocol countries needs to agree new binding targets by the South Africa negotiations at the latest, the United States needs to agree to significantly greater emissions reductions than it is currently considering, and finance and technology must begin flowing in earnest to developing countries. Once finance and technologies are flowing at sufficient scale then it would be appropriate to agree binding reductions for developing countries.

To conclude this section of the report:

- **A global carbon budget of 1,100 GtCO_{2e} that still gives a 75 per cent chance of exceeding 1.5 degrees and around a 30 per cent chance of exceeding 2 degrees would require emissions reductions greater than**

Table 5: reallocation of 30 GtCO_{2e} from capping emissions in some developing countries post 2030

	Before	After	Extra emissions (GtCO _{2e})
USA	-15% a year from 2010	-10% a year to 2015, then -15% a year	9.9
Russia	15% a year	-10% a year to 2022, then -15% a year	6.1
China	Peak in 2013	Peak in 2014	9.4
EU	-8% a year	-6% to 2015, then -8% a year	4.1
Total			29.5

15 per cent per year by the United States, Russia and Australia. Other developed countries would need to make reductions 8-15 per cent per year and similar reduction rates would be required in some developing countries (e.g. Saudi Arabia) assuming no negative emissions.

- Countries such as China would need to peak emissions within the next few years and then reduce their emissions by around 5 per cent per year thereafter and to do so they will need significant technology transfers and potentially finance from developed countries.
- Some developing countries, for example India and Indonesia, would be able to grow their emissions at around 5 per cent per annum for the next decade or two whilst some of the poorest developing countries would be able to increase their emissions for longer, albeit from an extremely small base.
- If deforestation is not reduced as fast as assumed in the analysis then emissions reductions

requirements would be greater still. Separate action is also needed in international aviation and shipping emissions.

- Many hundreds of billions of dollars would need to be paid by developed countries to developing countries to enable them to cut emissions by more than they would have had to do had historical emissions and/or embedded emissions been accounted for in reduction rates.
- These emissions rates are far tougher than anything currently on the negotiating table. This situation has arisen because of the failure of developed country leaders to fulfil their UNFCCC obligation to implement emissions reductions at an earlier date, in order to better manage the risk of dangerous climate change.

BOX 6 – CHINA

China has a very fast-growing (typically 8-10 per cent per annum), export-led economy, a very high carbon intensity of production; and a very large population with relatively low but rising per capita emissions. China's performance on climate change mitigation (reduction of emissions) is probably outstripping that of the USA and the EU. (See http://www.foe.co.uk/resource/briefing_notes/china.pdf).

The illustration of how a global carbon budget could be shared out detailed in this report all point to the need for China to peak its net emissions within the next five years followed by a decline in its net emissions. The challenge of achieving this in a country with widespread poverty and millions without access to basic energy services should not be underestimated. No other developing country (including India and Brazil) has an emissions/economic profile like this or would be confronted by so challenging a future carbon budget.

RESEARCH CONCLUSIONS

The problems depicted by this research - how to accommodate global economic activity, development needs and rising population within a constrained and rapidly reducing carbon budget - are stark. But Friends of the Earth has long campaigned for respect for environmental limits, and for social justice, so we must confront this issue.

Politicians have been quick to accuse bankers of reckless behaviour. But this report identifies that they themselves are guilty of much greater recklessness. This is because they have failed to lead by reducing their emissions significantly over the past 20 years and also because they have failed to inform their populations of the increasing risks of climate change; risks that have been incurred without these populations' knowing about them.

The consequence of this inaction is that the onset of dangerous climate change is now much more likely. Even with the extremely large and swift reductions in emissions presented in this research there is still only a 25 per cent chance of avoiding dangerous climate change, which, the most recent science suggests is no more than 1.5 degrees.

If global leaders really want to secure even this level of climate security - which many would argue still presents unacceptably high risks - then they have to accept that the scale of cuts required is far greater than those contemplated at present, let alone agreed. They must also accept that governments everywhere need to start decarbonising their economies as fast as possible. Developed countries must provide the funds and technology transfer to enable developing countries to develop without recourse to carbon-intensive

energy. And developing countries will need to prioritise providing their populations with sustainable livelihoods instead of structuring their economies around carbon intensive export-orientated economies.

The alternative is a huge planetary gamble: a severe and quantifiable risk of wide-scale and extreme events and of abrupt and/or irreversible climate change increasing relentlessly with every further year's delay. Even with action it is not now possible to have a low risk of extreme weather events, biodiversity loss or human casualties. Therefore adaptation efforts need to be stepped up to prepare for the worst (Box 7).

This report has not discussed how such a scale of reductions should be made (with or without negative emissions or other forms of geo-engineering); that is for further urgent debate. It does, however, indicate that rapid action to reduce and constrain emissions should be carried out in all countries. The illustrations of how the global carbon budget can be divided in practice demonstrates that this reduction is required not just in developed countries but in many developing countries as well.

Friends of the Earth inspires solutions to environmental problems and believes it is still possible to massively reduce these risks if all countries take immediate and transformational action. First of all this research has identified the largest global carbon budget possible which enables some chance of avoiding dangerous climate change. Global leaders and international business must now take immediate action - starting in the UNFCCC negotiations in Cancun 2010 and culminating in fair allocations of a global carbon budget in South Africa in 2011. The emissions

cuts by developed countries must be binding as part of the 2nd commitment period of the Kyoto Protocol. For developing countries requirements can be introduced once sufficient funds and technology are flowing. There must also be an end to the undermining of the UN international negotiations process that respects the rights of all countries.

Governments must level with their people about the gamble being taken with the lives of this and future generations. And we need a debate about the powerful interaction, and the choices to be made, between economic growth and emissions growth.

The time for reckless gambling is over. This is true for bankers. It is especially true for politicians gambling with climate change.

BOX 7 – ADAPTATION

The issue of adaptation has largely been overlooked in the public discourse on climate change, largely due to a perceived threat to mitigation efforts from a focus on adaptation. As this report indicates, dangerous climate change is currently “likely” and therefore it would be remiss not to adapt to at least this level of global warming. Although some may suggest that it is most prudent to prepare for the worst, if at all possible.

Some adaptation can be planned at short notice, but some requires longer planning. Those actions that require more planning are, for example: infrastructure

changes such as flood defences and increasing resilience of existing infrastructure (e.g. transport) for higher temperatures; plant breeding; and capacity for increased migration to some areas and away from others. However, while it may be possible for governments in developed countries to contemplate meeting huge adaptation costs in addition to equally large mitigation costs, that option will not be available to poorer, developing countries, who would have to face the consequences of dangerous climate change without the ability to organise and finance adaptation.

C-ROADS MODEL AND ASSUMPTIONS

Land-use data

The modelling above, unless it states otherwise, uses C-ROADS' baseline assumption of deforestation constant at 2005 levels, and afforestation falling from today's levels to 0 by 2030.

Using C-ROADS' other baseline assumptions changes the overall temperature and concentration results, for the same GHG emissions figures. In Scenario 1 different baseline assumptions are used - for tougher action - deforestation falling rapidly to 2030, and afforestation oscillating around today's levels – these are their "IIASA" assumptions. The afforestation change does not materially affect the results, but the deforestation change lowers risk and temperature.

Global Carbon Budget calculations – using C-ROADS

Input data into C-ROADS to generate Table 3 used varying assumptions for major blocks of countries' emissions 2000-2100 - C-ROADS gives various outputs: total global GtCO₂e to 2100, percentage likelihood of exceeding 2 degrees, ppmv CO₂e in 2100 etc. Table 1 shows probabilities of exceeding 2 degrees for a given global GtCO₂e 2010-2049.

Individual carbon budget calculations (see Section 4)

These calculations use carbon data from C-roads and Marland ¹⁴, and population data and projections from the United Nations. ¹⁵ Individual country allocations are calculated based on a country's fraction of total global population 2010-2049.

Post 2050 emissions

The C-ROADS model's results are based on assumptions for GCBs from now to 2100. For simplicity we show only values to 2050 here – each scenario to 2050 has associated with it a GCB for 2050-2100: for example Scenarios 1 and 2 have a 2050-2100 budget of 270 GtCO₂e, and Scenario 4 has a 2050-2100 budget of 340 GtCO₂e.

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RECKLESS GAMBLERS

This report aims to create a public debate about what level of risk society is willing to accept regarding the impact associated with climate change.

In particular the report assesses:

- What is dangerous climate change?
- What size of global carbon budget offers what chance of avoiding dangerous climate change?
- What would a global carbon budget commensurate with at least a limited chance of avoiding dangerous climate change mean for different countries?

Friends of the Earth is:

- the UK's most influential national environmental campaigning organisation
- the most extensive environmental grassroots network in the world, with around 2 million supporters across five continents, and more than 77 national organisations worldwide
- a unique network of campaigning local groups, working in more than 230 communities throughout England, Wales and Northern Ireland
- dependent on individuals for over 90 per cent of its income.



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