

The proof of climate change and the inevitability of 2°C.

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The benign climate that has allowed the human race to multiply, develop and prosper has remained more or less unchanged for 10,000 years. Its stability accounts for the entire span of civilised human history.¹

Since the 1780s the average global temperature has risen 0.78°C from a one-third increase in atmospheric CO₂.² To this should be added methane and other gasses,³ and the additional impact of water vapour.⁴

For the following reasons a 2°C rise is now inevitable:

Were we to stop all emissions immediately, temperature would continue to rise without any more input from us from latent heat⁵ and aerosol dimming.⁶

Latent heat commits the planet to about 0.45°C more;⁷ Aerosols shield us from a further 20%.

Together these are holding back the full impact of the CO₂-e in the atmosphere by twenty or thirty years. The increase so far reflects only what has been emitted up to the later 1970s.

The calculation is simple: Were we to instantly stop all emissions, stop everything today, average global temperature would continue to rise as follows:
Current temp + latent heat + dimming = 0.78 + 0.45 + 20% = 1.5°C.
This is double the increase of the past two centuries.

It is therefore *inevitable*, from what we have already emitted, that food production will decline, droughts will spread and species will become extinct. There will be more hunger, less available fresh water, the seas will rise and vast numbers of refugees will be on the move.⁸ These conclusions are supported in the May 2007 Bangkok IPCC report.⁹

In addition, it leaves a margin of only 0.5°C before we reach the critical threshold.¹⁰ Above 2°C it is believed that global heat would start to trigger the release of the greenhouse gases now stored in the oceans, in trees and in the soil.¹¹ Once started the process is unstoppable and could further increase average global temperature by 6°C or more.¹²

How close are we to a 2°C rise, and when will we get there?

2°C is closer than most are prepared to admit. Considering that no one knows for sure what temperature would trigger the tipping points, we are already in a zone of absolute risk.

Over the past three years the average annual increase in CO₂ has been nearly 3 ppm, about twice what it was twenty years ago.¹³ The annual rate is still rising from new coal-fired plants in all countries, especially China,¹⁴ from more vehicles and logging and mega-bushfires.

In the next ten years global emissions will add enough to make a 2°C rise inevitable, and with it catastrophic climate change over the following decades. The passing of this threshold will be of the most enormous significance. We will have entered the era of dangerous climate change where neither we nor our children can count on a safe future.

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The tipping points:

The research of the past five or so years shows that nearly all earth's systems known to effect climate change have begun the process of positive feedback. There are certain points "of no return" after which unstoppable heating will become irreversible. A report in May 2007 shows this has already started.¹⁵

The evidence is that these events occur very rapidly, often in less than a decade.¹⁶ The major tipping points are:

1. Glaciers collapse¹⁷ and raise sea levels enough to inundate world sea ports¹⁸ and reflect less heat into space.¹⁹ Earthquakes will follow as the weight comes off the land.²⁰
2. Methane clathrates held under the sea begin to burp.²¹
3. Permafrost thaws and releases vast quantities of methane.²²
4. Forests and soils no longer absorb carbon, but become emission sources.²³
5. Logging and bush fires increase the carbon load.²⁴
6. Drought degrades the Amazon forest, so releasing its carbon.²⁵
7. Disastrous weather and heat could bankrupt the insurance industry,²⁶ and with it one foundation of personal and commercial security.
8. Decline of cold fresh water from the Arctic²⁷ alters the Gulf Stream.²⁸
9. Hotter oceans absorb less carbon,²⁹ and acidification is killing the fisheries.³⁰
10. Drought, heat, pests and disease disrupt global food supplies.³¹
11. The human tipping point: culture shock,³² refugees,³³ wars³⁴ for water, land, food and shelter and the probable death of billions.³⁵ Nukes could worsen climate.³⁶

There would be minimal economic downturn if we prepare how to change our ways now.³⁷

Present policies:

The current consensus is politically driven, and is irrelevant. Most concerned politicians and green groups are satisfied with demanding we cut existing emissions by 60 percent or so in the next 40 years. The above calculation shows we need to achieve much more than that in the next ten.

Emission trading and carbon taxes are based on the assumption that the rich can go on living as we do with minimal adjustments to the system. The rush to 'clean coal' and sequestration follows the same rationale.³⁸ Long-term these are useful only if we have a survival strategy already in place.

The market-based approach diverts investment from renewable technology. It maintains our standard of living while continuing to use fossil fuels to maintain our consumerist society.

Conclusion from the above argument:

To keep below that threshold the world needs to cut emissions by 10 percent every year over the next 10 years, starting now. The major items needing attention are (in order) coal, vehicles, cement, aeroplanes, and shopping malls. Most people don't yet recognise the importance of the last three. And this makes no mention of emissions from the military.

In the final analysis this comes down to transforming our consumer society. If we would all buy less and travel less, we would emit less.³⁹ This is why the public has to be involved.

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Since these changes are revolutionary, and are pointless without some global consensus, we need to assume that some nations will not change in time, and that we should prepare on our own.

Part of this would be to cut emissions by a significant amount every year for the next decade, by reducing personal consumption and by strongly encouraging renewable technologies.

Preparing for our national security:

Since neither we nor the world will change from coal in time, sequestration and nuclear and renewables are less important than planning how this country and her people can cope as the climate becomes seriously worse. For that we need to prepare our governments, public opinion and community infrastructures to deal with it.

We believe Australia is one of the few countries that could survive the coming disintegration as we can seal our borders, have plentiful resources and an educated citizenry.

The following are a few of the consequences to Australia of rapid climate change. Risk assessment⁴⁰ would need to include the following:

Sea level rise: docks flooded, reduced trade, oil, import or export of food

Waterfront houses, roads, sewage, communication, fresh water, infrastructure

Internal distribution of food, essential services, power.

Violent weather: cyclones down the east coast, prolonged heat waves, hail and drought.

Fire and flood: hospitals, repairs, insurance, mortgages, disaster management.

Diseases migrate south: Ross River, malaria, cholera, West Nile, available hospitals.

Internal refugees: housing and resettlement, petrol, law and order, community structures.

External refugees: military, diplomatic, Fortress Australia, peace keeping, war, nukes.

Culture shock: public transport, travel to shops and work, change jobs, mortgages

lower standard of living: new technologies, changed life styles, reduced advertising

An unaware public will be less able to face it, and may polarise.

Local manufacture: electric cars, busses, trains, power tools, white goods

Develop a national resilience to a total shift in life expectations

Ethics: immigration, rationing, mandatory and draconian political control.

We recommend the immediate establishment of a national Risk Assessment Council that would appoint Expert Committees to assess each of these issues and prepare preliminary recommendations. Since time is of the essence all committee investigations should be completed in the first six months.

As one purpose should be to prepare citizens for the changes that are coming and to support their confidence in the willingness of government to protect and nurture them, all steps in these investigations should be made public.

Australians should be educated in the risks of climate change so they may be as prepared as possible in their private and commercial lives, and do so with the confidence that government is facing the issue and determined to deal with it for the common good.

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- 1 The terms used in this report are CO₂ for carbon dioxide, the major greenhouse gas after water vapour; CO₂-e for the equivalent in CO₂ of all greenhouse gasses including methane and fluorocarbons; Bts for the weight of greenhouse gasses in the atmosphere as billion tonnes metric; Mts for a million tons and ppm for the ratio of the number of greenhouse gas molecules in the air as parts per million: See WRI report for an excellent summary.^[a] The foundations for this information are the 2007 IPCC,^[b] Stern^[c] and SEG reports.^[d] There is widespread criticism that the IPCC report represents the minimal politically acceptable consensus. None of the tipping points discussed in the text were factored in, though a couple were mentioned. A survey of 1600 climate scientists reported almost half had experienced “Political interference ... in climate science is no longer a series of isolated incidents but a system-wide epidemic.”^[e] ^[a] pdf.wri.org/navigating_numbers.pdf. ^[b] www.ipcc.ch/SPM6avr07.pdf. ^[c] www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm. ^[d] www.unfoundation.org/SEG/. ^[e] Union of Concerned Scientists.
- 2 Present rise in temperature is caused by an increase of CO₂ from 270 ppm to 385 ppm since 1780. Including methane and industrial gasses the CO₂-e has risen to between 435 and 460 ppm.^[a] It is calculated that at 500 ppm a 2°C rise would be inevitable. The total CO₂ released in 200 years is 305 Bts. The annual increase is now 1.9 ppm/a from 45 Bts/a. This is three times the two-century average. Since emissions have already increased world temperature by 0.78°C and the oceans by 0.45°C, a doubling of that rate during this decade would have the most profound impact. When we take the rate-increase into account and add the potential emissions from soils and permafrost, forest fires and logging, we have to realistically expect an increase of up to 90 Bts/a in the near future, possibly in the next decade. ^[a] IPCC figures in Table SPM 1 suggest that other greenhouse gases add 21% to those of CO₂ alone. This is a high estimate – other authors (eg Stern, UK Department for Environment), suggest 10 to 15%.
- 3 Methane is 21 times more powerful a greenhouse gas than CO₂. Industrial gasses are recent inventions, and now account for 15% of the CO₂-e. These are chlorofluorocarbons CFCs, hydrofluorocarbons HFCs designed to replace CFCs, and perfluorocarbons PFCs emanating from the aluminium industry. They often have a larger impact than methane, though some have a shorter half-life.
- 4 The air absorbs more water as it gets hotter. Water vapour is a very effective greenhouse gas, and the amount in the atmosphere has been increasing in step with CO₂ emissions.
- 5 The temperature of the oceans has risen 0.45°C compared to 0.78°C in the atmosphere. This has kept air temperatures down. In time the oceans will take up more heat from the air and its temperature will rise to match that of the earth, and this is projected to raise air temperatures further.
- 6 Global Dimming comes from industrial pollution that masks the full impact of solar heating. If pollution suddenly stops the aerosols would fall out of the atmosphere in a very short time.^[a] If it were not there, about 20% would be straight way added to the present temperature.^[b] ^[a] James Lovelock, *Revenge of Gaia*. ^[b] Pearce, *New Scientist*, June 2003.
- 7 Estimated to be a further 0.4-0.5°C. Scientific Expert Study Group Report on Climate Change and Sustainable Development, based on IPCC figures.
- 8 The consequences of each step in temperature rise are described in detail in Hans Schellnhuber, *Avoiding Dangerous Climate Change*, Cambridge, 2006.
- 9 See report in Herald Tribune 4 May 2007: www.ihf.com/articles/ap/2007/05/04/asia/AS-GEN-Climate-Change-Conference.php
- 10 This is widely recognised as the uppermost safe limit to warming by the EU^[a] and the UN.^[b] Climatologist Malte Meinshausen argues that when greenhouse gases reach 550 ppm CO₂-e, there is a 63-99% chance (with an average value of 82%) that global warming will exceed 2°C. At 475 ppm the average likelihood is 64%. Only if concentrations are stabilised at 400 ppm or below is there a low chance (av. 28%) that temperatures will rise by over 2°C.^[c] Similarly in the IPCC’s draft report concentration of 510 ppm gives a 33% chance of preventing more than 2°C warming; a concentration of 590 ppm gives us only 10%.^[d] According to the Stern Report, at 650 ppm CO₂-e there is a 60-95% chance of 3°C warming, and this imposes much more massive strain on the world’s ecology than 2 degrees.^[e] The UK set its target at “550 parts per million”, but this is 550 ppm of CO₂ alone. When you include the other greenhouse gases, this translates into 630 to 660 ppm CO₂-e. This commits the UK to a very dangerous level of climate change, and has aware of this for at least four years. In 2003 the environment department found that “with an atmospheric CO₂ stabilisation of 550 ppm, temperatures are expected to rise by between 2°C and 5°C”.^[f] In March last year it admitted that “a limit closer to 450 ppm or even lower, might be more appropriate to meet a 2°C stabilisation limit”.^[g] Yet the target has not changed. The EU is also aware it is using the wrong figures, and in 2005 found that “to have a reasonable chance to limit global warming to no more than 2°C, stabilisation well below 550 ppm CO₂-e may be needed.”^[h]

In summary, no government in the world is heeding the advice of their appointed experts.

^[a] Council of the European Union, 11th March 2005. Information note 7242/05 @ <http://register.consilium.europa.eu/pdf/en/05/st07/st07242.en05.pdf> ^[b] Rijsberman and Swart (Eds), *Targets and indicators of climate change: Working Group II of the Advisory Group on Greenhouse Gases*, 1990, Stockholm Environment Institute; Hare, *Avoiding Dangerous Climate Change*, 2006, 191-9; Grassl et al, *WBGU Special Report*, Berlin, 2003, 11. ^[c] Meinshausen, “What Does a 2°C Target Mean for Greenhouse Gas Concentrations?” in Schellnhuber, *Avoiding Dangerous Climate Change*, 2006, Cambridge. ^[d] IPCC, *Mitigation of Climate Change, Unpublished draft report*, 2007, version 3.0, Table SPM 1. ^[e] Stern, *The Economics of Climate Change*, October 2006, HM Treasury, Part 3, p194. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm. ^[f] DEFRA, *The Scientific Case for Setting a Long-Term Emission Reduction Target*, 2003, http://www.defra.gov.uk/environment/climatechange/pubs/pdf/ewp_targetscience.pdf; ^[g] HM Government, *Climate Change: The UK Programme* 2006, <http://www.defra.gov.uk/environment/climatechange/uk/ukccp/pdf/ukccp06-all.pdf>; ^[h] Council of the European Union, *ibid*.

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- ¹¹ The best estimates for the quantity of carbon and methane stored on this planet are: atmosphere 730 Bts, oceans 40,000 Bts, soil 1500 Bts, vegetation 650 Bts and permafrost+yedoma 950 Bts. Compare this with the 305 Bts humans have emitted into the atmosphere in 200 years – a ratio of 150:1. We do not want to start releasing this.
- ¹² The mass-extinction at the end of the Permian 251 million years ago occurred from a sudden concentration of carbon in the atmosphere. Release of methane made it worse. The only land survivors were those that could adapt to the near-absence of oxygen, and plant life was almost eliminated.^[a] The temperature rose by 6°C.^[b] [a] Benton, *When Life Nearly Died*, London, 2003. [b] Kiehl, *Geology*, Sept 2003, 757-60.
- ¹³ The annual increase is now 1.9 ppm/a from 45 Bts/a CO₂. The Arctic Mount Zeppelin station has monitored a 48% increase in the rate of emissions over the past 25 years. www.sft.no/publikasjoner/overvaking/1970/ta1970.pdf; US EIA.
- ¹⁴ China could become the largest emitter in the world as early as November this year, from new coal-fired power stations and because it is manufacturing a vast range of the products we all consume. John Vidal, "China could overtake US as biggest emissions culprit by November", 25th April 2007, *The Guardian*.
- ¹⁵ There has been a surge in CO₂ levels in four of the past five year that is greater than from human emissions on their own. The report states "We find that the 2002-03 anomaly occurs across all latitudes to create an unusually strong out-gassing of CO₂ of the terrestrial biosphere." Trees and plants are no longer a sink, but are becoming a source of CO₂. We are now in the most dangerous zone of feedback, the tipping points that, once triggered, cannot be stopped. Knorr, et al, "Impact of terrestrial biosphere carbon exchanges on the anomalous CO₂ increase in 2002-2003", *Geophysical Research Letters*, Vol. 34, 5 May 2007.
- ¹⁶ For example, about 8,200 years ago the temperature in Greenland was reduced by 5°C within a decade, not over millions of years.
- ¹⁷ The melting of the Greenland and Western Antarctic is happening faster than computer models have predicted,^[a] partly from surface melting that floods through fissures to form subglacial lakes that are lifting the ice of the bedrock so that their movement into the sea is speeded up.^[b] It will cause sea rise that would take tens of thousands of years to reverse. They hold about 20% of the fresh water on the planet. Complete disintegration is highly likely at 3°C, well within the range of climate change projections for this century.^[c] Jim Hansen said, "Once a sheet starts to disintegrate, it can reach a tipping point beyond which break-up is explosively rapid". Mountain glaciers have been thinning by av. 600mm/a and this rate is accelerating.^[d] Glaciers of the Tibetan plateau are vanishing by 50% every decade and also accelerating.^[e] IPCC report suggests they will disappear entirely before 2035. Many of Asia's greatest rivers - including the Yangtze, the Indus, the Ganges, the Brahmaputra, the Mekong and the Yellow River – are fed by these glaciers.^[f] Their flows are expected to become seasonal, with enormous consequences on food production. [a] Intergovernmental Panel on Climate Change, February 2007. *Climate Change 2007: The Physical Science Basis. Summary for Policymakers*. http://www.ipcc.ch/WG1_SPM_17Apr07.pdf; Peter deMenocal, Lamont-Doherty Earth Observatory, Columbia University. [b] www.outlookseries.com/news/Science/1721.htm. [c] UK symposium on "Avoiding Dangerous Climate Change". [d] World Glacier Monitoring Service. [e] www.chinadaily.com.cn/china/2007-04/11/content_848576.htm. [f] Chinese Academy of Sciences.
- ¹⁸ If the whole of the Greenland ice shield melted the sea rise would be 6.55 meters, and 8.52 meters for the West Antarctic. Were all the mountain glaciers to melt this would add less than half a meter. If all the ice on earth melted (including the East Antarctic) the potential sea rise would be more than 80 meters.^[a] To this should be added the expansion of water with heat. Salt water pollution of drinking water from a moderate 40 cm. rise may compel some coastal cities to be abandoned.^[b] A rise of 3 meters would directly flood 670 million people and 2 million square miles of mainly agricultural land would be lost.^[c] A rise of 30 meters would affect one quarter of the population. [a] Williams and Hall, "Glaciers", *Atlas of Earth observations related to global change*, 1993, 401-422. [b] Pearce, *New Scientist*, April 2005. [c] Reuters, April 16.
- ¹⁹ The Greenland glacier is slipping faster into the ocean than anyone predicted, aided by the "lubricant" of melt-water forming underneath them. The rate is accelerating each year. [American Association for the Advancement of Science]
- ²⁰ It has been suggested that the Greenland continental shelf could rise enough to release the methane now stored underneath sea pressure to hold it in place.
- ²¹ High temperatures cause methane to escape from ice-like structures called clathrates, which raises the temperature which causes more methane to be released.^[a] Even though there was strong evidence that this mechanism had contributed to at least two extreme warming events in the geologic past, the scientific community did not focus on its impact on global warming until 2004. [a] www.ucar.edu/news/releases/2005/permafrost.shtml.
- ²² There has been a 3-7°C rise in local temperatures in the Arctic and Siberia, higher than anywhere else. Peat bogs cover an area of a million square miles to a depth of 25 meters. What was until recently a barren expanse of frozen peat is turning into a broken landscape of mud and lakes, some more than a kilometre across. Over the past 4 or 5 years this has started to melt. As it thaws it will release billions of tonnes of methane, a greenhouse gas 21 times more potent than carbon dioxide.^[a] Recent research shows the rate is five times higher than estimated.^[b] The Arctic permafrost contains some 450 Bts of methane, while the Siberian yedoma stores a further 500 Bts.^[c] This is a third

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more than all the CO₂ now stored in the atmosphere.^[d] In addition the clathrates held under the oceans are starting to burp, and may contain 6,000 Bts methane.^[e]

[a] Sergei Kirpotin and Judith Marquand, New Scientist. [b] Katey Walter, *Nature*, http://www.eesi.org/briefings/2006/Energy&Climate/6.15.06_ClimateSymposium/Katey%20Walter_6.15.06.pdf. [c] Zimov et al, *Climate Change: Permafrost*, Science, June 2006: 1612-1613. [d] www.planetextinction.com/planet_extinction_permafrost.htm. [e] Kennett et al, *Methane Hydrates in Quaternary Climate Change*, Washington, 2006.

- 23 One quarter of our carbon emissions are now being absorbed by the soil and one quarter by the oceans. Over the past 25 years 13 Mt/a of carbon held in UK soils has been released.^[a] There is some 300 times as much carbon trapped in the soils as we release each year from burning fossil fuels. Globally, soil could shortly be releasing 7 Bts.CO₂/a as heat speeds up the metabolism of the microbes in the soil.^[b] With more heat this could increase temperature-rise by a further 40%^[c] as it ejects all the man-made carbon it has absorbed over the past 150 years.^[d] Global warming is damaging the soil's ability to absorb carbon, creating a "compost effect" that would lead to CO₂ levels rising to more than three times current levels. The 2003 heat wave in Europe damaged the woodlands, causing them to release CO₂, the opposite of the assumptions built into computer models that treat forests as carbon sinks.^[e] At 1°C temperature rise trees start being the source, not the sink.^[f] While tropical forests do cool the planet, those in northern regions will increasingly heat it from the albedo effect, with the result that forests become net heating agents.^[g] This is already happening, see note 15.

[a] Kirk, National Soil Resources Institute at Cranfield University. [b] Jones et al, *Geophysical Research Letters*, May 2003: 1479. [c] UK Met. Office www.agu.org/sci_soc/prri/prri0312.html. [d] Professor Peter Cox, Exeter University. [e] www.planetextinction.com/planet_extinction_carbon_sink_reversal.htm. [f] Bellamy et al, *Nature*, Sept. 2005: 245-8. [g] Lawrence Livermore National Laboratory, Carnegie Institution and Université Montpellier.

- 24 Logging and deforestation contributes between 18% and 25% of global carbon emissions, some 2 Bts. This is second only to the burning of fossil fuels. In one day deforestation releases the same amount of CO₂ as 8 million people flying from London to New York. Some 1.6 billion trees are logged each year over 7.3 million hectares.^[a] Indonesia is the third-largest emitter of greenhouse gases, followed by Brazil, behind only the United States and China.^[c] Tropical rain forests store 430 Bts of CO₂, more than all we have put into the atmosphere in 200 years.^[b] As the Arctic heats, there are massive fires. 10% of Alaska burnt in 2004/5 followed by landslides.^[d] [a] Ian Pearson, UK Climate Change Minister. [b] www.forestry.gov.uk/climatechange. [c] Global Canopy Program report May 2007, www.globalcanopy.org/vivocarbon [d] Alaska Fire Service.

- 25 In current climatic conditions the Amazon is near its critical resiliency threshold. The Amazon is threatened by clearing (17% at the moment), and at double that research shows that it is likely to destabilise. Also, tests show that after three years of continuous drought the tree cover just falls over.^[a] The Amazon rainforest would be lost when rainfall moves away from the basin, and this would affect most of South America.

Last year drought and fires killed half a billion metric tons of trees.

This forest has the potential to release 2.7 Bts.CO₂/a for the next 20 years, while absorbing less and less of what we put out.^[b] The situation in the Malaysian and Indonesian rain forests is similar.^[c]

[a] glaucus.fcien.edu.uypcmya/sacc/saccdocs/saccfell/Cardinot_eco2003.pdf. [b] Cox, *Avoiding Dangerous Climate Change*, 2006, 155-61. [c] Rachel Warren, "Impacts of Global Climate Change at Different Annual Mean Global Temperature Increases", in Hans Joachim Schellnhuber (Ed), *Avoiding Dangerous Climate Change*. Cambridge University Press, 2006.

- 26 The CSIRO predicts coasts will be battered with massive 100-year storms, destroying properties and eroding the coastline, 110-metre storm surges, double the bushfires and rainfall down 40%.^[a] Average Sydney temperatures will soar by 5°C. Droughts will occur nine out of every 10 years, forcing water consumption down by about 60%.^[b] Globally, disaster losses increased from \$71 billion in the 1960s to \$608 billion in 1990s, and this trend is expected to continue. Insurance premiums are an indication of the cost of climate change.^[c]

[a] www.csiro.au/files/files/p6fy.pdf. [b] www.news.com.au/mercury/story/0,22884,21206062-5007221,00.html. [c] *ABI Financial_Risks_of_Climate_Change.pdf*.

- 27 Arctic sea ice has reached its smallest size ever. A US Navy survey suggests there will be no sea ice left in the Arctic summer by 2016. US National Snow and Ice Data Centre, Colorado.

- 28 The Atlantic conveyor belt brings warm surface water to northern Europe and returns cold, deep-ocean water southwards. The flow has slowed 30% in the past 50 years.^[a] Many computer models have determined there is a 50% chance the current will collapse with higher temperatures with a devastating effect on bordering states.^[b] In the warming after the last Ice Age, the ice dam holding back a vast lake in North America burst. The fresh water rushing into the Atlantic appears to have shut down the THC, European temperatures fell 5°C.

[a] Quadfasel, *Nature*, Dec. 2005: 565-6 and Bryden, *Nature*, Dec 2005: 655-7. [b] Hans Joachim Schellnhuber, director Potsdam Institute for Climate Impact Research].

- 29 Oceans now hold about 40,000 Bts CO₂, while the soil holds 1,500 Bts (plus 950 in permafrost) and vegetation 650.

- 30 As oceans take up CO₂ the pH falls, and when low becomes too acid for shells to form.^[a] has indicated that global warming leads to a reduction in the ocean's primary food supply, which in turn impacts on fisheries and ecosystems.^[b] [a] Royal Society, Policy Doc. 12/05. [b] Dec 10: NASA report.

- 31 Global agriculture is already in crisis from drought, flood, habitat destruction, overharvesting, pollution, collapse of bee colonies and alien species. Rising temperatures between 1981 and 2002 caused a loss in wheat, rice, soyabeans, corn and barley to some 40 Mts/a valued at £2.6 Bn. For every 0.5°C rise there has been a ±4% fall in production.^[a] Rice pollen is sterilised if local temperature stays above 35°C for one hour during flowering.^[b] Ozone from the interaction between sunlight and fossil fuel pollution is rising at about 1.5%/a, and it is estimated that this will reduce global crop yields by 30% over the next two decades.^[c] IPCC report expects a 25% crop loss

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by the end of the century when global population is expected to be 9-14 billion.^[d] The magnitude of the impacts is already overwhelming some areas such as the Sudan. One third of land-based species are now facing extinction and 90% of the top predator fish have vanished.^[e] This is one of the hugest extinctions in earth's history. The area under drought has doubled between 1970 and the early 2000s. Diseases such as malaria, diarrhoea and cholera are all associated with heat.^[f]

[a] Environmental Research Letters, March 2007. [b] Sligo et al, Phil. Trans. Royal Society, Nov. 2005, 1983-9. [c] Long et al, Phil. Trans. Royal Society, Nov. 2005, 2011-20. [d] www.un.org/esa/population/publications/longrange2/Long_range_report.pdf. [e] www.washingtonpost.com/wp-dyn/content/article/2005/08/22/AR2005082200036.html. [f] Patz et al, Nature, Nov. 2005, 310-17 and IPCC at www.grida.no/climate/ipcc_tar/wg2/005.htm.

32 Massive change and threats to life bring compassion and strengthen communities, but it also brings rage, grief and shock." These inevitable human responses highlight the importance of developing an informed public that understands that government is not only concerned, but proactive in creating viable solutions.

33 Christian Aid predicts that a billion people will become refugees over the next 50 years from lack of water, conflict, large-scale developments and environmental degradation.^[a] People who were once able to provide their own food will now have to be fed by the rest. In addition population is set to grow over 40% in the next forty years, and most of them will be living in giant cities in the poorer countries.^[b] Megacities on the coast would spill their population into the countryside, disrupting already-critical food production. "Owing to the confluence of nuclear proliferation, migration into megacities and the centralization of economies within these cities, human society is extremely vulnerable."^[c]

[a] www.christian-aid.org.uk/indepth/705caweekreport/human_tide.pdf [b] www.emagazine.com/view/?2849. [c] Turco, Department of Atmospheric and Oceanic Sciences, UCLA.

34 Scarcity of land, water and other natural resources is a major cause of conflict. Increased severe weather along coastal areas, glacial melting and sea-level rise, will lead to mass migration that will exert huge pressure on resources in neighbouring countries, many of which area already vulnerable to violent conflict. The Pentagon Report stated "As famine, disease and weather-related disasters strike... many countries' needs will exceed their carrying capacity. This will create a sense of desperation, which is likely to lead to offensive aggression."^[a] International Alert has identified 61 countries that are unstable and/or have recently been fighting. Half a dozen of these have nuclear potential.^[b] Two-thirds of global arms exports are sent to these unstable countries.^[c]

[a] www.gbn.com/GBNDocumentDisplayServlet.srv?aid=26231&url=%2FUploadDocumentDisplayServlet.srv%3Fid% [b] www.international-alert.org/press/article.php?id=128. [c] www.fas.org/sgp/crs/weapons/RL33696.pdf ; www.controlarms.org/the_issues/movers_shakers.htm

35 The following is a calculation of the realistic demographic cost of global warming:
Total 2007 greenhouse emissions = 46 Bts CO₂-e/a (Stern). Total 2007 world population = 6.6 billion people.
Average 2007 per capita emissions = 7 tonnes CO₂-e/a. The range is 26.5 tonnes for each Australian to less than 1 tonne in the poorer countries. If half the world raised their standard of living and produced Australia's per capita emissions the total would be 82 Bts CO₂-e/a.

This level of emission is unsustainable, yet it is where everyone is heading.

Many propose we reduce emissions to 60% of 1990 levels by 2050 to stabilise the climate, which was then 38 Bts CO₂-e/a (Stern). A 60% reduction = 15 Bts CO₂-e/a. Forecasted world population in 2050 is 9 billion. This computes to average emissions target of = 1.7 tonnes CO₂-e/a per person. For Australia this would mean a fifteen-fold reduction - impossible without revolution, though a six- or seven- fold reduction may be possible if people realise the situation.

Alternatively, we might ask how many people could the world sustain at our lifestyle: our emissions (26.5 tonnes pp/pa) divided into a global emissions target of 38 Bts = 570 million people (=15/26.5)? This is equally impossible. Since both scenarios for higher world living standards and higher population have impossible outcomes, and as there are few credible or ethical compromises, the consequences would most likely be disastrous.

36 Nuclear weapons continue to spread to countries at severe climate-risk. The disruption following even small wars would bring mass starvation. Were nukes used, fall-out would be like the impact of a major volcanic eruption. In the past these have produced a year or more without summers. Nuclear winter could endanger the entire population of the earth. www.sciencedaily.com/releases/2006/12/061211090729.htm

37 Many analyses have been made of the positive economic value of rapidly adapting to climate change. Among many: The Australian Business Roundtable on Climate Change (involving Westpac and Origin Energy),^[a] Peter Cosier to the Wentworth Group,^[b] various insurance groups,^[c] the Allianz^[d] and Powering Australia's Future by Australian Business Council for Sustainable Energy.^[e]

[a] IAG.climatechangeroundtable.2006.pdf. [b] www.wentworthgroup.org/docs/Will_climate_change_cost_us_the_Earth1.pdf; [c] ABI.Financial_Risks_of_Climate_Change.pdf; [d] Allianz.and.WWF.in.allianz_wwf_climate_change_and_insurance_embargoed_oct_2006.pdf. [e] Australian.Business.Council.BCSE.EcoGen.Nov.Dec06.pdf

38 See Mark Diesendorf,^[a] and CEEM submission.^[b] For one of many criticisms of carbon quotas see here.^[c] [a] Diesendorf_Coal-Geoseq.2006.pdf. [b] [CCS.Enquiry.Oct.06.2\).pdf](http://CCS.Enquiry.Oct.06.2).pdf). [c] www.eco-action.org/dt/blame.html, www.sfsf.com.au/CarbonQuota.CarbonTax.leaflet.pdf, news.bbc.co.uk/1/hi/sci/tech/4479226.stm.

39 For more information on suggested micro-changes see George Monbiot's *Heat*, Paul Brown's *The Last Chance for Change* and James Lovelock's *The Revenge of Gaia* and details on the pages of our site www.planetextinction.com.

40 *Infrastructure and Climate Change Risk Assessment for Victoria*, March 2007, CSIRO, Maunsell & Fox.

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