Climate Change, National Security and ethics.

Dr John James

Summary: *Calculations show that dangerous levels of global warming cannot now be avoided. The life-style changes needed internationally are so wide-reaching that effective and immediate action is unlikely. As Australia is one of the few countries that can survive, we should prepare now for the inevitable. Ethical issues will distort our responses for years to come if we fail to address them now.*

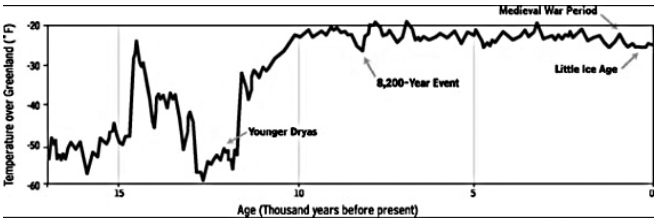
From the evidence, neither we nor the world will stop the full-on use of fossil-fuels before the growing use of these fuels have set off serious consequences from climate change. The possible consequences are so dire the survival of civilisation is at stake.

Government needs to prepare public opinion for the inevitable. We need to plan for changes to infrastructure, society and life styles, and defence so that we are ready in time. We need the support of our citizens in making the changes that will be necessary. In the process we will need to start a dialogue on a new ethical paradigm.

I have recommended to ministers at both Federal and State governments the immediate establishment of a National Risk Assessment Council that would assess various scenarios in conjunction with the local people, and collectively to evolve solutions.

The process should be public so that Australians become educated in the risks of climate change. They may then prepare in their private and commercial lives, and do so with the confidence that government is facing the issue and is determined to deal with it for the common good. This must lead to a better outcome than not being prepared, especially through developing a national resilience to a total shift in our lifestyle expectations**.**

The inevitability of 2^{o}C:



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. Fig. 1 of temperatures from ice cores showing the relatively even temperature of the past 10,000 years.

Since the 1780s the average global temperature has risen 0.78^{o}C from a one-third increase in atmospheric CO_2.[1] To this should be added methane and other gasses, and the concomitant impact of water vapour.

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

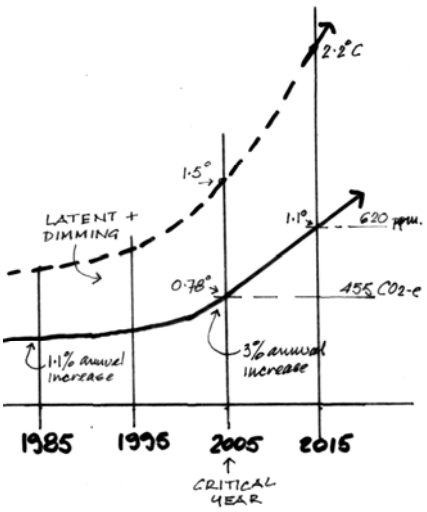
Thermal inertia comes principally from cooler ocean water keeping air temperatures down. As the oceans take up more heat from the air its temperature will rise to match. This is projected to raise average global temperature by about 0.45^{o}C.[2]

Aerosol dimming is the industrial pollution that masks the full impact of solar heating. If pollution suddenly stopped the haze would fall out of the atmosphere in a very short time,[3] and the temperature would increase about 20%.[4]

Together these are holding back the full impact of the CO_2-e already 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 + thermal inertia + 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.[5] These consequences cannot now be avoided.



We are now left with a margin of only 0.5°C before we reach the critical threshold that has been recognised as the uppermost safe limit to warming by the EU[6] and the UN.[7] This analysis is illustrated in Fig. 2 showing increasing emissions and the delayed impact of thermal inertia and global dimming.

If we continue on our present emission trajectory we will, *within eight years*, have emitted enough greenhouse gasses to ensure a rise of 2°C, and with it catastrophic climate change over the following decades.[8]

The passing of this threshold will be of the most enormous significance. We will have entered the era of unpredictable climate change where neither we nor our children can count on a safe future.

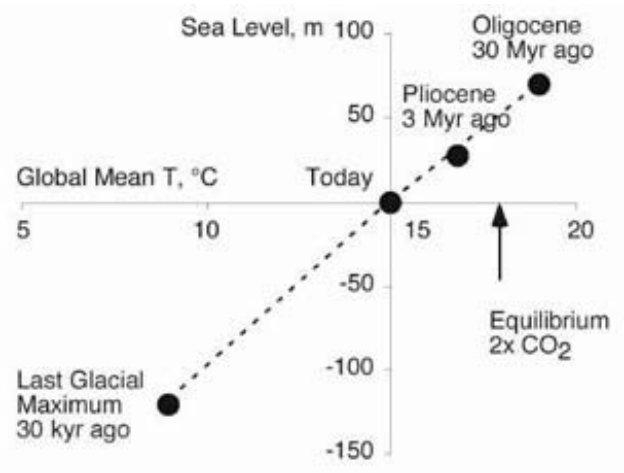
At 2°C it is believed that global heat would start to trigger the release vast quantities of the greenhouse gases now stored in the oceans, in trees and in the soil.[9]

The best estimates for the quantity of organic carbon stored on this planet are:[10] atmosphere 730 Bts, ocean (including clathrates) 10,000 Bts,[11] soil 1,400 Bts, vegetation 830 Bts (of which 430 Bts is in rain forests)[12] and permafrost 950 (of which 450 Bts is in Siberian yedoma).[13] Compare this with the 305 Bts humans have emitted into the atmosphere in 200 years – a difference of 150:1.

We do not want to start releasing any of these carbon/methane sinks. If we do a tipping point would be reached at which a positive feedback loop would begin. This inexorable process would be unstoppable and could increase average global temperature by up to 11°C or more.[14]

The mass-extinction at the end of the Permian 251 million years ago occurred from a sudden concentration of carbon in the atmosphere.[15] The consequent release of methane made it worse, and temperature quickly rose by 6°C.[16] The only land survivors were those that could adapt to the near-absence of oxygen, and plant life was almost eliminated.

One immediate consequence will be sea-level rise. Previous periods of high temperature have shown that the seas will rise at least 4 meters for every 1°C, perhaps as much as four times that, Fig. 3 of sea level against temperature over 30 million years showing this relationship between the two.[17]



NASA's James Hansen said "during the warmest interglacial periods - probably less than 1°C warmer than today - it was still basically the same planet. Sea level was perhaps a few metres higher. But if we go back to the time when the Earth was two or three degrees warmer, that's about three million years ago, sea level was about 25 metres higher."[18]

We are now guaranteed a sea-level rise of at least 6 meters and the loss of all our beaches, though the timescale is completely unknown and depends on how fast the great glaciers disintegrate.

2°C is closer than most are prepared to admit.

Hansen wrote that "further global warming of 1°C (above the 2000 temperature) defines a critical threshold. Beyond that we will likely see changes that make Earth a different planet to the one we know."[19] Considering that no one knows for sure what temperature would trigger the tipping points, we are already in a zone of absolute risk.

The Arctic Zeppelin station has monitored over the past three years that the average annual increase in the rate of CO_2 emission is about twice what it was twenty years ago, and this rate is accelerating.[20]

The human race is on a Gadarene rush headlong into the abyss by accumulating ever more coal-fired plants, more vehicles and logging, and relentless population increase. There are projections for a 23% power increase in the next decade, and China (building more than one plant a week) has recently overtaken the US as the largest emitter in the world.[21] There is no pause in our rush to extinction.

The IPCC report due out November will state that around mid-2005 we crossed a vital and dangerous threshold.[22] After reading the draft of this report Tim Flannery warned that it "establishes that the amount of greenhouse gas in the atmosphere is already above the threshold that could cause dangerous climate change."[23] In March last year the UK government reported that 450 ppm is the upper limit if global temperatures were to be stabilised at 2°C.[24]

We reached the figure of 455 ppm CO_2-e in 2005, two years ago.[25]

For two decades the world has had a window of opportunity. That window has now closed. There is no time left. We have to prepare ourselves to deal with the consequences.

The 13 tipping points that threaten civilisation:

In recent years there has been a surge in CO_2 levels that is greater than would have come from human emissions alone. Nearly all earth's systems known to effect climate change have begun positive feedback. Forests and oceans are no longer sinks, but are becoming sources of CO_2. We are now in the most dangerous zone when one or more tipping points will be triggered, and once triggered cannot be stopped.[26]

These events may be catastrophic: around 8,200 years ago it took less than a decade to reduce temperature in Greenland by 5°C. We have no way of knowing if this will happen again.

I will deal with each tipping point as shortly as I can.

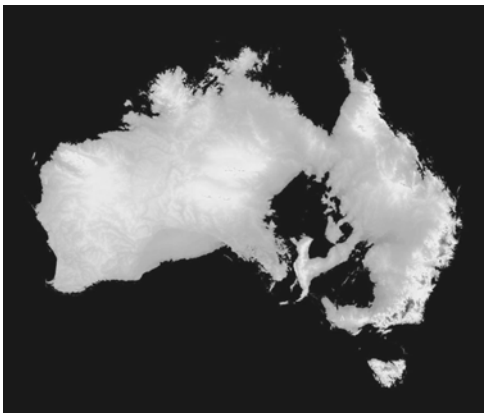
Glaciers: The melting of the Greenland and Western Antarctic is happening faster than shown in computer models,[27] partly from surface melting that floods through fissures to form subglacial lakes that are lifting the ice off the bedrock.[28] The gigantic masses of the Greenland glacier are picking up speed as they head towards the sea, as if running for home.[29] Complete disintegration is highly likely at 3°C, a temperature that is well within the range of climate change projections for this century.[30]

Mountain glaciers have been thinning by about 600mm/a and this rate is also accelerating.[31] Glaciers of the Tibetan plateau are losing half their mass every decade.[32] In the past ten years the movement of most glaciers has increased by 12%, as the meltwater lubricates the underside of the ice so.[33] The 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.[34] Their flows are expected to become seasonal, with enormous consequences on food production in the most populous countries in the world.

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 the planet melted, potential sea rise would be more than 80 meters.[35] The final level would be higher from the

expansion of water with heat and the upward movement of the land that once supported these glaciers. Fig. 4 shows the coastline of Australia were the sea-rise to be 100 meters. This is a very different place.

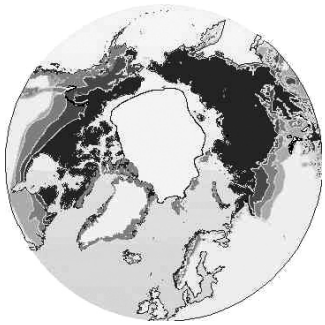


As this happens there would be a gradual inundation of the world's ports and docking facilities, along with frequent storm surges. Exports and imports will be severely affected. How will we get oil and food into the country? How high will prices go? Will there be rationing? Will road transport still be viable?

Salt water pollution of drinking water from a moderate 40 cm. rise would compel some coastal cities[36] to be abandoned.[37] Even a one-meter rise would make some airports inoperable, such as Sydney and Hong Kong. A 3 meter rise would directly flood 670 million people and 2 million square miles of mainly agricultural land would be lost.[38]

Methane: Methane is 21 times more powerful a greenhouse gas than CO_2. Most of it is held in Alaskan and Siberian peat bogs that cover an area of a million square miles to a depth of 25± meters. Local temperatures in southern Siberia have been 3-7^{o}C, higher than anywhere else.[39] Over the past 5 years the permafrost has been melting, turning a barren expanse of frozen peat into a broken landscape of mud and lakes, some more than a kilometre across. This is releasing five times more methane than estimated.[40]

There are 950 Bts of methane buried under the permafrost. It is three times all industrial emissions, and the release of only part of this would have a terrible impact on the globe, Fig. 5 showing the area of permafrost in Siberia and Canada.



In addition, under the northern oceans there are ice-like structures called clathrates.[41] A rise of merely 3^{o}C in local water temperature could cause some of the methane to escape.[42] There is strong evidence that this mechanism contributed to at least two extreme warming events in the geologic past.[43]

Forests: It is a false assumption that forests will remain carbon sinks. Carbon offsets are only a short-term money-making solution. When global temperatures reach 1^{o}C trees start being the source of carbon, not the sink.[44] The 2003 heat wave in Europe caused woodlands to release measurable quantities of CO_2.[45] Forests in northern regions will increasingly become heating agents.[46] This is why carbon-offsets are a farce and a diversion.

Logging and deforestation contribute about one fifth the global carbon emissions. This is second only to the burning of fossil fuels. In one day deforestation releases the same amount of CO_2 as 8 million people flying from London to New York. Some 1.6 billion trees are logged each year.,[47] and has turned Indonesia into the third-largest emitter of greenhouse gases in the world, followed by Brazil.[48]

Temperature rise is producing unstoppable megafires, like the recent conflagration in California where many small fires joined to create one huge fire with a front that stretched for hundreds of kilometres. They are likely to become the norm as rain falls a third or more.[49] The fire produced in ten days one-and-half times California's entire annual CO_2–e output.[50] The impact on global warming will be considerable.

Last year drought and fires killed half a billion metric tons of trees. Ten percent of Alaska burnt in 2004/5, followed by mudslides that made it impossible for the forests to regrow.[51]

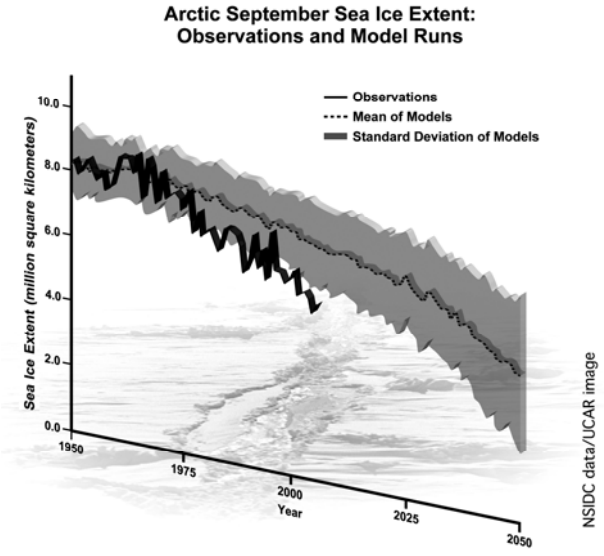
The great tropical forests of the Amazon, the Congo and Borneo are near their critical resiliency threshold as rainfall moves away.[52] One recent test shows that after three years of continuous drought the tree cover in the Amazon just falls over. [53] If the current rate of clearing doubles the forest is likely to destabilise, with the potential to double human emissions in a decade, while absorbing less and less of what we put out.[54]

Soils: One quarter of our carbon emissions are now being absorbed by the soil. There is some 300 times as much carbon trapped in the soils as we release each year from burning fossil fuels. Even over the past 25 years 13 Mts of carbon held in UK soils has been released each year.[55] Yet globally, soil could soon be

releasing large quantities as heat speeds up the metabolism of the microbes in the soil.[56] Peter Cox estimated this could increase temperature-rise by a further 40%[57] as it ejects all the man-made carbon it has absorbed over the past 150 years. [58]

Oceans: Another quarter of our carbon emissions are now being absorbed by the oceans.[59] As oceans heat they absorb less carbon:[60] the north Atlantic is now absorbing only half the CO_2 that it was a decade ago.[61] The chemistry of the oceans is changing more quickly than we could imagine.[62]

Globally, sea level has risen 1.8mm per year for the last 50 years,[63] but in the last decade this rate has more than doubled. Whole islands are disappearing, and Lohachara with 20,000 inhabitants in the Bay of Bengal has disappeared altogether.[64] This is escalating so fast that there could be 50 million environmental refugees within 3 years.[65]



All weather patterns depend on stratospheric air currents and deep ocean currents, both of which are changing. The Atlantic Gulf Stream is driven by cold water from the Arctic, which is retreating three times faster than estimated by any of the 18 computer models used by the IPCC in preparing its 2007 assessments,[66] Fig. 6,[67] and this summer temperatures in some areas have been 15°C above the average.[68] A US Navy survey suggests there will be no summer ice left by 2016.[69]

This will affect the Gulf Stream that brings warm surface water to northern Europe. The flow has slowed one third in the past 50 years.[70] Some computer models predict a possibility that the current will collapse as it has in the past, with a devastating effect on bordering states.[71]

Fisheries: As oceans take up CO_2 the pH falls, and becomes too acid for shells to form.[72] Oceans have acidified by 0.1 pH that has reduced plankton by 40% in some areas. Greater acidity makes it hard for organisms like corals, shellfish, sea urchins and starfish to build their calcium structures from carbon. The consequence is that less CO_2 can be absorbed by the sea. Fifty years ago, for every tonne of CO_2 emitted, 600kg were removed by land and ocean sinks. However, in 2006 only 550kg was removed.[73] This is positive feedback with a vengeance.

Many fish stocks are in crisis. A third of fish stocks have collapsed, and up to 90% of predator fish have disappeared.[74] Marine food security is being threatened, which is devastating for the many coastal communities dependant on fishing.[75]

Weather: Catastrophic weather is forecast in all models. There has been an increase in extreme, damaging events, particularly in coastal areas. In the past 35 years the number of Category 4 and 5 hurricanes worldwide has doubled while the wind speed and duration of all hurricanes has jumped by half.[76] Catastrophe will begin to strike often at the same place, as with New Orleans tat was devastated by Hurricane Katrina (half the population has not returned) and again flooded in September 2007.

As average temperatures soar by 5°C, droughts will occur nine out of every 10 years, and water supplies will decline by about 60%.[77] Lack of water is already threatening electricity supplies and many country towns are under severe water restrictions.

The CSIRO predicts coasts will be battered with massive 100-year storms and 110-metre storm surges that would destroy properties well above sea level, and erode the coastline.[78] Cyclones are expected to range down the whole of the Queensland eastern coast. Cyclone Larry in March ’06 obliterated the Queensland banana crop and pushed prices up four or five times.

Agriculture is already in crisis from drought, flood, habitat destruction, over-harvesting, pollution, collapse of bee colonies,[79] and the migration of pests. The IPCC report expects a one-quarter crop-loss by the end of

the century when global population is expected to have doubled.[80] In the past year the price of wheat has more than doubled, and our crop is projected to be a quarter of expectation.[81] With over a billion malnourished today,[82] how can the world feed so many more with a minimal reduction in agriculture of one quarter at 2°C?

Measurements over twenty years show that rising temperatures is causing a loss in wheat, rice, soyabeans, corn and barley[83] that works out at a ±4% for every half-degree rise.[84] Rice is particularly at risk as pollen is sterilised if local temperature stays above 35°C for one hour during flowering.[85]

Ozone from the interaction between sunlight and fossil fuel pollution is rising at about 1.5% a year. This could reduce global crop yields by a further third over the next two decades.[86] Globally, the area under drought has doubled between 1970 and the early 2000s. The magnitude of the impacts is already overwhelming some areas such as the Sudan.

Together these will disrupt global food supplies and hasten mass starvation. One third of land-based species are now facing extinction.[87] This is one of the hugest extinctions in earth's history and threatens humanity's very survival. Expansion of diseases such as malaria, diarrhoea and cholera are all associated with heat.[88]

Vulnerable cities: This year, for the first time, half of the world's population is living in cities,[89] and most of the extra population will join them.[90] People who were once able to provide their own food will now have to be fed by those that remain on the land. Megacities on the coast would spill their population into the nearby fertile countryside, disrupting already-critical food production. Low-lying cities like Bangkok are already sinking into the sea.[91]

"Owing to the confluence of nuclear proliferation, migration into megacities and the centralization of economies within these cities, human society is extremely precarious."[92] As cities disintegrate where will the people go? As their houses cover more land where will the food that is decreasing available come from to feed them?

On the other hand, a large 'lumpen proletariat' exercising enormous political power from the concentration of numbers, poses even more unsettling possibilities as increasingly severe weather along coastal areas and sea-level rise leads to mass movements.

Refugees: Christian Aid predicts that a billion people will become refugees over the next 50 years.[93] A one meter sea-level rise would affect 6 million people in Egypt, 13 million in Bangladesh, and 72 million in China. The anticipated multi-meter sea rise from glacier collapse will directly uproot 1,000 million people, one in six of the world's population, and three-quarters of them live in Asia. The ricochet will be far-reaching and incalculable as more people will be on the move than ever before.

Imagine eastern European countries struggling to feed their populations with a falling supply of food, water, and energy, eyeing Russia, whose population is already in decline, for its grain, minerals, and energy. Or Japan, with flooded coastal cities and contamination of its fresh water, eying Russia's Sakhalin Island oil to power desalination plants and energy-intensive agricultural processes. Envision Pakistan, India, and China skirmishing at their borders over these refugees, as well as over access to shared rivers, and the remaining arable land.

Conflict for water, land, food and shelter, and from mass migration will exert huge pressure on resources in neighbouring countries where refugees will flee to, many of which are already vulnerable. A 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" and the probable death of billions.[94]

International Alert has identified 61 countries that are politically volatile and/or have recently been fighting. Two-thirds of global arms exports are sent to these unstable countries.[95] Half a dozen of them have nuclear potential as these weapons continue to spread to countries at severe climate-risk.[96] The disruption following even small wars would bring mass starvation and additional climatic disruption.[97]

Under the circumstances I do not see any way these misfortunes can be prevented.

Finance and Insurance: There are many studies on the positive economic value of rapidly adapting to climate change. They all predicted that if this was begun at the time of writing (1999-2004) and if Australians started to retool now they would be better off in fifty years, but if they left it for only ten years they would be much worse off.

Among many such positive studies: The Australian Business Roundtable on Climate Change (involving Westpac and Origin Energy),[98] Peter Cosier to the Wentworth Group,[99] various insurance groups,[100] the Allianz Group[101] and the Australian Business Council for Sustainable Energy.[102] Little of this bore fruit.

Now it may be too late. This does not mean that their advice should not be taken, for we should do we can to clean up the earth, but nothing will stop us reaching 2°C except for *massive and immediate reduction in emissions*. Since the grindingly slow evolution of international agreements will not succeed in time, we must prepare.

Nature will be making the decisions for us, and eliminating prosperity and private wealth in the process.

Insurance is one of the foundations of personal and commercial security. Disastrous weather and heat could bankrupt the industry within a short time.[103] Globally, disaster losses increased from $70 billion in the 1960s to $600 billion in 1990s, and this trend is expected to continue. Total economic losses (insured and uninsured) are doubling every 10 years. They are 15 times higher today than in the 1960s, even after adjusting for inflation. Insurance premiums are an indication of the cost of climate change.[104]

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

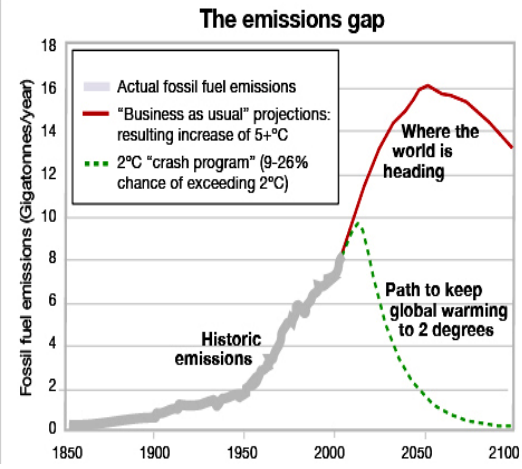
We all know, be it consciously or unconsciously, that we are killing the world we love, and our families and friends. The emotions this stir are being hidden. Massive and almost universal refusal to face the truth is creates a permanent shock to the collective psyche, with well-known psychotic consequences.[105]

One noted outcome is to withdraw to our sofas and wait for someone else to fix it. Another is to make hay while the sun shines, which underlies much of the greed that is driving our culture. That so many can be so blind to the reality and so active in increasing the damage to our future just emphasises the communal withdrawal from reality.

Was there some deep unconscious understanding of our situation when the term 'Y-generation' was first used in 1993?[106] Did this imply that the next, the Z-generation born after 1995, could be the last?

If we were desperate enough we would all be on the streets in tens of millions, or are we too addicted to our comforts? Is altering our lifestyles too large a price to pay? Are we unconsciously intoning to ourselves "I would prefer to be dead than give up what I have got!" Some epitaph!

Present policies:



The current consensus is politically driven, and is irrelevant. Most politicians and green groups are satisfied with demanding we cut existing emissions by 60% of 1990 levels in the next 40 years. The above argument shows we need to achieve much more than that in the next ten, Fig. 7, of the emissions gap that shows our current trajectory compared to the immediate reductions we need.

Emission trading and carbon taxes are based on the assumption that rich countries can go on living in the same way with minimal adjustments to the system.[107] The rush to 'clean coal' and sequestration follows the same rationale.[108] Long-term these are useful only if we have a survival strategy already in place.

George Monbiot described these solutions as "pushing the food around on your plate to give the impression that you have eaten it." Emission trading diverts investment from renewable technology, retains current profits and prolongs the world's dependence on oil, coal and gas. It is designed to maintain our standard of living while continuing to extract as much fossil fuel out of the ground as we can.

It is too late for market solutions. It is too late to try to keep our prosperity as sumptuous as it is. With ten years to go, our politicians are leading from the rear.

The one strategy that could combine limits to consumerism and equi-discriminatory restrictions on emitters is to use carbon rationing[109] to bring emissions and consumption down.[110] But against political inertia there is nothing we can do in the short time we have, and therefore we must prepare.

Conclusion from the above argument:

To keep below the 2°C threshold the world needs to cut emissions by 10% every year over the next 10 years, **starting now**. This means reducing personal consumption and encouraging renewable technologies.

In the final analysis it comes down to transforming our consumer society. If we would all buy less and travel less, we would emit less.[111] This is why the public has to be involved in the risk assessment process.

Since the required changes are revolutionary, and are pointless without some global consensus, we can assume that some nations will not change, and therefore we in Australia should prepare on our own. Sequestration and nuclear and renewables are less urgent than planning how this country and her people can cope as the climate becomes seriously worse.

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. This is our great advantage.

As ethical issues will affect and often distort the critical decisions we will have to make, it is up to us as thinkers and communicators to open the debate on the dilemmas that will affect decision-making.

When hundreds of millions are hungry and dispossessed do we help them from our own food resources that are in decline, and do we welcome them here, and in what numbers? Or do we protect our borders and try to survive inside Fortress Australia?

As the seas rise and trade and oil imports are reduced, how do we restore the manufacturing industries we have lost overseas? Who funds the reconstruction of flooded infrastructure, especially as there will be additional littoral damage from cyclones, prolonged heat waves, hail and drought?

What responsibility should the community accept for compensating those who have lost their waterfront homes? Who compensates who for the lost mortgages? How do we house our own refugees? Do we compel those with houses further up the hill to open their doors to those who have been flooded?

And how do we handle law and order when food may be scarce, transport rationed, and increasing numbers of refugees in a country that is no longer self-sufficient in manufacture or agriculture?

As disaster management becomes more important, what level of government direction do we accept? What of rationing of petrol and even food? Some level of draconian political control will be required over where we work and how we distribute food and services. What are the minimum limits to such powers, and is our slow-moving legal system able to protect our rights at a time of rapid change?

With less petrol the distribution of food and other goods will change, and shopping centres will turn into warehouses. The issues of ownership, compensation and retooling involving some of the politically most powerful groups in the country need to be thought through now, rather than in ten years.

As the tax base declines what are the priorities for essential services like hospitals and schools compared to public transport and security? Where will the money come from for rebuilding coastal infrastructure, and do we start this work while we still have a powerful economy?

Above all, emotional happiness would be under server stress as our wealthy culture shrinks inwards. I like to think it would be the greatest service to our community to encourage public awareness of how the future is going to affect each person. An aware public should be more able to face the future. To ignore these issues while we have time is to open ourselves to panic and polarisation when it comes.

A National Risk Assessment Council would investigate the issues and prepare citizens for the changes that are coming. Then people may alter their private and commercial lives with the confidence that government is facing the issues and determined to deal with them for the common good.

In this way we could develop a national resilience to a total shift in life expectations.

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[1] IPCC "Climate Change 2007" Fourth assessment report; Stern, *Review on the economics of climate change*, HM Treasury 2006; Schellnhuber, *Avoiding Dangerous Climate Change*, 2006, Cambridge.

[2] Scientific Expert Study Group Report, *Climate Change and Sustainable Development*, based on IPCC figures.

[3] James Lovelock, *Revenge of Gaia*, Penguin, 2006.

[4] Pearce, *New Scientist*, June 2003

[5] Schellnhuber, *Avoiding Dangerous Climate Change*, Cambridge, 2006, and in www.planetextinction.com/planet_extinction_consequences.htm; May 2007 Bangkok IPCC, *Herald Tribune* 4 May 2007: www.iht.com/articles/ap/2007/05/04/asia/AS-GEN-Climate-Change-Conference.php

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