

**Senate Standing Committee on Environment and Communications**

**Submission  
on  
Recent trends in and preparedness for Extreme Weather Events**

**Ian T Dunlop**

**Update 17<sup>th</sup> February 2013**  
(original submission 18<sup>th</sup> January 2013)

**Contents:**

**Summary**

**Time To Dispense With “Political Realism”**

**The Real Climate Challenge**

**A 4°C World – 1 Billion People**

**Realistic Targets to Prevent Catastrophic Climate Change**

**Resource Scarcity**

**So What Are We Doing?**

**Emergency Action Required**

**The Need for Forward-Looking Risk Management**

**Conclusion**

**Appendix: Typical Extreme Weather Events 2003-13**

**References**

**Author**

*Ian Dunlop is a former an international oil, gas and coal industry executive. He chaired the Australian Coal Association in 1987-88, chaired the Australian Greenhouse Office Experts Group on Emissions Trading from 1998-2000 and was CEO of the Australian Institute of Company Directors from 1997-2001. He is a Director of Australia21, Chairman of Safe Climate Australia, a Member of the Club of Rome and Fellow of the Centre for Policy Development.*

*“Want of foresight, unwillingness to act when action would be simple and effective, lack of clear thinking, confusion of counsel until the emergency comes, until self-preservation strikes its jarring gong—these are the features which constitute the endless repetition of history.”*

**Winston S. Churchill - 2<sup>nd</sup> May 1935**

## Summary

Extreme weather events, now escalating around the world, are evidence of major changes to our climate, which inevitably will lead to a fundamental re-design of our democratic, economic, business and social systems, with long-term survival as the prime objective.

Hurricane Sandy, the Queensland and NSW floods, the heat dome over Australia and the related bushfires around the country, are only the most recent of these extreme events, and we can expect more of them. Whether business or politics like it or not, climate change and resource scarcity are going to be the key drivers of policy from now on.

The risk implications of the critical climate science have been, and are being, officially ignored. As a result, Australia is ill-prepared to handle escalating weather extremes. Policy is focused almost exclusively on emergency response and recovery, with minimal effort to proactively anticipate, mitigate and manage the very high risks of catastrophic events. Much of this failure is due to an ideological and wilful refusal to acknowledge the extent and speed of anthropogenic global warming as a driver of extreme events, while we pretend that we can grow our high-carbon economy indefinitely.

Current climate policies, if unchanged, will lead to a major reduction in world population to around 1 billion people, with severe impact on Australia. The world can only burn less than 20% of existing proven fossil-fuel reserves if catastrophic climate change is to be avoided, which removes any justification for continued exploration for, and development of, fossil-fuel resources. Every new fossil-fuel project now represents death and destruction for communities somewhere in the world, including in Australia.

The first priority of responsible government is to address major threats to national security. Climate change and the inter-related issues of peak oil, water and food security are arguably the greatest threats to national security Australia will face in the next decades. The legitimacy of any State, Federal Government, or Opposition, depends on its preparedness to acknowledge these realities and take the serious action required

The refusal of current leaders to accept the climate science and its risks is condemning the Australian community to a catastrophic future. Given that our leaders are well aware of the extreme risks we now run, in maintaining this attitude they are wilfully perpetuating nothing less than a crime against humanity, and against the Australian community in particular.

The same leaders lack the imagination to see the great opportunities these risks present, let alone guide us to them. In the process, they are throwing away the real future of Australia.

Our children and grandchildren will have to survive in an extremely difficult world, but this does not appear to be a consideration to current leaders. Their actions today are making that future infinitely worse, by perpetuating the system which created the problem. This is not good enough. Every parent and grandparent must become aware of the real risks and opportunities ahead, and force politics and business to change, fast.

I urge the Senate Committee to initiate a major re-consideration of the Australian Parliament's approach to these issues, before it is too late, based on bi-partisan cooperation, incorporating the catastrophic risk management framework suggested.

-----

*“They go on in strange paradox, decided only to be undecided, resolved to be irresolute, adamant for drift, solid for fluidity, all-powerful to be impotent.....Owing to past neglect, in the face of the plainest warnings, we have now entered upon a period of great danger..... The era of procrastination, of half-measures, of soothing and baffling expedients, of delays, is coming to a close. In its place we are entering a period of consequences..... We cannot avoid this period, we are in it now.....*

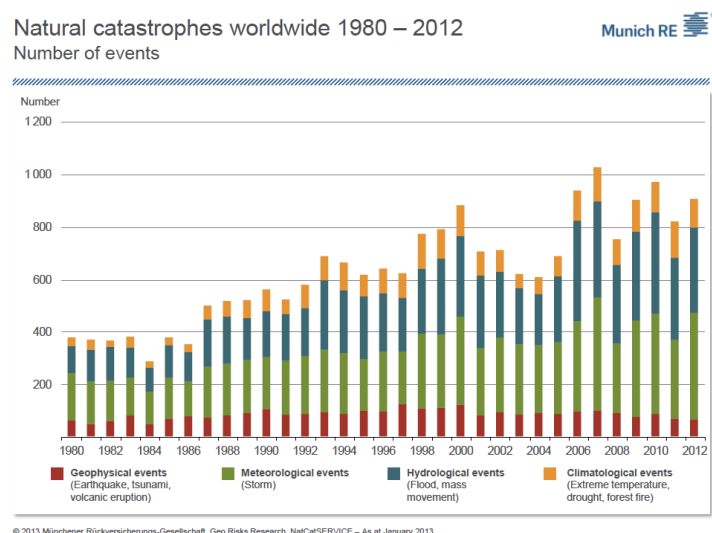
**Winston S. Churchill - 12<sup>th</sup> November 1936**

### Time to dispense with ‘Political Realism’

Australia is currently living in a “fools paradise”, ignoring the most critical issues which will impact upon this country in both the short and long term.

Weighty reports are being published on the “official” future of Australia. For example, Intergenerational Reports, Tax Reviews, Infrastructure Reports, Population and Competitiveness strategies, the Asian Century White Paper <sup>1</sup> and most recently the final Energy White Paper <sup>2</sup>. Scenarios abound, setting out the implications of differing assumptions for the future of our children and grandchildren. All of which would be laudable were it not for the fact that the critical scenario, of accelerating anthropogenic climate change and resource scarcity, is deliberately ignored - apparently too scary for “political realism” to contemplate. Which is a nonsense, for the whole idea of scenarios is to prepare for the real, and increasingly likely, risks and opportunities which we face.

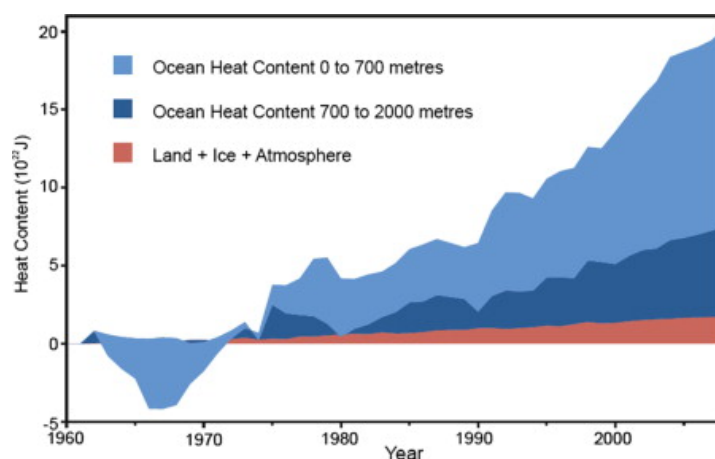
The occurrence of extreme weather events, events which are statistically outside the normal range of historical experience, is accelerating around the world, and is well-documented, as recent analysis by Munich RE shows.



Appendix I. lists some of the extreme events which have occurred in the last decade. Science is now able to link these events to long-term climate change trends with increasing confidence <sup>3 4 5</sup>. The climate is undoubtedly warming at an accelerating rate, albeit extreme weather, which is the short-term manifestation of long-term climate trends, is highly variable, both regionally and globally. For example it can take the form of excessive heat as recently experienced in Australia <sup>6</sup>, or excessive cold as currently evident in China and parts of North America. It may simultaneously result in drought and floods even within one geographic area- witness the Southern USA last year, with severe drought in the South West and severe flooding in the South East <sup>7</sup>.

Many claim that the world has not warmed since the anomalously hot year of 1998, and hence the anthropogenic global warming thesis can be discounted. Unfortunately this is not born out by the facts <sup>8</sup>. Whilst the increase in average global surface temperatures has slowed, much as expected after a record hot year and subsequent La Nina events, the heat content of the oceans, where most of the accumulating net energy is stored, has continued to increase rapidly <sup>9 10 11</sup>.

### Global Warming did not stop in 1998



The question is frequently asked: “Is a particular extreme event caused by climate change”. The answer is that all events now have both a natural variability and a climate change component. The latter is due to the fact that the environment in which they occur is now warmer and more moist than it used to be. As warming increases, the climate change component will also increase <sup>12</sup>.

Uncertainty remains over the manner in which climate change will develop in the next decades, but the accelerating warming trend is clear. The uncertainties relate to the manner in which that trend will manifest itself regionally and in the form of extreme events.

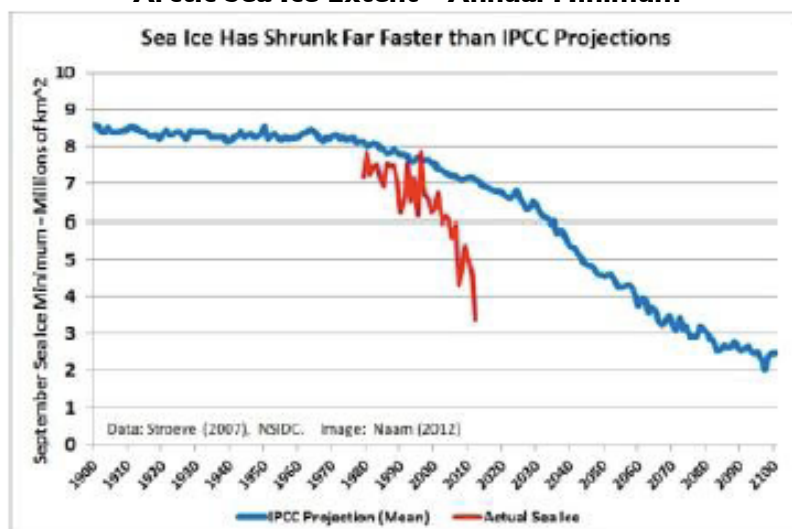
The implications of recent extreme weather events, and our preparedness to handle their likely evolution, can only realistically be assessed in the context of the real climate change and resource scarcity challenges we face. These are far greater and more urgent than is acknowledged by political and business leaders in Australia, as discussed below.

### The Real Climate Challenge

As Voltaire put it: “Men Argue, Nature Acts”.

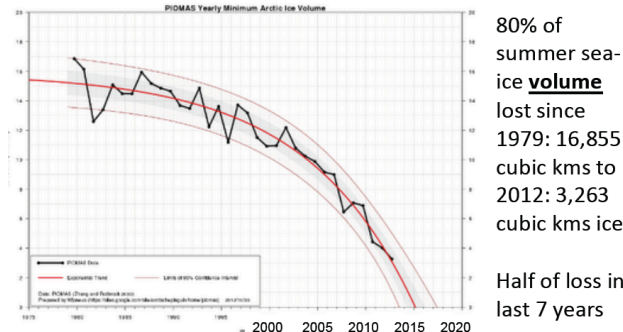
Due to our refusal to heed continued scientific warnings on the need to reduce greenhouse gas emissions, we have probably passed climate tipping points in the Arctic which have the potential to halt human development as we know it.

### Arctic Sea Ice Extent – Annual Minimum



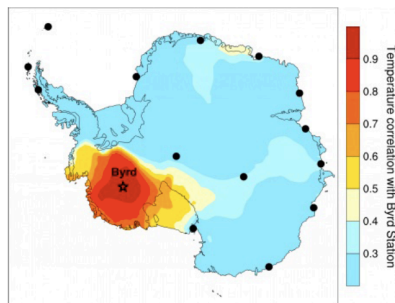
The Arctic is now warming at around 3 times the rate of the planet in general. The resulting large and unexpected changes are further accelerating warming via positive feedbacks<sup>13 14 15 16 17</sup>. For example less reflective ice, more solar radiation warming the ocean, more permafrost melt<sup>18</sup> and methane emissions<sup>19</sup>, hence even more warming. Annual minimum Arctic sea ice volume, as opposed to the areal extent above, has reduced by 80% since 1979, 40% in the last 7 years. On current trends, the Arctic will be sea ice-free in summer by around 2015, something which was not previously predicted to occur until late in the 21<sup>st</sup> Century:

### Arctic Sea Ice Volume – Annual Minimum



Unexpected changes are also occurring in the Antarctic. The West Antarctic ice sheet, for example, has been warming faster than virtually anywhere else on the planet<sup>20</sup>.

### West Antarctic Ice Sheet Warming

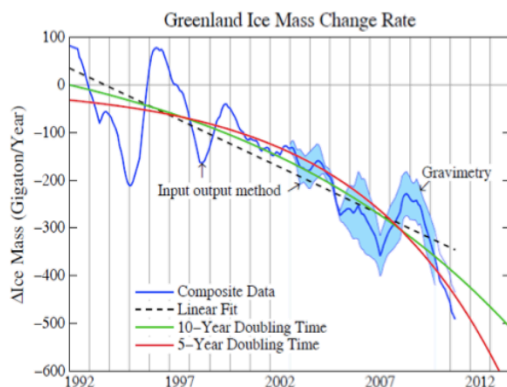


#### Western Antarctic Ice Sheet

is warming nearly twice as fast as previously thought — an increase of 2.4C in average annual temperature between 1958 and 2010

Whilst these changes may seem remote from Australia, they have enormous impact on the global climate system and on sea level rise, and thus directly impact upon us. For example, sea ice melt has a relatively minor impact on sea level rise as the ice is already floating. However, the land-based Greenland ice sheet is another matter as its melt water directly increases sea level. Recent evidence suggests that the ice sheet melt is speeding up.

### How Rapidly is The Greenland Ice Sheet Melting?



There is insufficient data over a long enough period as yet, but if current trends eventually confirm an exponential ice mass loss rate:

- A 10-year doubling time (green line) would lead to  
**1 metre sea level rise by 2067 & 5 metres by 2090**
- A 5-year doubling time (red line) would lead to  
**1 metre sea level rise by 2045 & 5 metres by 2057**

Source: "Update of Greenland Ice Sheet Mass Loss: Exponential? J Hansen & M Sato, December 2012<sup>21</sup>

The dilemma is that, given the likely non-linear acceleration of melting, by the time this becomes clear, it will probably be too late to take corrective action. These estimates stand in stark contrast to the sea level rise planning parameter used by most Australian authorities, of around 1 metre by 2100.

Whilst evidence of rapid climate change is very obvious in the polar regions, multiple signs are also evident elsewhere. For example ocean acidification, record sea surface temperatures, coral reef disintegration, biodiversity loss, rainforest dieback, glacier melt, record droughts and flooding etc.

Science has clearly established human carbon emissions as a prime cause of climate change<sup>22 23 24 25 26</sup>. These major changes are happening at the 0.8°C temperature increase we have already experienced relative to pre-industrial conditions, let alone the additional 0.6°C to 3.5°C to which we may already be committed as the full effect of historic emissions is felt<sup>27</sup>. If nothing is done to counteract these trends, by cutting carbon emissions rapidly, it will be impossible to prevent catastrophic outcomes.

"Official" solutions to reducing emissions, such as carbon capture and storage, and clean coal technology, are not working and even if they did, it would require decades for them to take effect, time we no longer have<sup>28 29</sup>. The fact that the fossil fuel industries are not seriously investing in them is a sure sign these technologies are in trouble.

Current climate policy commitments, such as Australia's Clean Energy Future package, if fully implemented will result in 4-6°C mean warming, with the Arctic experiencing 10-16°C regional warming - way beyond the official target of 2°C - worsening an already very dangerous situation<sup>30 31 32</sup>. This could occur long before 2100. The Federal Opposition's Direct Action proposals would only compound the problem.

#### **A 4°C World - 1 Billion People.**

Australian political and business leaders glibly talk about adapting to a 4°C world with little idea of what it means - which is a world of 1 billion people or less, not 7 billion<sup>33</sup>.

As the UK Royal Society put it January 2011, "In such a 4°C world, the limits for human adaptation are likely to be exceeded in many parts of the world, while the limits for adaptation for natural systems would largely be exceeded throughout the world"<sup>34</sup>.

When asked at the Melbourne 4 Degree Conference in July 2011 to explain the difference between a 2°C and a 4°C world, Hans Joachim Schellnhuber, Director of the Potsdam Institute for Climate Impact Research replied simply: "human civilisation"<sup>35</sup>.

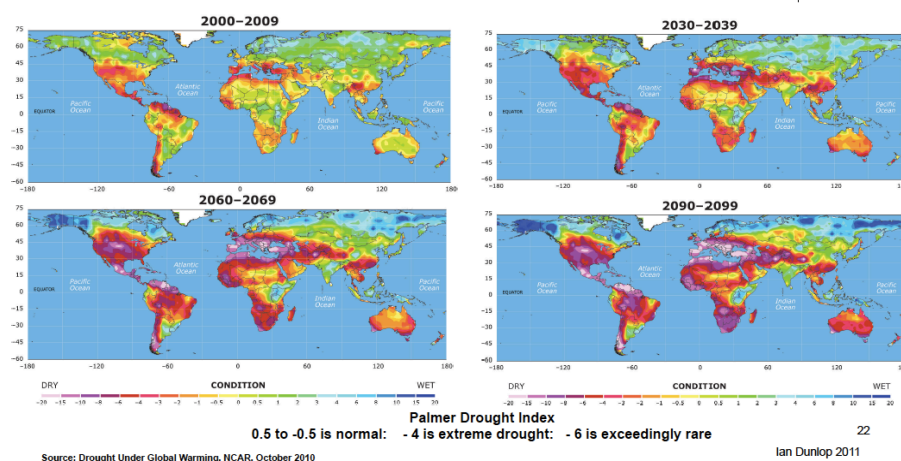
Kevin Anderson, Deputy Director of the UK Tyndall Centre for Climate Change Research summarises the dilemma as follows:

*"For humanity it's a matter of life or death. We will not make all human beings extinct as a few people with the right sort of resources may put themselves in the right parts of the world and survive. But I think it's extremely unlikely that we wouldn't have mass death at 4°C. If you have got a population of nine billion by 2050 and you hit 4°C, 5°C or 6°C, you might have half a billion people surviving."*<sup>36</sup>

*"It is fair to say, based on many discussions with climate change colleagues, that there is a widespread view that a 4°C future is incompatible with any reasonable characterisation of an organised, equitable and civilised global community. A 4°C future is also beyond what many people think we can reasonably adapt to. Besides the global society, such a future will also be devastating for many if not the majority of ecosystems."*<sup>37</sup>

Large parts of the world would be subject to extreme drought, with severe impact on food and water supply and human health, whilst other parts experience intense rainfall and flooding, sometimes both in short order, as per recent Australian experience<sup>38 39</sup>.

### Increasing Extreme Drought



**As a hot, dry continent, the impact on Australia is likely to be severe. It implies a major reduction in the Australian population.**

**An analogy with human physiology is appropriate. Normal body temperature is 37°C. Add 2°C and you have high fever. Add 4°C and you are probably dead. Just so with the climate.**

In short, as the World Bank emphasises <sup>40</sup>, if we have any sense of responsibility to current and future generations, a 4°C world is to be avoided at all costs.

### Realistic Targets to Prevent Catastrophic Climate Change

Gradually, the world is starting to understand that, if catastrophic outcomes are to be avoided, on the balance of probabilities the real target for a safe climate is to prevent global mean temperature rising more than 1.5°C above pre-industrial levels. This requires a rapid reduction of atmospheric carbon concentrations back toward the pre-industrial levels below 350ppm CO<sub>2</sub> from the current 392 ppm CO<sub>2</sub>.

For developed countries like Australia, this will require global emission reductions in the order of 50% by 2020, almost complete de-carbonisation by 2050 and continuing efforts to draw down legacy carbon from the atmosphere <sup>41 42 43 44 45</sup>. Already total greenhouse gas concentrations, including gases such as methane and nitrous oxide in addition to carbon dioxide, are around 470ppm CO<sub>2</sub>equivalent, in excess of the official UNFCCC and International Energy Agency (IEA) 450ppm CO<sub>2</sub>e stabilization target, which supposedly corresponds to the maximum 2°C temperature increase. At present the full warming of this CO<sub>2</sub>e concentration is reduced by the cooling effect of aerosols produced mainly by coal combustion.

Looked at from a total carbon budget perspective, to have a less than 25% chance of exceeding the 2°C target relative to pre-industrial levels, the world can only emit a further 800 Gigatonnes CO<sub>2</sub> in toto from today, a budget which would be used up in less than 20 years <sup>46</sup>. The Australian budget, as one of the world's highest per capita carbon emitters, runs out in 5-8 years – no more carbon emissions after say 2020.

If the temperature target has to be less than 1.5°C, as is now the case, the budgets are considerably lower. This requires global emissions to peak in the next year or so, and then fall in the 9 -10% pa range, something never previously achieved in human history. An equitable approach would require developed world emissions to fall rapidly, while developing world emissions continued to rise for a period before also falling <sup>47 48</sup>.

Given our inaction to date, it is almost inevitable we will overshoot the 1.5°C, and probably the 2°C, target, but it has to remain our medium-term objective.

The cost of this degree of change is probably in the range 3-5% of global GDP, rising the longer real action is delayed. This is a manageable amount. However, the potentially catastrophic cost of continuing inaction would be in excess of 20% of GDP, equivalent to the costs of WWI, WWII and the Great Depression combined, let alone the deaths and human suffering involved. We only play the fossil-fuel emissions game once, there is no trial run; we need to get it right first time.

In short, we are faced with an unprecedented task to transform global society on to a low-carbon basis, a task which becomes far harder with every year of procrastination.

### **Resource Scarcity**

The critical resource scarcity confronting us is the lack of disposal space to dump the carbon waste from our profligate use of fossil fuels, and other pollution. We can no longer use the atmosphere as a free dumping ground if we wish to avoid catastrophic climate change, and much-vaunted carbon capture and storage solutions are not working. Hence the need for rapid emission reductions. That said, there are other critical resource scarcities developing.

Cheap conventional oil supply peaked globally in 2005 and has since been stagnant, with Australia's oil self-sufficiency continuing to decline below 50%. Increasing global demand is being met by new high-cost supply from unconventional sources such as tar sands and shale oil. The rapid decline of existing oil reservoirs globally is not being offset by these new sources, official and media hype about a glorious unconventional oil and gas future notwithstanding. Price rises and supply shortages will be the inevitable outcome if demand continues to grow. Further, the carbon emissions, and other resource demands of unconventional oil and gas, such as water, are disastrously high <sup>49</sup>.

Complacent official Australian assumptions on oil supply, that "the market will always provide", as implied by the recent Energy White Paper and related analysis <sup>50</sup>, are dangerously irresponsible in these circumstances <sup>51</sup>.

**Of far greater importance is the fact that, as a result of our collective inaction, the world can only burn less than 20% of existing proven fossil-fuel reserves if catastrophic climate change is to be avoided <sup>52 53 54</sup>, which removes any justification for continued exploration for, and development of, fossil-fuel resources.**

The global rush from coal to gas is accelerating warming, not reducing it, due to leakage of methane and the removal of aerosols in the atmosphere. Coal seam gas (CSG) is particularly damaging; methane leakage is high, its impact on water resources and arable land is poorly understood, and its production potential is considerably less than its proponents maintain <sup>55</sup>.

Water and food security are acute problems globally <sup>56</sup>, exacerbated by both population growth and climate change. In Australia, the rush for short-term profit from CSG is destroying arable land and water resources, resources which will be of infinitely greater, and lasting, importance than gas given the likely severe impact of climate change on this country.

### **So What Are We Doing ?**

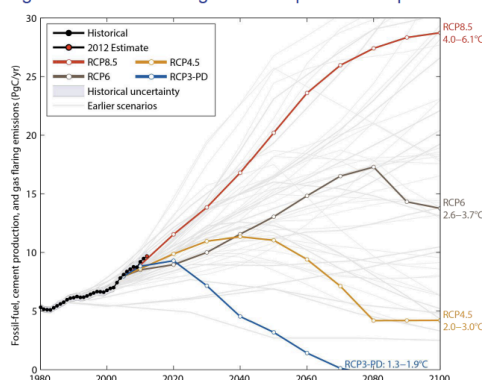
In the 20 years since negotiations on reducing carbon emissions commenced, virtually nothing has been done to curb emissions, and there are no signs of that occurring via international treaties in the short term. Meanwhile, after a brief pause during the Global Financial Crisis, emissions continue to rise at record rates, aided and abetted by Australia's determination to rapidly expand high-carbon coal and gas exports <sup>57</sup>.



### Global Fossil Fuel & Cement Emissions

Emissions are heading to a 4.0-6.1°C "likely" increase in temperature

Large and sustained mitigation is required to keep below 2°C



Linear interpolation is used between individual datapoints

Source: Global Carbon Budget 2012

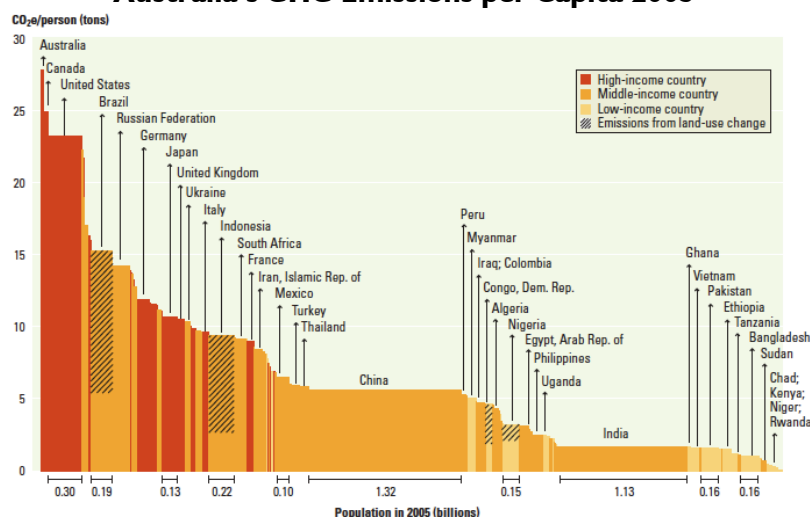
The inertia of the climate system means that our emissions today virtually lock-in potentially catastrophic outcomes for decades ahead.

Credit is due to the Federal Government, and supporters, for introducing a carbon tax in 2012 in the face of stiff opposition. However, the emission reduction targets implicit in the Clean Energy Future package, 5% on 2000 levels by 2020 and 80% by 2050, are ludicrously low compared with the real reductions now required. Obstruction from the Federal Opposition and special pleading by vested interests has seriously undermined the efficacy of even that package. It is morally and ethically bankrupt for government and business leaders to publicly rejoice in the fact that the carbon tax has had such little impact. It was meant to have an impact. The fact that it is having none, demonstrates it is not working.

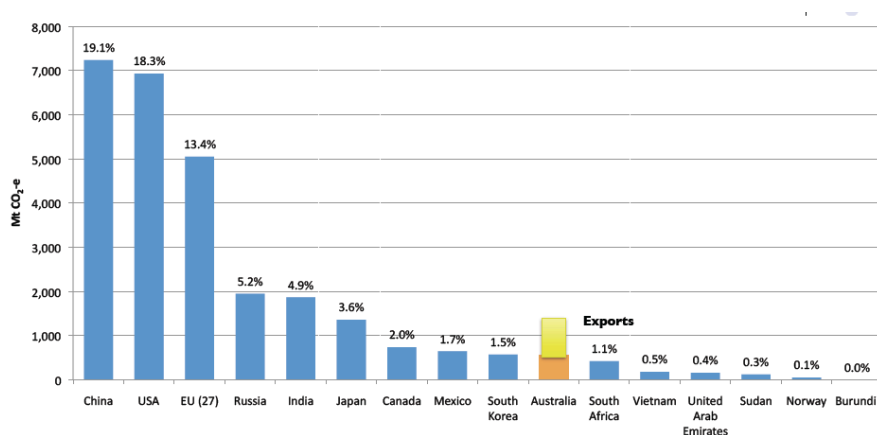
However, the real tragedy of Australian climate policy is the total disconnect between the supposed commitment of both major parties, and business, to serious action on climate change on the one hand, and their energy and economic policies on the other. In particular the commitment of both parties to continued expansion of the fossil fuel industries, particularly coal, the most emission intensive fossil fuel source.

By 2025, the Australian coal industry is planning to more than double coal exports, and the gas industry to quadruple gas exports. We are amongst the world's highest carbon emitters on a per capita basis, and on an absolute basis if exports are included. These expansions will leave us in the top six global emitters.

### Australia's GHG Emissions per Capita 2005



### Australia's GHG Emissions in a Global Context 2005



Source: Climate Analysis Indicators Tool (CAIT) Version 7.0. (Washington, DC: World Resources Institute, 2010). Total GHG emissions in 2005 (excludes LULUCF)

26

One critical impact will be on the Great Barrier Reef. The Reef is already under severe pressure from climate change and pollution. Apart from its major contribution to accelerating warming, coal and CSG expansion will probably administer the coup de grace to the Reef, the vast ecosystem around it, and the large food and tourism economy dependent upon it, as coal and gas export shipping intensifies.

In the light of the imperative to reduce emissions rapidly if catastrophic climate change is to be avoided, it is incomprehensible that Federal and State Governments continue to approve new coal mines and CSG projects, such as Maules Creek, the Boggabri extension and AGL's Gloucester project, let alone the mega-coal projects being mooted for Queensland's Galilee Basin.

### Every new fossil-fuel project represents death and destruction for communities somewhere in the world, including Australia

The only conclusion is that neither of the main political parties have any serious intent to address climate change, and that current leaders are paying little more than lip-service to community concerns.

Neither are major businesses, financial markets, bankers or insurers, doing anything meaningful in the context of our real challenge, despite much worthy rhetoric on the need for serious action. The dominant view is that governments will never get to the point of taking such action and thus business is at liberty to pursue high-carbon investment. The fossil fuel industries in particular, go further in subverting any attempts at serious reform.

Financial incentives are the main culprit, in particular the bonus culture which has spread through Australian business since the early 1990s, resulting in the current obscene remuneration of senior executives. Recently there has been some recognition that this might be a problem. The Chairman of Rio Tinto acknowledged that "the spiral in executive remuneration over the last two decades, simply cannot continue"<sup>58</sup>, and chief executives graciously decided for a while to forgo their annual bonuses in the light of adverse corporate performance. Very worthy, but the damage caused by this culture is far more insidious than a debate about quantum.

The bonus mentality inevitably bred short-termism – few directors or executives are prepared to give serious attention to long-term issues such as climate change when their rewards are based almost entirely on short-term performance. As Upton Sinclair put it: "It is difficult to get a man to understand something if his salary depends on him not understanding it".

Many privately agree that climate change needs far more urgent action than we are seeing, but few are prepared to speak out for fear of derailing "business-as-usual". This is a fundamental failure of governance – directors have a fiduciary responsibility to objectively assess the critical risks to which

their companies are exposed, and take action to ensure these risks are adequately managed. But if they acknowledge climate change as a serious risk, they are bound to act, which requires a radical redirection of Australian business away from our addiction to high-carbon coal and gas, our most powerful vested interests losing out in the process. Better then to stick to absolute denial, irrespective of the consequences, and ensure that others do the same.

This flows through to politicians, NGOs and the bureaucracy, who are subjected to immense pressure from the corporate sector not to rock the “business-as-usual” boat. The chorus is picked up with vehemence by a compliant media and shock jocks, the result being politically expedient and contradictory climate policy, which is building into a disaster for the Australian community.

Ethically and morally indefensible it may be, but that is what a deregulated market has delivered, and why it is so dangerous for the health of democracy, and to our survival.

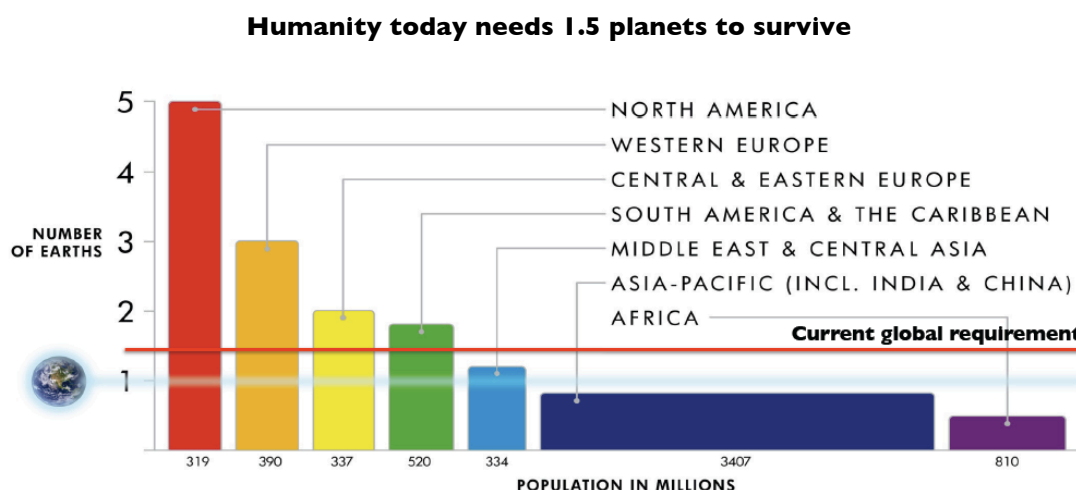
Ross Garnaut made the point, in his 2008 Climate Change Review, that: “*The most costly and damaging policy for Australia would be to implement a policy that was designed to appear meaningful, but was largely meaningless in application*”<sup>59</sup>. That is indeed the point we have reached today.

Meanwhile, the Chinese, Indians and other trade partners are in the process of rapidly abandoning a high carbon future, which will leave Australia within a decade, with a stack of stranded assets in mines, ports and railways, “*beautifully equipped for a world which no longer exists*”. And with severely degraded food production capacity.

Not smart thinking for a “clever country”.

### Emergency Action Required

Humanity is now the dominant global force. What was workable in a relatively empty world of 2-3 billion people post-WWII is not workable in today’s full world of 7 billion, let alone the 9 or 10 billion to come. Humanity today requires on average the biophysical capacity of 1.5 planets to survive<sup>60</sup>. If everyone lived at US levels, we would require 5 planets, at Australian levels around 4 planets. This cannot continue any longer as we are fast destroying the global commons of clean air, water and the fertile soil and oceans on which we depend for our food supply and life support.



Our ideological preoccupation with a market economy, based on political expediency and short-term profit maximization, is rapidly leading toward an uninhabitable planet, as sustainability issues of theoretical concern for decades manifest themselves physically, particularly in regard to climate, energy, water and food<sup>61 62</sup>.

Progressive business leaders around the world are beginning to recognize that change is urgently needed. For example the annual World Economic Forum Global Risks Report<sup>63</sup> has, for several

years, acknowledged climate change as one of the major risks to business viability. Sadly it has had little impact so far on the actions of prestigious leaders attending the annual WEF Davos meeting. Others, for example McKinsey and the World Business Council for Sustainable Development, urge a move away from short-termism, refocusing on the long term and incorporating a wider range of social and environmental considerations in decision-making<sup>64 65</sup>. These efforts, whilst laudable, to date have not produced a discernible change in business short-termism, certainly not embracing the need for emergency action on climate change. However, pressure is mounting, particularly from the major supranational organizations<sup>66 67 68 69</sup>. As Christine Lagarde, Head of the IMF bluntly put it at the 2013 Davos meeting: *“Unless we take action on climate change, future generations will be roasted, toasted, fried and grilled ”*<sup>70</sup>.

However, what our leaders are not facing up to, either in Australia or globally, is that the only realistic way to avoid catastrophic climate change, is to immediately halt any new high-carbon development and to initiate emergency action by placing key economies on a war-footing, to rapidly implement low-carbon re-structuring; akin to the manner in which preparations were made for WW2 in the UK, Germany & the US, or the way in which the Marshall Plan was implement in reconstructing Europe post-WW2<sup>71 72 73</sup>.

There is no inkling of this anywhere in Australia’s “official futures”; there is a passing nod to climate change, and oil scarcity is ignored. The entire focus of mainstream political and business thinking is to squeeze the last drop of juice from our high-carbon lifestyle.

**Given that our leaders are well aware of the extreme risks we now run, in maintaining this attitude they are wilfully perpetuating nothing less than a crime against humanity, and against the Australian community in particular.**

Australia has enormous ingenuity, low-carbon resources and opportunities, but only if we are honest about the real challenge and initiate our own emergency action, which must include new approaches to risk management.

### **The Need for Forward-Looking Catastrophic Risk Management**

Climate change and extreme weather events are essentially matters of risk management, but not in the conventional government, business, financial markets or insurance sense. These changes have potentially catastrophic outcomes, with the ability to destroy communities, businesses, countries and indeed the world as we know it. As such, their risks have to be handled entirely differently from conventional practice. This is particularly so as the actions we take today are locking in potentially catastrophic outcomes for decades, indeed centuries, to come. These are factors which humanity has never previously had to confront.

Catastrophic risk management has to be forward-looking, factoring in the best scientific advice to anticipate the impact of our current economic and social system on the climate, and to take proactive steps to avoid the worst outcomes. It should not rely on backward-looking historical analysis as a guide to action, as we are currently doing, otherwise it will be too late to prevent irreversible catastrophic outcomes.

This point is emphasised by numerous global experts<sup>74 75 76</sup>. In 2008 Ross Garnaut wrote: *“prudent risk management would suggest that it is worth the sacrifice of a significant amount of current income to avoid a small chance of a catastrophic outcome .....”*<sup>77</sup>. Since then the chance of catastrophic outcomes has risen substantially.

The following catastrophic risk management framework is suggested:

- I. **Normative Policy.** *“Politically realistic”*, incremental change from “business-as-usual” is not tenable. This must be replaced with a normative view of the targets required to avoid catastrophic consequences, based on the latest science. Action is then determined by the imperative to achieve the target, not by incremental, art-of-the-possible, change from business-as-usual. This will involve both mitigation – *avoiding the unmanageable*, and adaptation – *managing the unavoidable*.

In short, the target for stabilisation of atmospheric carbon to avoid dangerous consequences is now less than 350ppm CO<sub>2</sub>. Our objective must be to reach that target as rapidly as possible. Many will dismiss this as unattainable given that current concentrations are 392ppm CO<sub>2</sub>; it will require not only the rapid curtailment of emissions, but the re-absorption of some carbon already in the atmosphere. We have the technology to achieve this; so far we have lacked the will to make it happen.

The target is only unattainable when viewed with a business-as-usual mindset, influenced by established vested interests. When real emergencies loom, as at present, then remarkable change is possible, but only with a paradigm shift in thinking.

2. **Change Mindsets**, to now regard the climate change challenge as a genuine global emergency, to be addressed with an emergency global response. This is not extremist nonsense, but a call echoed by an increasing numbers of world leaders as the science is better understood.
3. **Moral & Ethical Considerations**. Climate change, and its potential to trigger catastrophic failure, must be thought of differently from short term economics, risk assessment and cost benefit analysis which have dictated policy thus far. Irreversible climate change scenarios require that we base our response primarily on moral and ethical considerations than on quantitative economics. Under these circumstances, we should be prepared to pay a great deal to maintain societal, environmental and economic flexibility for both current and future generations. Economic analysis is valuable in charting the most efficient pathway to reach the targets, but it should not be the prime consideration in determining the targets themselves. They must be set based on the latest science and its moral and ethical implications.

It is clear that the existing economic system, based on conventional growth, is broken. Rather than being paralysed by the prospect of having to move away from conventional economic and business concepts, we should recognise that we now have a unique opportunity to establish our society and economy on a genuinely sustainable footing. Further, the economic and business opportunities presented by the required restructuring will, in the medium to long term, far outweigh the inevitable short term costs of change. There is no point in pouring billions of dollars into shoring up an existing system which is fundamentally unsustainable; indeed to do so will only compound the problem.

The potential for catastrophe also requires the creation of a margin of safety, or insurance, against its occurrence. A margin of safety can be “purchased” by the use of innovative scenario and real option techniques to maintain flexibility, approaches which are not part of current policy formulation. Most importantly, sensible risk management, given climate change lag and the escalating probability of catastrophic impact, demands early and rapid action to curtail emissions, not the gradual incremental response now being advocated.

4. **Genuine Global Leadership**. Current responses reflect the dominance of managerialism – an emphasis on optimising the conventional political and corporate paradigms by incremental change, rather than adopting the fundamentally different normative leadership needed to contend with the potential for catastrophic failure. In practical terms, genuine leadership means committing today to rapid, deep emission reductions, and actively promoting concrete proposals to involve the developing world, for example Contraction and Convergence concepts. The conditional approach, where Australia’s emission reduction task is made dependent upon other countries undertakings, guarantees failure. A nexus-breaker is urgently needed, and Australia is ideally placed to provide the leadership required, with the potential for considerable national benefit.
5. **Integrated Policy**. Climate change, though difficult, is only one of a number of critical, inter-related, issues now confronting the global community, which threaten the sustainability of humanity as we know it. The immediate pressure point is the convergence of climate change with the peaking of global oil supply, water and food shortages and the financial crisis. Rather than viewing these issues separately in individual “silos” as at present, integrated policy is essential if realistic solutions are to be implemented <sup>78</sup>.

6. **Honesty.** There needs to be an honest articulation of the catastrophic risks and the integrated sustainability challenge we now face, with extensive community education to develop the platform for commitment to the major changes ahead. This must include a more mature and responsible political approach, as catastrophic risk cannot be handled realistically with current negativity and adversarial attitudes.

## Conclusion

Extreme weather events, now escalating around the world, are evidence of major changes in our climate, which inevitably will lead to a fundamental re-design of our democratic, economic, business and social systems, with long-term survival as the prime objective.

Hurricane Sandy, the Queensland and NSW floods, the heat dome over Australia and the related bushfires around the country, are only the most recent of these extreme events, and we can expect more of them. Whether business or politics like it or not, climate change and resource scarcity are going to be the key drivers of policy from now on.

The risk implications of the critical climate science have been, and are being, officially ignored. It is incomprehensible, given the wealth of scientific information available, and the practical evidence, that debate in Australia still centres around whether warming is even occurring, let alone whether we should take any serious action to address its implications.

As a result, Australia is ill-prepared to handle escalating weather extremes. Policy is focused almost exclusively on emergency response and recovery, with minimal effort to proactively anticipate, mitigate and manage the very high risks of catastrophic events. Much of this failure is due to an ideological and wilful refusal to accept the extent and speed of anthropogenic global warming as a driver of extreme events, while we pretend we can grow our high-carbon economy indefinitely.

The first priority of responsible government is to address major threats to national security. Climate change and the inter-related issues of peak oil, food and water security are arguably the greatest threats to national security Australia will face in the next decades. The legitimacy of any State, Federal Government or Opposition, depends on its preparedness to acknowledge these realities and take the serious action required

The refusal of current leaders to accept the climate science and its risks is condemning the Australian community to a catastrophic future. The same leaders lack the imagination to see the great opportunities these risks present, let alone guide us to them. In the process, they are throwing away the real future of Australia.

Our children and grandchildren will have to survive in an extremely difficult world, but this does not appear to be a consideration to current leaders. Their actions today are making that future infinitely worse, by perpetuating the system which created the problem. This is not good enough. Every parent and grandparent must become aware of the real risks and opportunities ahead, and force politics and business to change, fast.

I urge the Senate Committee to initiate a major re-consideration of the Australian Parliament's approach to these issues, before it is too late, based on bi-partisan cooperation, incorporating the catastrophic risk management framework suggested .

-----

**Appendix: Typical Extreme Weather Events 2003-13**

1. European Heatwave 2003
2. Hurricane Katrina, New Orleans 2005
3. Greek Bushfires 2007
4. Californian Bushfires 2007
5. Cyclone Sidr, Bangladesh 2007
6. Cyclone Nargis, Myanmar 2008
7. Darfur, ongoing extreme drought
8. North Queensland floods, 2009
9. Victorian Bushfires, 2009
10. High temperatures and/or flooding 2010 & 2011
  - a. USA
  - b. Northern Europe
  - c. Russia
  - d. Pakistan
  - e. China
  - f. Japan
  - g. Thailand
  - h. Australia
11. Russia wheat harvest destruction 2010
12. Cyclone Yasi, Australia 2011
13. Syrian extreme drought 2006-10
14. Texas & Oklahoma extreme drought 2011-12
15. East Siberian Arctic Shelf methane emissions 2008-12
- 16.** Arctic sea ice & Greenland ice sheet melt 2012
- 17.** Hurricane Sandy 2012
- 18.** Queensland & NSW floods 2013
- 19.** Australia Heat Dome 2013

**“None can be put down to global warming exclusively,  
but they are in line with its forecast evolution”**

**Would these events have happened at pre-industrial levels of CO<sub>2</sub>?**

**“Almost certainly not”**

James Hansen, Director, Goddard Space Institute, NASA

## References

- <sup>1</sup> Asian Century White Paper, DPMC, October 2012:  
<http://asiancentury.dPMC.gov.au/white-paper>
- <sup>2</sup> Energy White Paper, DRET, November 2012:  
[http://www.ret.gov.au/energy/facts/white\\_paper/Pages/energy\\_white\\_paper.aspx](http://www.ret.gov.au/energy/facts/white_paper/Pages/energy_white_paper.aspx)
- <sup>3</sup> "Perceptions of Climate Change", J Hansen et al, PNAS, September 2012:  
<http://www.pnas.org/content/109/37/E2415.full.pdf+html>
- <sup>4</sup> "Turn Down The Heat: Why a 4°C Warmer World Must Be Avoided", The World Bank, November 2012:  
[http://climatechange.worldbank.org/sites/default/files/Turn\\_Down\\_the\\_heat\\_Why\\_a\\_4\\_degree\\_centrigrade\\_warmer\\_world\\_must\\_be\\_avoided.pdf](http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoided.pdf)
- <sup>5</sup> "Did Climate Change Contribute to Sandy? Yes", Corell Masters & Trenberth, Politico, 5<sup>th</sup> November 2012:  
<http://dyn.politico.com/printstory.cfm?uuid=354B40F4-0BBD-4828-A725-97BC45421EC7>
- <sup>6</sup> "What's Causing Australia's Heat Wave?", Plummer et al, BOM, The Conversation, 18<sup>th</sup> January 2013:  
<http://theconversation.edu.au/whats-causing-australias-heat-wave-11628>
- <sup>7</sup> "Provisional Statement on the State of Global Climate 2012", WMO, 28<sup>th</sup> November 2012:  
[http://www.wmo.int/pages/mediacentre/press\\_releases/pr\\_966\\_en.html](http://www.wmo.int/pages/mediacentre/press_releases/pr_966_en.html)
- <sup>8</sup> Nuccetelli et al (2012) Show that Global Warming Continues, Skeptical Science, October 2012:  
<http://www.skepticalscience.com/print.php?n=1659>
- <sup>9</sup> "Earth's energy imbalance and implications", Hansen et al, Goddard Institute for Space Studies, NASA, December 2011:  
[http://pubs.giss.nasa.gov/docs/2011/2011\\_Hansen\\_etal.pdf](http://pubs.giss.nasa.gov/docs/2011/2011_Hansen_etal.pdf)
- <sup>10</sup> "Revisiting the Earth's sea-level & energy budget from 1961-2008", Church et al, September 2011:  
<http://www.agu.org/journals/gl/gl1118/2011GL048794/2011GL048794.pdf>
- <sup>11</sup> "Breaking News: The Earth is warming – Still!", Skeptical Science, February 2012:  
[http://www.skepticalscience.com/Breaking\\_News\\_earth\\_still\\_warming.html](http://www.skepticalscience.com/Breaking_News_earth_still_warming.html)
- <sup>12</sup> "Framing The Way to Relate Climate Extremes To Climate Change", Kevin Trenberth, NCAR, Boulder Colorado, March 2012:  
[http://download.springer.com/static/pdf/618/art%253A10.1007%252Fs10584-012-0441-5.pdf?auth66=1360755685\\_101342cf3f85ff2fcb498cc84b687b20&ext=.pdf](http://download.springer.com/static/pdf/618/art%253A10.1007%252Fs10584-012-0441-5.pdf?auth66=1360755685_101342cf3f85ff2fcb498cc84b687b20&ext=.pdf)
- <sup>13</sup> "Arctic Warning: As the System Changes, We Must Adjust Our Science", Climate Code Red, 20<sup>th</sup> September 2012:  
<http://www.climatecoderead.org/2012/09/as-arctic-system-changes-we-must-adjust.html>
- <sup>14</sup> Loss of Ice, Melting of Permafrost and Other Climate Effects are Occurring at an Alarming Pace", Scientific American & Think Progress, 29<sup>th</sup> November 2012: <http://thinkprogress.org/climate/2012/11/29/1246891/scientific-american-ice-melting-permafrost-climate-effects-occurring-alarming-pace/>
- <sup>15</sup> "NOAA: Climate Change Driving Arctic Into a 'New State' With Rapid Ice Loss and Permafrost Warming", Think Progress, 6<sup>th</sup> December 2012: <http://thinkprogress.org/climate/2012/12/06/1293011/noaa-climate-change-driving-arctic-into-a-new-state-with-rapid-ice-loss-and-record-permafrost-warming/>
- <sup>16</sup> "2012 Arctic Report Card", NOAA, 6<sup>th</sup> December 2012: [http://www.arctic.noaa.gov/reportcard/exec\\_summary.html](http://www.arctic.noaa.gov/reportcard/exec_summary.html)
- <sup>17</sup> "Loss of Arctic Sea Ice Indicates Global Risks From Climate Change", Climate Commission, September 2012:  
<http://climatecommission.gov.au/wp-content/uploads/Climate-Commission-Arctic-sea-ice-summary.pdf>
- <sup>18</sup> "Policy Implications of Warming Permafrost", UNEP, 27<sup>th</sup> November 2012:  
<http://www.unep.org/pdf/permafrost.pdf>
- <sup>19</sup> "Activation of old carbon by erosion of coastal and subsea permafrost in Arctic Siberia", Vonk, Semiletov, Shakhova et al, Nature, August 2012:  
<http://211.144.68.84:9998/91keshi/Public/File/34/489-7414/pdf/nature11392.pdf>
- <sup>20</sup> "West Antarctic Warming More Than Expected", Bromwich et al, NCAR, 23 December 2012:  
<http://www2.ucar.edu/atmosnews/news/8570/west-antarctica-warming-more-expected>
- <sup>21</sup> "Update of Greenland Ice Sheet Mass Loss: Exponential?", J Hansen & M Sato, GISS, New York, 26<sup>th</sup> December 2012:  
[http://www.columbia.edu/~jeh1/mailings/2012/20121226\\_GreenlandIceSheetUpdate.pdf](http://www.columbia.edu/~jeh1/mailings/2012/20121226_GreenlandIceSheetUpdate.pdf)
- <sup>22</sup> "The Scientific Guide to Global Warming Skepticism", John Cook, Skeptical Science, December 2010:  
<http://www.skepticalscience.com/The-Scientific-Guide-to-Global-Warming-Skepticism.html>
- <sup>23</sup> "The Critical Decade", Climate Commission, May 2011: <http://climatecommission.gov.au/report/the-critical-decade/>



- 
- <sup>24</sup> “State of the Climate 2012”, Australian Bureau of Meteorology & CSIRO, March 2012:  
<http://www.csiro.au/Outcomes/Climate/Understanding/State-of-the-Climate-2012.aspx>
- <sup>25</sup> “Earth’s Energy Budget Remained Out of Balance Despite Unusually Low Solar Activity”, NASA, January 2012:  
<http://www.giss.nasa.gov/research/news/20120130b/>
- <sup>26</sup> “Earth’s Energy Imbalance and Implications”, J Hansen et al, Journal of Atmospheric Chemistry & Physics, December 2011:  
<http://www.atmos-chem-phys.net/11/13421/2011/acp-11-13421-2011.pdf>
- <sup>27</sup> “On Avoiding Dangerous Anthropogenic Interference with the Climate System” Ramanathan & Feng, PNAS 2008.  
<http://www.pnas.org/content/105/38/14245.full.pdf+html>
- <sup>28</sup> “World Energy Outlook 2012”, IEA, Paris, November 2012:  
<http://www.worldenergyoutlook.org/>
- <sup>29</sup> “CCS is a necessity for a world hooked on fossil fuels”, IEA, 1<sup>st</sup> January 2013:  
<http://www.iea.org/newsroomandevents/news/2013/january/name.34527.en.html>
- <sup>30</sup> “Climate Change Going Beyond Dangerous – Brutal Numbers and Tenuous Hope”, Professor Kevin Anderson, Director, Tyndall Centre, UK, September 2012: [http://whatnext.org/resources/Publications/Volume-III/Single-articles/wmv3\\_andersson\\_144.pdf](http://whatnext.org/resources/Publications/Volume-III/Single-articles/wmv3_andersson_144.pdf)
- <sup>31</sup> *ibid* “Turn Down The Heat: Why a 4°C Warmer World Must Be Avoided”
- <sup>32</sup> “Low Carbon Economy Index Report 2012”, Price Waterhouse Coopers, November 2012:  
[http://www.pwc.com/en\\_GX/gx/low-carbon-economy-index/assets/pwc-low-carbon-economy-index-2012.pdf](http://www.pwc.com/en_GX/gx/low-carbon-economy-index/assets/pwc-low-carbon-economy-index-2012.pdf)
- <sup>33</sup> Hans Joachim Schellnhuber, Director, Potsdam Institute for Climate Impact Research, New York Times, 13<sup>th</sup> March 2009:  
<http://dotearth.blogs.nytimes.com/2009/03/13/scientist-warming-could-cut-population-to-1-billion/>
- <sup>34</sup> “Four Degrees and Beyond – the potential for a global temperature increase of four degrees and its implications”, Royal Society Transactions, January 2011: <http://rsta.royalsocietypublishing.org/content/369/1934.toc>
- <sup>35</sup> “4 Degrees Hotter”, Climate Action Centre Primer, David Spratt, 14<sup>th</sup> February 2011:  
<http://www.climateactioncentre.org/sites/default/files/4-degrees-hotter.pdf>
- <sup>36</sup> The Scotsman, 28<sup>th</sup> November 2009:  
<http://www.webcitation.org/5ul6K9jmt>
- <sup>37</sup> *ibid*: “Climate Change Going Beyond Dangerous”
- <sup>38</sup> “Insights from past millennia into climatic impacts on human health and survival”, A J McMichael, PNAS, December 2011:  
<http://www.pnas.org/content/early/2012/02/03/1120177109.full.pdf>
- <sup>39</sup> “Climate Change: Drought may threaten much of globe within decades”, Aiguo Dai, NCAR, October 2010:  
<http://www2.ucar.edu/news/2904/climate-change-drought-may-threaten-much-globe-within-decades>
- <sup>40</sup> *ibid*: “Turn Down The Heat: Why a 4°C Warmer World Must be Avoided”
- <sup>41</sup> “Target Atmospheric CO<sub>2</sub> – Where Should Humanity Aim?”, Hansen et al, Goddard Institute for Space Studies, NASA, December 2008.  
[http://www.giss.nasa.gov/research/briefs/hansen\\_13/](http://www.giss.nasa.gov/research/briefs/hansen_13/)
- <sup>42</sup> Hans Joachim Schellnhuber, Potsdam Institute for Climate Research, Guardian 15<sup>th</sup> September 2008.  
<http://www.guardian.co.uk/environment/2008/sep/15/climatechange.carbonemissions>
- <sup>43</sup> “Climate Code Red”, 2008.  
<http://www.climatecodedred.net/>
- <sup>44</sup> “Transition Plan Strategic Framework”, Safe Climate Australia, November 2009. <http://www.safeclimateaustralia.org/wp-content/uploads/2009/05/Transition.Framework.01B.pdf>
- <sup>45</sup> *ibid*: “Climate Change Going Beyond Dangerous”
- <sup>46</sup> “Greenhouse gas emission targets for limiting global warming to 2°C”, Meinhausen et al, Nature, April 2009.  
<http://www.nature.com/nature/journal/v458/n7242/abs/nature08017.html>
- <sup>47</sup> “World in Transition: A Social Contract for Sustainability”, German Advisory Council on Global Change WGBU, 2011:  
<http://www.wbgu.de/en/flagship-reports/fr-2011-a-social-contract/>
- <sup>48</sup> “Assessing Fair Shares”, P42, Garnaut Climate Change Review 2011:  
<http://www.garnautreview.org.au/>

<sup>49</sup> “World Energy Outlook 2012 – Special Topic: Water for Energy”, IEA, Paris, November 2012:  
<http://www.worldenergyoutlook.org/>

<sup>50</sup> *ibid*: DRET Energy White Paper

<sup>51</sup> “The Future of Energy. The Most Likely Scenario – Emergency Action”, Ian Dunlop, Submission on Draft Energy White Paper, March 2012:  
<http://www.ret.gov.au/energy/Documents/ewp/draft-ewp-2011/submissions/140.Ian-Dunlop.pdf>

<sup>52</sup> *ibid*: “Greenhouse gas emissions for limiting global warming to 2°C”, “World Energy Outlook 2012”, plus author’s adjustment for <350ppm CO<sub>2</sub> target

<sup>53</sup> “A Profound Contradiction at the Heart of Climate Change Policy”, Nicholas Stern, Financial Times, December 2011:  
<http://www.ft.com/intl/cms/s/0/52f2709c-20f0-11e1-8a43-00144feabdc0.html#axzz2L6tAKbcZ>

<sup>54</sup> “Unburnable Carbon”, Carbon Tracker Initiative, July 2011:  
<http://www.carbontracker.org/wp-content/uploads/downloads/2012/08/Unburnable-Carbon-Full1.pdf>

<sup>55</sup> *ibid*: “The Future of Energy”

<sup>56</sup> “Welcome to Dystopia: Entering a Long-Term and Politically Dangerous Food Crisis”, Jeremy Grantham, GMO, July 2012:  
<http://www.scribd.com/doc/101694369/GMOQ2letter>

<sup>57</sup> “Global Carbon Budget 2012”, Global Carbon Project, December 2012:  
<http://www.globalcarbonproject.org/carbonbudget/12/files/CarbonBudget2012.pdf>

<sup>58</sup> “Rebuilding Trust: The Road to Economic Recovery”, Jan du Plessis, Chairman Rio Tinto, Chatham House, London, 4<sup>th</sup> July 2012:  
<http://www.chathamhouse.org/sites/default/files/public/Meetings/Meeting%20Transcripts/040712duplessis.pdf>

<sup>59</sup> The Garnaut Climate Change Review, Final Report, P315, September 2008:  
<http://www.garnautreview.org.au/2008-review.html>

<sup>60</sup> “Living Planet Report 2010”, Global Footprint Network.  
<http://www.footprintnetwork.org/press/LPR2010.pdf>

<sup>61</sup> “The Real Message of the *Limits to Growth* – A Plea for Forward-looking Global Policy”, Prof. Jorgen Randers, Norwegian Business School, Gaia, 2012:  
<http://docserver.ingentaconnect.com/deliver/connect/oekom/09405550/v21n2/s7.pdf?expires=1361074948&id=72920683&titleid=6690&accname=Guest+User&checksum=9580388B75B78C320F17BF47A4D3C865>

<sup>62</sup> “On the Cusp of Global Collapse: Updated Comparison of *The Limits To Growth* with Historical Data”, Graham Turner, CSIRO, Gaia, 2012:  
<http://docserver.ingentaconnect.com/deliver/connect/oekom/09405550/v21n2/s10.pdf?expires=1361074655&id=72920665&titleid=6690&accname=Guest+User&checksum=ADE9F08C86D87C7467C0CAF366700557>

<sup>63</sup> “Global Risks Report 2013”, World Economic Forum, January 2013:  
<http://www.weforum.org/issues/global-risks>

<sup>64</sup> “Capitalism for the Long Term”, Dominic Barton, McKinsey & Co, April 2011:  
<http://www.mckinsey.com/features/capitalism>

<sup>65</sup> World Business Council for Sustainable Development:  
<http://www.wbcsd.org/home.aspx>

<sup>66</sup> *ibid*: “Turn Down the Heat”, World Bank

<sup>67</sup> *ibid*: World Energy Outlook 2012, IEA

<sup>68</sup> “Environmental Outlook to 2050”, OECD, Paris, 2012:  
<http://www.oecd.org/environment/indicators-modelling-outlooks/49846090.pdf>

<sup>69</sup> “Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Summary for Policymakers”, IPCC, 2012:  
<http://ipcc-wg2.gov/SREX/report/>

<sup>70</sup> Christine Lagarde, World Economic Forum, Davos, January 2013:  
<http://www.theglobeandmail.com/commentary/roasted-toasted-fried-and-grilled-climate-change-talk-from-an-unlikely-source/article8077946/>

---

<sup>71</sup> "Climate Code Red", Philip Sutton & David Spratt, July 2008, <http://www.climatecoded.net/index.html>

<sup>72</sup> "The Great Disruption; How The Climate Crisis Will Transform The Global Economy ", Paul Gilding, 2011: <http://paulgilding.com/buy-the-great-disruption>

<sup>73</sup> Transition Strategies, Post Carbon Pathways, University of Melbourne, 2012: <http://www.postcarbonpathways.net.au/transition-strategies/>

<sup>74</sup> "On Modeling and Interpreting the Economics of Catastrophic Climate Change", Martin Weitzman, Harvard University, May 2008. <http://www.economics.harvard.edu/faculty/weitzman/files/REStatModeling.pdf>

<sup>75</sup> "Why the Global Warming Skeptics Are Wrong", William Nordhaus, New York Review of Books, 22<sup>nd</sup> March 2012: <http://www.nybooks.com/articles/archives/2012/mar/22/why-global-warming-skeptics-are-wrong/?pagination=false>

<sup>76</sup> "Building a Green Economy", Paul Krugman, New York Times, 7<sup>th</sup> April 2010: [http://www.nytimes.com/2010/04/11/magazine/11Economy-t.html?pagewanted=all&\\_r=0](http://www.nytimes.com/2010/04/11/magazine/11Economy-t.html?pagewanted=all&_r=0)

<sup>77</sup> *ibid*: The Garnaut Climate Change Review 2008

<sup>78</sup> *ibid*: "The Future of Energy"

-----