



SUBMISSION TO THE SENATE FOREIGN AFFAIRS,
DEFENCE & TRADE REFERENCES COMMITTEE

IMPLICATIONS OF CLIMATE CHANGE FOR AUSTRALIA'S NATIONAL SECURITY

SENATE INQUIRY

AUGUST 2017

SUBMISSION SUMMARY

Climate change is the most significant medium- to long-term threat to Australia's security. Post-Paris emissions pathways are consistent with 3°C or more of warming, with the potential for a 4–5°C temperature increase. The global risks include dramatic changes to agricultural patterns, water systems and food security, and coastal inundation and forced migrations, which have the capacity to destabilise nations, fuel multi-national conflict and increase the risk of nuclear war. The evidence, including from senior US analysts that such conditions could result in "outright chaos", is that climate change is an existential risk, that is, an adverse outcome that would either annihilate intelligent life or permanently and drastically curtail its potential.

RECOMMENDATION 1:

- (a) The Australian Government recognise that climate change, especially when considered in a conflict and security context, represents an existential risk to Australian society, to cooperative relationships between nations, and to human civilisation itself; and
- (b) The Australian Government urgently establish a top-level climate and conflict task-force, to report to the parliament within six months, on the existential risks of climate change and the development of risk-management techniques and policy-making methodologies appropriate to the challenge.

The pace and severity of climate change impacts and costs have often been underestimated by the scientific community. Much attention has been given to the low and middle-range risks in climate change projections. To address high-end risks, more thorough exploration is needed of the uncertainties within the physical climate system, such as carbon cycle feedbacks and ice-sheet dynamics.

RECOMMENDATION 2: The Australian Government, in understanding the national security implications of climate change, and adopting prudent risk-management approaches to climate and security policy, consider the full range of plausible emission scenarios, and the full range of plausible consequences and impacts, including the "high-end" risks.

Climate change is exacerbating existing instability and conflicts in the Middle East, Africa and Asia, posing significant security challenges to governments and regional stability. Australia's capacity to respond will be undermined if recognition of these challenges is delayed. Integrating climate change responses into a whole-of-government approach strengthens the national capacity to respond climate change–security risks.

RECOMMENDATION 3: The Australian Government, in responding to the national security implications of climate change, recognise the need for a whole-of-government approach by integrating climate risks across all relevant departments, build cross-department processes, and fully integrate climate fragility risks into the policies and operations of the Department of Defence and the Department of Foreign Affairs and Trade.

RECOMMENDATION 4:

- (a) The Australian Government ensure Australian Defence Force and emergency services preparedness, mission and operational resilience, and capacity for humanitarian aid and disaster relief, across the full range of plausible climate change scenarios;
- (b) The Department of Defence and military commanders factor in the impacts of projected climate change across their full spectrum of planning and operations; and
- (c) The Department of Defence regularly report to Parliament on progress in so doing.

Preparing for potentially disruptive challenges, and the provision of humanitarian assistance, is more effective if done with foresight, and the causes of disruption are alleviated. This includes material support for vulnerable nations in likely hotspots of climate impacts and social disruption.

RECOMMENDATION 5:

- (a) The Australian Government recognise that building more resilient communities in the most climate-change-vulnerable nations by high-level financial commitments and development assistance can help protect peoples in climate hotspots of potential instability and conflict; and
- (b) That Australia, as a first step, fully fund its commitments to climate financing through the Green Climate Fund.

The 2°C global warming target is considered the boundary between "dangerous" and "extremely dangerous" climate change, but the Paris climate agreement puts the world on a path to a much higher level of warming. The current circumstances warrant an immediate global climate emergency, whole-of-society, response, before the window for sufficient action closes.

RECOMMENDATION 6: The Australian Government recognise that climate change now represents a global emergency, which threatens human civilisation, and:

- (a) commits to building international processes that specifically recognise and formulate the practical steps necessary for a coordinated, global climate emergency response based on a sound, existential risk-management approach; and
- (b) launch an emergency-scale initiative, to decarbonise the Australian economy no later than 2030, and build the capacity to draw down carbon dioxide from the atmosphere, in order to stabilise safe climate conditions for national and global security.

Australia is extremely vulnerable to a downturn or significant slowing of the Chinese economy, Australia's largest trading partner. A significant reduction in China's growth rate would cause a damaging economic recession in Australia. The Chinese economy is vulnerable to climate disruptions, such as more intense natural disasters, impacts of water insecurity on the agricultural sector, and inundation of low-lying cities and industries due to sea-level rise and cyclone storm surges.

RECOMMENDATION 7: The Australian Government, as a matter of priority, consider and plan responses to the likely consequences of significant economic disruption caused or made worse by climate change impacts on Australia's major trading partners, in particular China.

INTRODUCTION

This submission is made by Breakthrough, the National Centre for Climate Restoration, an Australian-based research and advocacy organisation. During the last year, Breakthrough has given priority to climate and security issues, including the following activities:

- Meeting with senior business leaders and government officials to highlight the risks, including the existential risk consequences, associated with climate change and conflict. These engagements included private screenings of the documentary film "The Age of Consequences". Through the lens of national security and global stability, the film looks at the impacts of climate change on increased resource scarcity and migration. Admirals, generals and military veterans from the USA look beyond the headlines of the conflict in Syria, the social unrest of the Arab Spring, the rise of groups like ISIS, and the European refugee crisis, and lay bare how climate change stressors interact with societal tensions, sparking conflict. Breakthrough is able to arrange a private viewing of the film to inquiry members.
- A national engagement tour including Sydney, Canberra and Melbourne in April 2017 by Ms Sherri Goodman, a key figure in climate change and security issues in Washington. Ms Goodman is former US Deputy Undersecretary of Defense for Environmental Security, Founder and Executive Director of the CNA Military Advisory Board, and a Senior Fellow at Woodrow Wilson International Center for Scholars.
- Publishing the report *Disaster Alley: Climate change, conflict and risk* by Ian Dunlop and David Spratt, with a foreword by Ms Goodman, in June 2017, and releasing reports on the implications of the Paris climate agreement, and Antarctic tipping points for multi-metre sea-level rise.

TERMS OF REFERENCE (a) the threats and long-term risks posed by climate change to national security and international security, including those canvassed in the National Security Implications of Climate-Related Risks and a Changing Climate Report by the United States Department of Defense.

RISK MANAGEMENT

The security implications of climate change may be viewed through the lens of sensible risk-management practices. The risks involved are multitudinous and will impact on almost all areas of society and every corner of government, and are potentially very large.

The evidence is that climate change is now an existential risk, that is, an adverse outcome that would either annihilate intelligent life or permanently and drastically curtail its potential (Bostrom 2013). This is the case because:

- The projected path of future warming, taking into account the commitments in relation to the 2015 Paris Agreement, is for more than 3°C of warming by 2100, as compared to a late 19th century baseline (Climate Interactive 2017). See Figure 1.
- When the full range of climate cycle feedbacks are taken into account, the post-Paris emissions path is for 4–5°C of warming (Reilly et al. 2015:2).

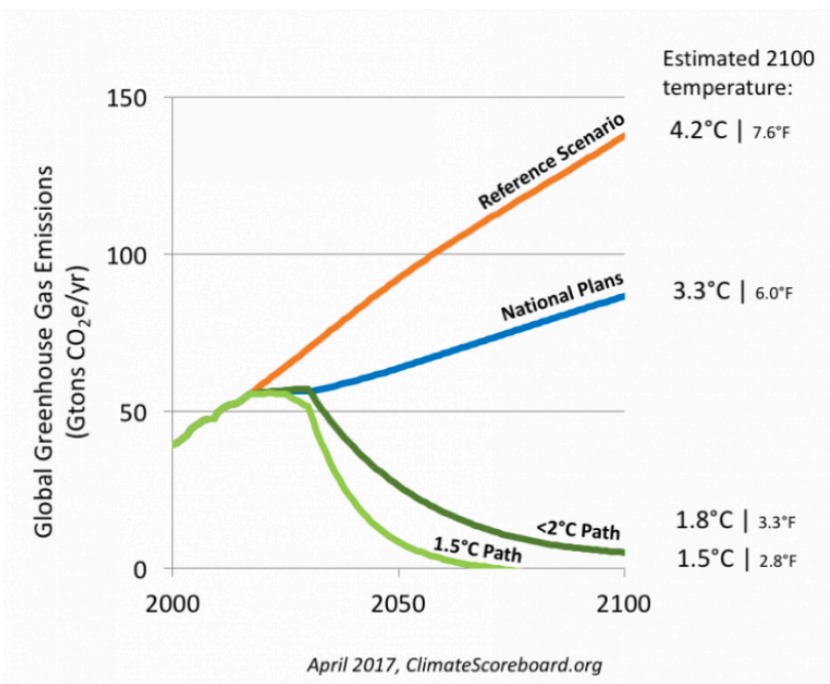


FIGURE 1: PROJECTED WARMING

(Climate Interactive: www.climateinteractive.org)

- A study by two US national security think tanks — led by a number of prominent intelligence and military figures including R. James Woolsey, a former director of the CIA, and Kurt M. Campbell, a former deputy assistant secretary for defence — concluded that 3°C of warming and a 0.5 metre sea level rise would likely lead to "outright chaos". Their full scenario description is: "In this scenario, nations around the world will be overwhelmed by the scale of change and pernicious challenges, such as pandemic disease. The internal cohesion of nations will be under great stress, including in the United States, both as a result of a dramatic rise in

migration and changes in agricultural patterns and water availability. The flooding of coastal communities around the world, especially in the Netherlands, the United States, South Asia, and China, has the potential to challenge regional and even national identities. Armed conflict between nations over resources, such as the Nile and its tributaries, is likely and nuclear war is possible. The social consequences range from increased religious fervor to outright chaos. In this scenario, climate change provokes a permanent shift in the relationship of humankind to nature” (emphasis added). (Campbell et al. 2007:7)

- Some of the world's leading scientists and institutions have described the consequences of a 4°C-warmer world as follows:
 - Prof. Kevin Anderson says “a 4°C future is incompatible with an organized global community, is likely to be beyond ‘adaptation’, is devastating to the majority of ecosystems, and has a high probability of not being stable” (Anderson 2011). And: “I think it’s extremely unlikely that we wouldn’t have mass death at 4 degrees. If you have got a population of 9 billion by 2050 and you hit 4 degrees, 5 degrees or 6 degrees, you might have half a billion people surviving” (Fyall 2009).
 - Asked at a 2011 conference in Melbourne about the difference between a 2°C world and a 4°C world, EU and German government advisor, Prof. Hans Joachim Schellnhuber, replied in two words: “Human civilisation” (personal observation by author).
 - The World Bank reports: “There is no certainty that adaptation to a 4°C world is possible” (World Bank 2012:xviii).
 - A Royal Society publication dedicated to “Four degrees and beyond” says that in 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” (Warren 2010).

In other words, the accelerating impacts posed by human-induced climate change are an existential risk to humanity which, unless addressed as an emergency, will have catastrophic consequences. This is illustrated in Figure 2.

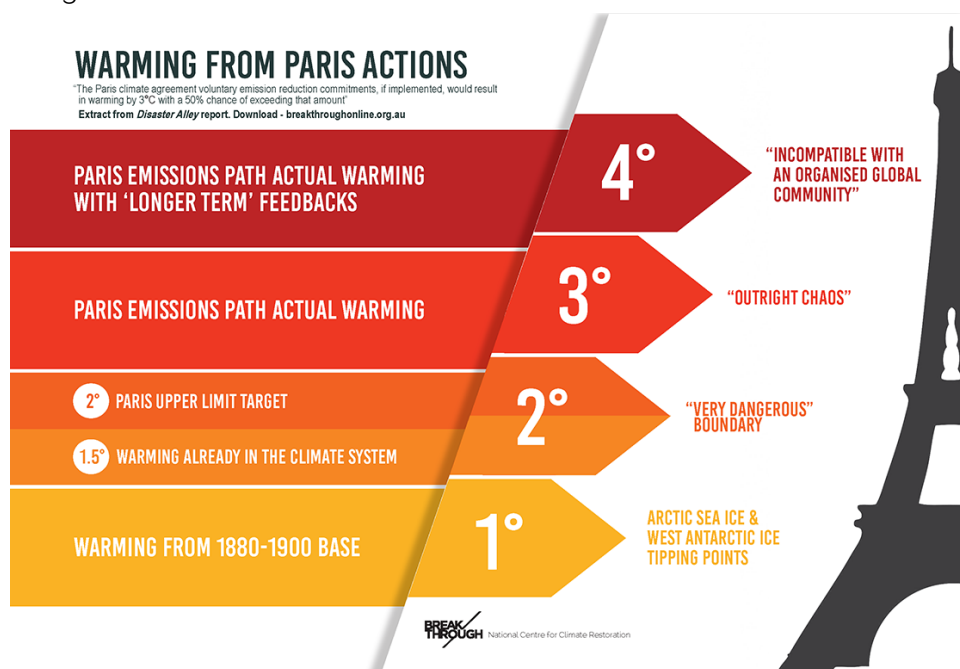


FIGURE 2: PARIS EMISSIONS PATH AND EXISTENTIAL RISK

The management of existential risk cannot be handled with conventional, learn-from-failure techniques. It requires an objective look at the real risks, including the more extreme possibilities with consequences that human civilization, as we know it today, would be lucky to survive.

Viewed from the standpoint of existential risk, it is concluded that Australia's political, bureaucratic and corporate leaders are abrogating their fiduciary responsibilities to safeguard the people and their future well-being. They lack understanding and are ill-prepared for the real risks of climate change at home and in the region (Dunlop and Spratt 2017:16).

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SCIENTIFIC RETICENCE

The scientific community has generally underestimated the likely rate of climate change impacts and costs. Sir Nicholas Stern wrote that the *IPCC Fifth Assessment Report* "reported on a body of literature that had systematically and grossly underestimated the risks [and costs] of unmanaged climate change" (Stern 2016:407).

Too often, mitigation and adaptation policy is based on consensus scientific projections that downplay what Prof. Ross Garnaut called the "bad possibilities", that is, the lower-probability outcomes with higher impacts. In his 2011 climate science update for the Australian Government, Garnaut questioned whether climate research had a conservative "systematic bias" due to "scholarly reticence". He pointed to a pattern, across diverse intellectual fields, of research predictions being "not too far away from the mainstream" expectations and observed in the climate field that this "has been associated with understatement of the risks". (Garnaut 2011:54)

To be useful in a risk context, climate change assessments need "a much more thorough exploration of the [high-end] tails of the distribution of physical variables such as sea level rise, temperature, and precipitation, where our scientific knowledge base is less complete, and where sophisticated climate models are less helpful. We need greater attention on the strength of uncertain processes and feedbacks in the physical climate system [...] (e.g., carbon cycle feedbacks, ice sheet dynamics), as well as on institutional and behavioural feedbacks associated with energy production and consumption, to determine scientifically plausible bounds on total warming and the overall behavior of the climate system. Accomplishing this will require synthesizing multiple lines of scientific evidence [...] including simple and complex models, physical arguments, and paleoclimate data, as well as new modeling experiments to better explore the possibility of extreme scenarios." (Weaver et al. 2017)

A prudent risk-management approach for safeguarding people and protecting their ways of life means a tough and objective look at the real risks to which we are exposed, including climate and conflict risks — especially those "fat tail" events whose consequences are damaging beyond quantification — and which human civilization, as we know it, would be lucky to survive. We must understand the

potential of, and plan for, the worst that can happen and be relieved if it doesn't. If we focus on "middle of the road" outcomes, and ignore the "high-end" possibilities, we may end up with catastrophic outcomes that could have been avoided.

RECOMMENDATION 2: The Australian Government, in understanding the national security implications of climate change, and adopting prudent risk-management approaches to climate and security policy, consider the full range of plausible emission scenarios, and the full range of plausible consequences and impacts, including the "high-end" risks.

TERMS OF REFERENCE (b) the role of both humanitarian and military response in addressing climate change and the means by which these responses are implemented.

Numerous studies by the US military and by the most senior retired military officers in the USA (including Campbell et al. 2007; CNA MAB 2014; US Department of Defense 2010) have demonstrated that:

- Climate change impacts basic resources such as food and water that allow humans to survive and nation states to continue;
- Scarce resources and water, declining crop yields and rising prices become catalysts for instability and conflict;
- Climate change interacts with pre-existing political and social problems to become a threat multiplier;
- Reciprocal interactions between intersecting crises become an accelerant to instability in unexpected ways.

This is particularly the case in Australia's region.

In 2014, the CNA Military Advisory Board reported that: "In many areas, the projected impacts of climate change will be more than threat multipliers; they will serve as catalysts for instability and conflict. In Africa, Asia, and the Middle East, we are already seeing how the impacts of extreme weather, such as prolonged drought and flooding—and resulting food shortages, desertification, population dislocation and mass migration, and sea level rise—are posing security challenges to these regions' governments. We see these trends growing and accelerating... The projected impacts of climate change could be detrimental to military readiness, strain base resilience both at home and abroad, and may limit our ability to respond to future demands." (CNA MAB 2014:2)

The 2010 *Quadrennial Defense Review Report* by the US Department of Defense found that: "While climate change alone does not cause conflict, it may act as an accelerant of instability or conflict, placing a burden to respond on civilian institutions and militaries around the world. In addition, extreme weather events may lead to increased demands for defense support to civil authorities for humanitarian assistance or disaster response both within the United States and overseas" (US Department of Defense 2010:85).

Key recommendations from the 2014 *National Security Risks and the Accelerating Risks of Climate Change* (CNA MAB 2014:5) included:

- To lower the national security risks, the United States should take a global leadership role in preparing for the projected impacts of climate change;
- Supported by National Intelligence Estimates, the U.S. military's Combatant Commanders (CCMDs) should factor in the impacts of projected climate change across their full spectrum of planning and operations;
- Climate adaptation planning should consider the water-food-energy nexus to ensure comprehensive decision making;
- The projected impacts of climate change should be integrated fully into the National Infrastructure Protection Plan and the Strategic National Risk Assessment;
- In addition to DOD's conducting comprehensive assessments of the impacts of climate change on mission and operational resilience, the Department should develop, fund, and implement plans to adapt, including developing metrics for measuring climate impacts and resilience. The Department should place a greater emphasis on the projected impacts of climate change on both DOD facilities and associated community infrastructures.

These findings, in outline, are directly relevant to, and should be appropriately applied in, Australia. This year Marine Corps General Jim Mattis, the US Secretary of Defense, concluded that: "Climate change is impacting stability in areas of the world where our troops are operating today.

It is appropriate for the Combatant Commands to incorporate drivers of instability that impact the security environment in their areas into their planning" (Johnston 2017).

In 2014, the CNA Military Advisory Board found that, as the world's population and living standards continue to grow, "the projected climate impacts on the nexus of water, food, and energy security become more profound. Fresh water, food, and energy are inextricably linked, and the choices made over how these finite resources will be produced, distributed, and used will have increasing security implications... From today's baseline of 7.1 billion people, the world's population is expected to grow to more than 8 billion by 2025. The US National Intelligence Council assesses that by 2030, population growth and a burgeoning global middle class will result in a worldwide demand for 35% more food and 50% more energy. Rising temperatures across the middle-latitudes of the world will increase the demand for water and energy. These growing demands will stress resources, constrain development, and increase competition among agriculture, energy production, and human sustenance. In light of projected climate change, stresses on the water-food-energy nexus are a mounting security concern across a growing segment of the world." (CNA MAB 2014:3)

Between 1970 and the mid-1990s, the amount of economically available water per person globally dropped by more than 35%, according to the United Nations. One estimate projects a gap of 40% between global water requirements and accessible, reliable water supply by 2030 (WRG 2009:12). Today, approximately 1.8 billion people around the world lack access to safe drinking water and nearly two billion people lack access to sanitation. According to the 2017 report, *Global Trends: Paradox of Progress*, "more than 30 countries — nearly half of them in the Middle East — will experience extremely high water stress by 2035, increasing economic, social, and political tensions" (US NIC 2017: 24).

Over the coming decades, climate change is projected to cause southern Australia, portions of India, and much of inland China to experience sustained drought, resulting in lowered agricultural production and food security issues (CNA MAB 2014:14). Many of the major river systems in Asia — home to more than a billion people — are fed by glacial melt from the Himalayas and the Tibetan Plateau. With less snowfall and the predicted shrinking of glaciers, in the future they may not provide enough water to meet year-round demand. Water challenges will increase the risk of instability and state failure, and exacerbate regional tensions in South Asia. India's national water supply is forecast to fall 50% below demand as early as 2030, and increasing irregularities in the pattern of monsoon rains are likely to undermine South Asia's agricultural and domestic water needs. (Ahmed 2017:71)

Drought and water insecurity, made worse by climate change, will be primary drivers of instability and conflict in the years ahead, and hence the mass displacement of people and forced migrations. These are challenges that may overwhelm Australia's capacity to respond, unless immediate action is taken to address the human causes of continued climate warming, and to make the most-likely-affected communities more resilient. This effort will become a primary concern of governments everywhere, including in Australia. This cannot be addressed piecemeal by government, but only in an integrated manner and with eyes wide open.

US Navy Admiral Samuel Locklear (ret.), former Commander of US Pacific Command, has noted that: "Climate change is the Pacific region's biggest long-term security threat" and "is probably the most likely thing that is going to happen . . . that will cripple the security environment, probably more likely than the other scenarios we all often talk about" (Bender 2013). Delay in recognizing the challenges will worsen the problem.

Climate policy, including from a security perspective, is a wicked problem, with responsibilities that cross boundaries, including DoD, DFAT, AGD, DEE, PMC and ONA, and must be a core priority of government. Bureaucratic silos are dangerous, especially in the security arena.

A 2015 report to the G7 recommended that "G7 governments should establish a unified, shared, and accessible risk assessment methodology for identifying climate-fragility risks..." and that "Integration begins at home: Make climate-fragility risks a central foreign policy priority. G7 governments can begin by integrating climate-fragility responses into planning, implementation, and evaluation processes across their departments. This requires new capacities within departments and new cross-sectoral policy processes" (Brown et al, 2015).

RECOMMENDATION 3: The Australian government, in responding to the national security implications of climate change, recognise the need for a whole-of-government approach by integrating climate risks across all relevant departments, build cross-department processes, and fully integrate climate fragility risks into the policies and operations of the Department of Defence and the Department of Foreign Affairs and Trade.

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- c) The Department of Defence regularly report to Parliament on progress in so doing.

TERMS OF REFERENCE (c) the capacity and preparedness of Australia's relevant national security agencies to respond to climate change risks in our region.

The Department of Defence is making significant progress in mission preparedness and operational resilience. However, there has been less work done thinking about the strategic implications of climate change impact on regional stability.

At a federal government department level, some steps are being taken in inter-agency work, especially with regard to domestic emergency and climate resilience, but consideration of the full extent of the broader international climate and conflict risks remains inadequate.

It is difficult to identify many, if any, analysts employed in the Australian public sector whose primary professional research role is the strategic implications for Australia of climate change in the Asia-Pacific region. Some leading security think-tanks have no specialists in this area. Some relevant Australian government departments appear to be in a similar situation.

It is difficult to be definite in any assessment because the work of some government agencies is not transparent. However, it is very likely the case that Australia lacks skilled national security and climate change specialists. Certainly, the work seems under-resourced across the public sphere as a whole.

The inquiry may wish to ask:

- What analytical capacity is currently deployed across the Australian Government in this area, and is it sufficient?
- What specific conclusions have been drawn by departmental and agency work on the impacts of climate change for Australia's economic and strategic interests in the Asia-Pacific region?
- Whether Australian intelligence has identified security risks that might arise from situations in which climate events in the Asia-Pacific region, acting as an accelerant to instability, have consequences that exceed the capacity of affected countries or populations to cope and respond; and what planning has been done by Australian Government departments and agencies in those cases?

TERMS OF REFERENCE (d) the role of Australia's overseas development assistance in climate change mitigation and adaptation more broadly.

During her recent tour to Australia, and since, Ms Sherri Goodman has emphasised a number of issues relevant to this term of reference:

- Internationally, we must establish methods to better forecast potentially disruptive climate changes — such as severe drought — well in advance.
- Only then can we develop the capacity for reducing risks through building global and community resilience and strength before we encounter full-on crises.

- We also need to rethink refugee governance to better support the climate refugees who will comprise an increasing proportion of the refugee mix. Current governance structures are simply inadequate.
- Strengthening the resilience of vulnerable nations to the climate impacts already locked into the system is critical; however this will only reduce long-term risk if improvements in resilience are accompanied by strong actionable agreements to stabilise the climate.
- Responding effectively to climate change requires greatly increased co-operation globally, regionally and among Australian institutions, to build more resilient communities. (Dunlop and Spratt 2017:2)

In April this year, Prof Alan Dupont told a Lowy Institute forum that Australians could live in an Asian region with 150 million climate change refugees this century (Lowy 2017). In 2014, the CNA Military Advisory Board concluded that: "The potential security ramifications of global climate change should be serving as catalysts for cooperation and change. Instead, climate change impacts are already accelerating instability in vulnerable areas of the world and are serving as catalysts for conflict" (CNA MAB 2014:2).

It is in Australia's interest to:

- Support research that can better forecast climate-disruptive events. The application of humanitarian assistance in advance is more effective and may avoid disruption, compared to waiting for the events to unfold. Syria is a good example where, if the analytical tools had been available, early humanitarian intervention at the onset of the record-breaking drought may have forestalled a catastrophe.
- Contribute to building more resilient communities by fully funding its commitments to climate financing under the UNFCCC processes, via the Green Climate Fund. Australia has pledged public and private funding of \$2 billion by 2022, however the Australian Government budget forward estimates to 2020 include an amount of \$200 million, or 10% of the pledged amount. In addition, Australia should increase its official development assistance to further address the challenges of mitigation and adaptation, especially in the near region.
- Rethink domestic and global refugee governance to better support those displaced by climate change.

RECOMMENDATION 5:

- a) The Australian Government recognise that building more resilient communities in the most climate-change-vulnerable nations by high-level financial commitments and development assistance can help protect peoples in climate hotspots of potential instability and conflict; and
- b) That Australia, as a first step, fully fund its commitments to climate financing through the Green Climate Fund.

TERMS OF REFERENCE (e) the role of climate mitigation policies in reducing national security risks.

Australia's per capita greenhouse emissions are among the highest in the world, and its commitment to reduce emissions rated as inadequate by leading analysts. For example, Climate Action Tracker says that "Australia's current policies will fall well short of meeting" its Paris Agreement target, that the Emissions Reduction Fund "does not set Australia on a path that would meet its targets" and "without accelerating climate action and additional policies, Australia will miss its 2030 target by a large margin" (CAT 2016).

The 2015 Paris climate conference declared its aim was "to hold the increase in global average temperature to well below 2°C, and to pursue efforts to limit the temperature increase to 1.5°C". And yet it agreed upon measures that would instead result in warming of 3–5°C (Reilly et al. 2015:2).

Warming of 2°C is now widely considered a boundary between "dangerous" and "extremely dangerous" climate change (Anderson and Bows 2011:20). Former NASA climate science director, James Hansen, says it is "well understood by the scientific community" that goals to limit human-made warming to 2°C are "prescriptions for disaster", because "we know that the prior interglacial period about 120,000 years ago was less than 2°C warmer than pre-industrial conditions" and sea level was at least five to nine metres higher (Hansen et al. 2015; ABC 2015).

A significant fraction of the total impacts of climate change on particular system elements occur with less than 2°C of warming. This is the case for coral reefs, fresh-water security, terrestrial vegetation and increased river flooding (Ricke et al. 2015:5). At the current level of warming — around 1°C above the late nineteenth century — coral bleaching is devastating (Knaus and Evershed 2017), Arctic sea ice has lost two-thirds of its thickness (Lindsay and Schweiger 2015:269) and some West Antarctic glaciers have passed their tipping points (Rignot, Mouginot et al. 2014:3508), with multi-metre sea level rise as a medium-term consequence (Hansen et al. 2015).

The safe level of warming for some polar system elements is well under 1°C, and probably under 0.5°C for coral reefs (Veron 2009). Polar researchers say the Paris commitments will not prevent Earth "crossing into the zone of irreversible thresholds" in polar and mountain glacier regions, and that crossing these boundaries may result in processes that cannot be halted unless temperatures were returned to below the pre-industrial level (IPCC 2016:v).

Yet human activity has already caused 1°C of warming compared to the late nineteenth century — or 1.2°C compared to the late seventeenth century pre-industrial climate. At least another 0.5°C of warming is temporarily masked by sulfate and other cooling aerosols, whose primary source is fossil fuel combustion (Mann et al. 2008; Mann 2015). There is no pathway limiting warming to under 1.5°C without unproven solar radiation management. Current emissions scenarios for 1.5°C assume "overshoot", in which the target is significantly exceeded before returning to below 1.5°C by the deployment of large-scale negative-emission technologies later in the century (Carbon Brief 2015).

As noted earlier, the post-Paris emissions path is for around 3°C of warming, and 4–5°C of warming if carbon-cycle feedbacks (such as permafrost carbon activation, and weakening of ocean and terrestrial carbon store efficiency) are taken into account. Yet analysis by US security experts suggest that even 3°C of warming would likely result in a world where "The internal cohesion of nations will be under great stress... armed conflict between nations over resources... is likely and nuclear war is possible (with) social consequences rang[ing] from increased religious fervor to outright chaos" (Campbell et al. 2007:7).

The challenges we face are not amenable to a gradualist response. Emergency action is essential when events threaten to overwhelm the capacity to respond; when failure is not an option; when action is time sensitive (delay leads to event escalation, to the point of passing climate system tipping points); and when the costs of inaction massively outweigh the costs of acting.

RECOMMENDATION 6: The Australian Government recognise that climate change now represents a global emergency, which threatens human civilisation, and:

- (c) commits to building international processes that specifically recognise and formulate the practical steps necessary for a coordinated, global climate emergency response based on a sound, existential risk-management approach; and
- (d) launch an emergency-scale initiative to decarbonise the Australian economy no later than 2030, and build the capacity to draw down carbon dioxide from the atmosphere, in order to stabilise safe climate conditions for national and global security.

TERMS OF REFERENCE (e) other related matters:

AUSTRALIA'S ECONOMIC VULNERABILITY TO CLIMATE IMPACTS ON THE CHINESE ECONOMY

Australia faces severe national consequences if the growth rate of the Chinese economy significantly declines, or the economy falls into recession. Two vital questions that appear not to have been adequately considered are: (1) whether climate change impacts in China could significantly damage the Chinese, and potentially the Australian, economies; and (2) the regional strategic consequences should climate impacts in China undermine economic, and then political, domestic stability.

China is Australia's largest trading partner and overseas market for Australian resources, services and agriculture, representing over a quarter of all Australian exports at \$85.9 billion in 2015-2016. Two-way China–Australia trade is more than twice that of our next largest trading partner, Japan. This relationship with China represents Australia's largest dependence on any one nation since the UK in the 1950s. In addition, while China ranks third for foreign investment in Australia, future increases in investment from China are central to the prosperity of many Australian industries, such as agriculture and construction.

Modelling from Deloitte's Access Economics, released by economist Chris Richardson, shows that a slowing of China's growth rate from 6.5% to 3% would effectively cause a recession in Australia. There would be a loss of 500,000 jobs, a 9% drop in house prices costing Australian families \$600 billion, and a 17% share market drop costing \$300 billion. Construction and mining sectors would be hit the hardest, resulting in a housing market crash, and a drop in iron ore exports. Iron ore, the biggest component of Australian exports to China, is extremely sensitive to economic conditions (Uren 2017).

Victor Shvets of Macquarie Bank describes a Chinese economic downturn or "collapse" as inevitable due to the "misalignments" of resources and the affected return on investment and equity. While the timing of a Chinese downfall cannot be accurately estimated, Shvets says that any collapse would have severe ramifications due to China's central role in the global economy. China currently controls 15% of global trade, 30% of global savings and more than 30% of global investment (ABC 2017). However, China is experiencing record debt levels: its debt to GDP ratio stands at an eye-watering 277 per cent; there is a large and opaque "shadow banking" system; and "no nation has ever emerged from such a debt-fuelled growth binge in such a short space of time without a serious lift in bad debts, and a deep recession" (Verrender 2017).

This potential downturn or crash of the Chinese economy could be significantly influenced or heightened by climate change events. Increased natural disasters, growing water shortages impacting the agricultural sector, the threat of rising sea levels on low-lying cities and industries including agriculture, and damage to infrastructure are just some of the potential impacts. Some key issues are:

- **Infrastructure hotspots:** Research has identified infrastructure hotspots in China, including Beijing, Shanghai, Tianjin, Zhejiang and Jiangsu, that are most vulnerable to economic impacts from climate change. Critical hotspots are concentrated critical infrastructure on which large numbers of people are dependent, and include transport systems, water treatment centres and power plants. Unprecedented incidents, including frequent power outages, intermittent water supply, transport cancellations, production losses, property damage and industrial accidents, are likely to impact both individuals and companies. The Thailand floods in 2011 are an example of the economic ramifications of climate change events. Manufacturing plants, including Toyota and Honda, were closed for months, and the disaster represented 80% of the world's total economic losses for the same year. A similar event in China would likely have even greater global consequences due to China's manufacturing dominance in the global supply chain (Xi 2016).
- **Water insecurity:** China comprises 20% of the global population but has only 7% of available fresh water. Changing climate patterns, causing droughts and increased desertification, have reduced freshwater reserves by 13% between 2000 and 2009. Twenty-four thousand villages in north and west China have been abandoned due to desertification in the last 50 years: the advancing Gobi Desert is now only 150 miles from Beijing. Three hundred million rural people have no access to safe drinking water, and 54% of the main rivers contain water unfit for human consumption (Cho 2011). Four-fifths of China's grain harvest comes from irrigated land, which uses surface water principally drawn from the Yellow and Yangtze rivers, which are fed from the Tibetan Plateau. Irrigated areas are highly vulnerable to changes in water availability. The water table under the North China Plain is falling fast. This is an area that produces half of the country's wheat and a third of its corn. Overpumping has largely depleted the shallow aquifer and forced well-drillers to turn to the region's unreplenishable deep aquifer. A World Bank report on China's water situation foresees "catastrophic consequences for future generations" unless water use and supply can quickly be brought back into balance (Brown 2013).
- **Inundation of primary manufacturing zone:** China's Pearl River Delta special industrial zone, which includes the cities of Guangdong and Shenzhen, is responsible for 20% of national GDP, more than 30% of foreign direct investment, and 40% of China's exports. In 2012, Guangdong handled more than 1.2 billion tonnes of freight. However, this area is less than two metres above sea level, and built on a sinking delta, and is very vulnerable to both rising sea levels and storm surges caused by cyclones. The region is home to the greatest number of people (after Kolkata) estimated to be at risk of flooding anywhere in the world. A 2013 study researched coastal defenses and their level of protection, and found that, in terms of the overall cost of damage from inundation and rising sea levels, Guangzhou was the city at the greatest risk while Shenzhen was ninth most vulnerable (Hallegatte et al, 2013). "Hard" defences are not considered to be feasible (Spratt and White 2016), however, the question of the Pearl River Delta's vulnerability to cyclone-driven storm surges and rising sea levels is pertinent. Waters in the South China Sea and Philippines are considered to be "Cyclone Alley" highlighted by Cyclone Haiyan, which hit the Philippines in 2013, and was the strongest cyclone on record to make landfall anywhere in the world (Schiermeier 2013).

- **Sea level rise:** Climate change has already likely triggered the collapse of the West Antarctic Ice Sheet (WAIS), with loss of a significant fraction of WAIS on a decadal to century time-scale, and Antarctica alone could contribute more than a metre of sea-level rise by 2100 (Rignot et al. 2014:3508, DeConto and Pollard 2016). The US Department of Defence is now using sea-level rise scenarios of 1 and 2 metres by 2100 and a US government agency has just lifted its maximum sea-level rise estimate to 2.5 metres by 2100 (Hall et al. 2016, NOAA 2017).

China's vulnerability to such climate impacts should be of urgent concern to the Australian Government. Imagine the following scenario:

In China's north, a water crisis deepens with overexploitation of groundwater, reduced irrigation capacity, and a two-year northern monsoon failure. A political crisis develops in rural communities, strengthened in the north-west by long-standing grievances among the Muslim minority, and there is significant internal migration to the large cities. A category 5 typhoon hits the Pearl River Delta/Guangdong free-trade zone, and storm surges inundate half of the delta, destroying infrastructure and significantly disabling export capacity for up to a year. Consequently, the Chinese economy stalls and tips into recession, while chronic and opaque debt, especially in the state sector, cascades into a full-blown credit crisis. The crash infects Asian markets, and Australian banks are exposed. As Chinese output stagnates, Australian resource exports fall, putting further pressure on a fragile Australian domestic stock market. Chinese employers try to replace organised labour with new migrants from the countryside, but workers resist, especially in unionised overseas firms in the Guangdong zone, and labour disputes escalate. The middle class joins the revolt as they lose out from over-leveraged stocks in a plunging share market. An internal political crisis gathers strength, and other parties decide to test Chinese sovereignty claims in the South China Sea.

The economic and strategic implications for Australia would be profound, but it is difficult to find evidence that the Australian Government has assessed the consequences in any systematic way.

RECOMMENDATION 7: The Australian Government, as a matter of priority, consider and plan responses to the likely consequences of significant economic disruption caused or made worse by climate change impacts on Australia's major trading partners, in particular China.

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