CLIMATE COUNCIL

THE GOOD, THE BAD AND THE UGLY: LIMITING TEMPERATURE RISE TO 1.5°C

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The good, the bad and the ugly: Limiting temperature rise to 1.5°C.
Authors: Professor Will Steffen, Dr Martin Rice, Professor Lesley Hughes and Dr Annika Dean.

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Professor Will Steffen
Climate Councillor

Dr Martin Rice
Head of Research

Professor Lesley Hughes
Climate Councillor

Dr Annika Dean
Senior Researcher

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Key Findings

1

Global temperatures have been rising rapidly, posing grave risks for humanity.

- Global temperatures have risen 1°C in the era following mass industrialisation and mass greenhouse gas pollution from coal, oil and gas burning. This has directly affected Australians, with worsening extreme weather events like heatwaves, droughts, bushfires and coastal flooding.
- Keeping global temperature rise below 1.5°C is considered a critical limit by the world's scientific community to protect lives and livelihoods around the world.
- Although past inaction has already locked in significant costs, there is much at stake in meeting the 1.5°C target, as a 2°C world would be much worse.

2

The global effort to tackle climate change has begun but must be accelerated.

- By 2030 global emissions must be down by at least 45% from 2010 levels to keep global temperature rise to no more than 1.5°C.
- If greenhouse gas pollution continues at the present rate, human-driven warming will exceed 1.5°C between 2030 and 2052.
- The Australian government has committed to reduce our greenhouse gas pollution levels by 26-28% by 2030 (based on 2005 levels). We are not on track to achieve this woefully inadequate target.
- Without accelerating and concerted action by all nations, particularly significant polluters like Australia, it is unlikely that we will stay below the 1.5°C limit. This would condemn our children and grandchildren and the natural world to devastating climate impacts.

3

Australia is one of the most vulnerable developed countries to the impacts of climate change but is contributing little to solutions.

- Australia is experiencing the impacts of climate change and needs to be prepared for worsening extreme weather, including more frequent and severe bushfires, droughts, heatwaves and coastal flooding.
- Australia's greenhouse gas pollution levels have continued to rise over the past three years, and we have no credible policy settings to reverse this trend.
- If other countries followed Australia's approach to dealing with climate change, we would be heading to global warming well above 2°C and up to 3°C. This degree of climate change would be unmanageable for most communities.

4

Inaction has already cost us dearly. A 1.5°C world, our best possible future, will change our lives even further.

› At just 1°C warming Australia has felt the brunt of climate change:

- **Heatwaves:** 2013-2014 heatwaves cost approximately $8 billion (roughly 0.33 – 0.47% of Australia's GDP).
- **Bushfires:** The 2009 Black Saturday fires claimed 173 lives and economic costs of around $4 billion.
- **Drought:** Between 2002 and 2003 decreases in agricultural production due to drought resulted in a 1% fall in the Gross Domestic Product (GDP), which is equivalent to half of Australia's decline in annual GDP following the global financial crisis in 2009.
- **Storms:** Cyclone Yasi in 2011 cost the agriculture and tourism industries $1.6 billion and $600 million respectively.

› A 1°C increase in global temperatures has already made the world a more dangerous place. A further half a degree rise will have serious consequences on health, livelihoods, food and water supply, human security, infrastructure and the environment.

- Even if warming is limited to 1.5°C, instabilities in the Greenland and West Antarctic ice sheets could be triggered resulting in a multi-metre sea-level rise.
- Coral reefs could lose a further 70-90% of cover, eliminating the Great Barrier Reef as we know it.
- Increased ocean acidity in a 1.5°C world will affect the survival and abundance of a broad range of marine species, from algae to fish.

› Failure to slow or stabilise the rate of greenhouse gas pollution over the past two decades has made achieving the 1.5°C target much more difficult.

› Further temperature rise beyond 1.5°C would drastically damage the environmental systems on which humanity depends.

5

Limiting global warming to no more than 1.5°C is a formidable challenge but solutions are available.

› Limiting global warming to 1.5°C will require rapid and far-reaching transitions in energy, land, urban, and industrial systems in just one to two decades.

› The solutions are available and are both technologically and economically feasible. We need to accelerate the transition to renewables and storage technologies and ramp up other climate solutions across all sectors of the economy.

1. The Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is the most authoritative international body on climate science.

In addition to IPCC Assessment Reports, which provide a comprehensive summary of climate change, from the physical science to its impacts and how to tackle it, the IPCC is periodically tasked with preparing special reports on specific climate change issues of relevance to nations around the world, including Australia. Previous special reports include managing the risks of extreme events and disasters; renewable energy; the ozone layer; emissions scenarios; carbon dioxide capture and storage; and land use, land-use change, and forestry.

2. Special Report on Global Warming of 1.5°C

In its adoption of the Paris Climate Agreement, the Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) at its 21st Session in Paris, France (30 November to 11 December 2015), invited the IPCC to provide a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels.

Launched on 8 October 2018, the **Special Report on Global Warming of 1.5°C** (SR1.5) outlines the impacts of global warming of 1.5°C above pre-industrial levels and explores global greenhouse gas pollution reduction pathways consistent with meeting the 1.5 °C Paris target. The report describes measures to strengthen the global response to the threat of climate change, in the context of sustainable development, and efforts to eradicate poverty. The author team of the SR1.5 includes 91 authors and editors from 40 countries, more than 6,000 research papers were assessed, and 42,000 comments received in the three reviews of the report.

This Climate Council report provides a brief summary of the main findings of the **Special Report on Global Warming of 1.5°C**, its implications, and how Australia is tracking when it comes to tackling climate change.

3. It's a big deal: The difference between 1.5°C and 2°C

In December 2015 countries around the world, including Australia, agreed to support the Paris Climate Agreement. Central to this Agreement is the aim of keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C (UNFCCC 2018). The 1.5°C limit is an acknowledgement from nations that our climate is changing more rapidly and with greater and more damaging impacts than previously thought. This means emissions will have to be reduced more deeply and more rapidly.

Australia is one of the most vulnerable developed countries in the world to the impacts of climate change. Heatwaves have already become longer, hotter and are starting earlier in the year. In the populous south of the country, dangerous bushfire weather is increasing, and cool season rainfall is dropping off, stretching firefighting resources, putting lives at risk and creating challenges for the agriculture industry. All of these climate impacts are being experienced at only a 1°C rise in average temperature. The risks to our wellbeing and livelihoods, and to other species and ecosystems, become much more profound as temperatures rise.

The IPCC Special Report shows that the risks for both human and natural systems are lower if temperature gradually stabilises at 1.5°C compared to overshooting 1.5°C and then returning to 1.5°C later in the century. Any overshoot of 1.5°C will require the use of negative emissions technologies, which are measures to remove CO_2 from the atmosphere and store it on land, underground or in the oceans. There are substantial increases in extremes (e.g. extreme heat, heavy precipitation events and drought) projected between now and 1.5°C, and even more between 1.5°C and 2°C. Impacts on land-based biodiversity and ecosystems are less at 1.5°C than 2°C but overshooting this target could have irreversible impacts on some species and ecosystems. Limiting warming to 1.5°C compared to 2°C could prevent the thawing of an estimated 1.5 to 2.5 million km^2 of permafrost area (ground that remains permanently at or below freezing point), which would reduce the amount of additional warming caused by release of carbon.

Warm water coral reefs would lose a further 70-90% of cover at 1.5°C warming, with devastating consequences for the Great Barrier Reef. Increased ocean acidity in a 1.5°C world would affect the survival, calcification, growth, development and abundance of a broad range of marine species from algae to fish. Sea-level rise will continue well beyond 2100. Increasing instabilities in the Greenland and West Antarctic ice sheets could result in multi-metre sea-level rise on a centuries- to-millennium-timeframe, and could be triggered even if warming is limited to 1.5°C by 2100.

Disadvantaged and vulnerable populations will be disproportionately affected by warming of 1.5°C and beyond. Impacts of 1.5°C warming on global economic growth are larger than present-day impacts. A warming of 1.5°C will increase the challenges of adaptation across many sectors compared to present-day, but the adaptation challenges will be lower for 1.5°C than for 2°C warming.

The impacts that we are experiencing now at around 1°C rise in average temperature are the forerunners of rapidly escalating risks as the temperature rises towards 2°C and beyond. A 2°C temperature rise will have serious impacts on the lives and livelihoods of Australians and people all over the world.

4. The Carbon Budget

By using the carbon budget approach (a scientifically based method to determine how much carbon humanity can "spend" to limit climate change to a specific temperature target), the IPCC Special Report provides guidelines to show how emissions must track if we are to meet the Paris target. The more stringent the budget, the higher the probability of limiting warming to no more than 1.5°C.

There are a number of uncertainties in calculating a carbon budget, such as the estimation of the pre-industrial temperature baseline, the role of non-CO_2 greenhouse gases such as methane and nitrous oxide, the sensitivity of the climate system to the amount of cumulative CO_2 emissions, and the magnitude of climate-carbon cycle feedbacks. These uncertainties play a less important role in estimating budgets for high temperature targets such as 2°C and above, but become more important when the size of the remaining budget is so small that it is about the same size as some of the uncertainties. This is the case for the 1.5°C carbon budgets.

The importance of the temperature baseline is a good example of how these uncertainties affect the carbon budget. Using the IPCC AR5 (Fifth Assessment Report) estimate of the observed rise in global mean temperature gives a remaining carbon budget, from the start of 2018, of 115 Gt C (420 Gt CO_2; Gt = billion tonnes) for a 66% probability of meeting the 1.5°C target and 160 Gt C (580 Gt CO_2) for a 50% probability. Based on the estimate of global temperature rise used in the IPCC SR1.5 report the respective carbon budgets become 155 Gt C (570 Gt CO_2; 66% probability) and 210 Gt C (770 Gt CO_2; 50% probability).

Accounting for feedbacks in the Earth System, such as permafrost melting and Amazon and boreal forest dieback (estimated from Steffen et al. 2018), would reduce the AR5 budget to 45 Gt, less than five years of emissions at current rates. Even the more generous SR1.5 budget would be reduced to 85 Gt. In either case, failure to achieve deep and rapid reductions in non-CO_2 greenhouse gases such as methane and nitrous oxide, coupled with feedbacks, could eliminate the carbon budget altogether.

There are several issues that need to be considered in interpreting 1.5°C carbon budget estimates in either the IPCC SR1.5 report or those based on the IPCC AR5 global mean temperature estimates.

1. All emission reduction pathways require rapid reductions in CO_2 emissions as well as in emissions of non-CO_2 greenhouse gases such as methane. Greater emission reductions by 2030 increase the chances of limiting warming to 1.5°C without overshoot or large-scale negative emissions (carbon dioxide removal).

2. If non-CO_2 GHGs (e.g. methane) are not reduced at the same rate (very rapidly), the CO_2 budgets would have to be reduced by around 70 Gt C (250 Gt CO_2) – or could increase the CO_2 budget if they are reduced at a much greater rate. See Table 1.

3. Pathways that aim to limit the need for overshoot/carbon dioxide removal require very deep global emissions reductions by 2030 – estimated to be at least 45% reduction from 2010 levels. The percentages would be higher based on current levels – over 50% reduction.

4. Carbon dioxide removal: afforestation and reforestation, bioenergy with carbon capture and storage, direct air carbon capture and storage and soil carbon sequestration have widely varying costs and feasibilities (Williamson 2016).

5. Any overshoot scenarios require CO_2 removal at rates exceeding CO_2 emissions.

Table 1: Carbon Budget for 1.5°C Target.

Chance of meeting target	50% probability **Gt C** (Gt CO_2)	66% probability **Gt C** (Gt CO_2)
IPCC AR5 budget	**160** (580)	**115** (420)
IPCC SR1.5 budget	**210** (770)	**155** (570)
Uncertainties		
Non-CO_2 forcing and response		**-110 to +55** (-400 to +200)
Non-CO_2 scenario variation		**+/-70** (+/-250)
Historical temperature uncertainty		**+/-70** (+/-250)
Earth System feedbacks (permafrost)		**-30** (-100)
Other Earth System feedbacks (e.g., Amazon, boreal dieback)[1]		**-40** (-145)
Net average uncertainty		**-95** (+/-250 $GtCO_2$)

[1] Estimated from Steffen et al. (2018).

The IPCC Special Report concludes that:

"Limiting global warming to 1.5°C would require rapid and far-reaching systems transitions occurring during the coming one to two decades – in energy, land, urban, and industrial systems" (IPCC 2018).

That is, we need a deep and rapid transformation of economic, technological and social systems, beginning immediately. But, as the SR1.5 report acknowledges, "These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors" (IPCC 2018). This means that 'business as usual', or slight modifications of it, will not be enough to limit warming to no more than 1.5°C.

Given the nature and magnitude of the challenge as outlined in the IPCC SR1.5, it is highly likely that we will overshoot the 1.5°C target and will be severely challenged to meet the 2°C target. There is no excuse for any further delay in implementing effective action on climate change.

Limiting global warming to 1.5°C would require rapid and far-reaching transitions occurring during the coming one to two decades – in energy, land, urban, and industrial systems.

5. Australia is a global laggard

Australia's emissions reduction target of 26-28% below 2005 levels by 2030 is woefully inadequate and is not aligned with what the science says is necessary to effectively tackle climate change.

The Climate Change Authority recommended a 45-65% emissions reduction target for 2030 below 2005 levels, based on scientific evidence, what comparable countries are doing, and what is in the best interests of Australia. Yet this expert advice has been ignored by the Federal Government. Worse still, recent analysis implies that Australia will not meet its woefully inadequate 26-28% emissions reduction target (The Australia Institute 2018; Skarbek 2018; Australian Government 2017; UNEP 2017). Australia lacks a credible climate policy and emissions have continued to rise over the past three years.

If all other countries followed Australia's emission reduction target we'd be heading to global warming of well over 2°C and up to 3°C. In addition, if all other countries were to follow Australia's current policy settings, warming could reach over 3°C and up to 4° (Climate Action Tracker 2018). A temperature rise of up to 4°C above pre-industrial levels would be catastrophic, leading to a vastly different world, with very high risks for most natural ecosystems and highly damaging impacts on the most vulnerable people and societies. The risk of severe impacts from extreme weather would be extremely high, and the crossing of tipping points would likely take the climate to even hotter and more damaging conditions (IPCC 2014).

6. The window of opportunity is rapidly closing

The IPCC Special Report on Global Warming of 1.5°C confirms that the more we learn about climate change, the riskier it looks.

The science of climate change has advanced enormously, and it is an unassailable fact that human emissions of greenhouse gases, primarily from burning fossil fuels, are driving rapidly increasing temperatures. The risks of climate change are now coming into much sharper focus, and the evidence of its damaging impacts are there for all to see. With just a 1°C rise in global average temperature, the severity and frequency of many extreme weather events are increasing, the great polar ice sheets on Greenland and Antarctica are melting at increasing rates, and some of world's most treasured ecosystems, such as the Great Barrier Reef, are being battered towards extinction by intensifying underwater heatwaves (Climate Council 2017).

The global temperature averaged over the last five years (2013 - 2017) was the highest ever on record for any five-year period (NOAA 2018). This record is part of a sharp, long-term upswing in global temperatures, with 17 out of the 18 years hottest years on record all occurring in this century.

Australia's climate has warmed by around 1°C since 1910, with most warming occurring since 1950 (CSIRO and BoM 2016). The rapidly warming climate is driving a wide array of impacts in Australia with deadly and costly consequences; many of them are associated with worsening extreme weather events.

Heatwaves

Over the last decade, severe heatwaves around Australia have resulted in deaths and an increased number of hospital admissions for heart attacks, strokes, kidney disease and acute renal failure (DHS 2009; Wang et al. 2009; Nitshke et al. 2011; Schaffer et al. 2012). During severe heatwaves in southeastern Australia in 2009, Melbourne experienced three consecutive days at or above 43°C in late January. There were 980 heat-related deaths during this period, 374 more than would have occurred on average for that time of year (DHS 2009). Heatwaves in Australia during 2013-2014 cost approximately $8 billion through absenteeism and a reduction in work productivity (Zander et al. 2015). This is the equivalent to 0.33 to 0.47% of Australia's gross domestic product (GDP).

Bushfires

Bushfires have had a major impact in recent times in terms of lives lost and damage to property, forestry and livestock. The 2009 Black Saturday fires in Victoria claimed 173 lives, killed 8,000-11,800 stock (Teague et al. 2010; Stephenson et al. 2013) and caused $1.3 billion of insured losses (ICA 2013). This value is significantly less than the total economic cost of the fires, estimated to be at least $4 billion (Teague et al. 2010). Projections by Deloitte Access Economics (2014) reveal that Australian bushfires cost approximately $380 million per annum, a figure incorporating insured losses and broader social costs.

Drought

Australia is currently in the grip of a severe drought, particularly affecting rural and farming communities of New South Wales and Queensland. Droughts can have wide ranging implications for health, with impacts on nutrition, an increased risk of infectious diseases and air pollution from bushfires (Haines et al. 2006). Declines in physical health are particularly prevalent amongst the elderly in drought affected rural communities in Australia (Horton et al. 2010). Furthermore, drought can exacerbate mental health problems and increase suicide rates in drought-affected rural populations, especially amongst male farmers (Alston 2012). The economic impacts of droughts in Australia are severe. Between 2002 and 2003 decreases in agricultural production due to drought resulted in a 1% reduction in the Gross Domestic Product (GDP) (ABS 2004). This is a significant hit to the economy, considering that the global financial crisis caused a reduction of 2% in Australia's annual GDP from 2008 to 2009 (World Bank 2015).

Storms

Storms in Australia can cause damage to property, infrastructure and claim human lives. Australia has experienced a stormy last ten years, with some of the most damaging storm events in recent times occurring within this period. Severe tropical cyclone Yasi in 2011 was one of the most powerful cyclones to have affected Queensland since records began, and was one of Australia's costliest natural disasters. The costs to the agricultural and tourism industries were estimated at $1.6 billion and $600 million respectively (QRA and World Bank 2011).

The impacts of extreme weather events on Australians, our economy and natural ecosystems will likely become much worse unless greenhouse gas emissions are reduced rapidly and deeply.

Missing or overshooting the 1.5°C Paris target will have severe consequences. Direct impacts from changing rainfall patterns, accelerating sea-level rise and worsening extreme weather will escalate the risks of starvation, massive migration and conflict as some agricultural zones collapse and coastal infrastructure is inundated. Worse yet, some tipping points in the climate system could be crossed at less than 2°C, and more at higher temperatures, driving even more severe warming and taking the trajectory of the climate system out of human control (Steffen et al. 2018). Time is rapidly running out for humanity to avoid the extremely serious risks of a 2°C or warmer world.

The tension between the need for urgent action and ideologically-driven denialism and inaction is evident in Australia. The Federal Government has no credible climate policy in place to effectively tackle climate change, contributing to escalating risks to Australians' health and well-being and to the health of the natural ecosystems that our wellbeing depends on.

The window of opportunity to effectively tackle climate change is closing fast. We need to rapidly and deeply cut our emissions. Solutions are available, and are both technologically and economically viable. We need to accelerate the transition to clean, affordable and reliable renewables and storage technologies and ramp up other climate solutions in transport, agriculture and other sectors.

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