Beyond the limits: Australia in a 1.5-2°C world
Creating change takes leadership. We need people to lead: individuals, communities, investors and business leaders. We need people from all walks of life to step forward and join us as leaders of change.

This policy brief was written by Erwin Jackson, with contributions from other staff of The Climate Institute.

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Page 2: XL Catlin Seaview Survey.
In response to recent developments in both climate science and international climate commitments, The Climate Institute commissioned Climate Analytics to examine the impacts on Australia of limiting global temperature rise to 1.5°C and 2°C, and to provide estimates of the global carbon budgets associated with achieving these temperature limits.

This policy brief outlines some of the implications for Australia. It is based on Climate Analytics’ findings, explained in their report, Implications of the 1.5°C limit in the Paris Agreement for climate policy.

1 The Paris Agreement defines the long-term objective of collective action to limit global warming to “well below” 2°C above pre-industrial levels and pursue action to limit warming to 1.5°C. To achieve these goals, countries agreed to achieve net zero emissions. Australia has signed this agreement and has stated it will seek to ratify it by the end of 2016. It has also committed to examine a long-term emissions pathway in 2017.

2 Climate change is already having costly and dangerous impacts. Warming above 1.5-2°C would have profoundly damaging consequences for Australia. Even warming of 1.5°C would have significant extra costs. If the world warms by 1.5°C, currently rare climate related extremes (extreme heatwaves, unusual dry spells, extreme rainfall, massive global coral bleaching events) would become the new normal. If global mean warming were to reach 2°C, the climate system would move into uncharted territory.

3 By defining a long-term temperature objective, the Paris Agreement has implicitly defined the total net amount of heat trapping greenhouse gas emissions the world can release. This amount is termed a carbon budget. National budgets can be determined by weighing up scientific, ethical and economic factors. If Australia is to play its part in global efforts to limit warming to 1.5-2°C, a mid-range carbon budget of around nine billion tonnes between 2015-2050 would need to be targeted. Australia would need to achieve net zero emissions well before 2050. If it does not update its current 2030 target, to remain within this carbon budget, Australia would need to reduce emissions to zero within around five years after 2030.

4 The sustained decarbonisation of Australia’s electricity sector is necessary to meet the Australian carbon budget. Electricity decarbonisation is a strategic priority because it is the biggest source of emissions, has a multitude of technological options available to reduce emissions, and is a key to decarbonising other sectors (e.g. zero emissions electric vehicles and buildings). If Australia fails to decarbonise electricity, we would only be able to meet the objectives of the Paris Agreement by requiring other economic sectors to reduce emissions more significantly and/or by placing a greater reliance on carbon sequestration. For example, if electricity emissions were only to decline in line with the current 2030 overall national target (26-28 per cent below 2005 levels), the transport and other major carbon emitting sectors would have to reduce emissions to around 40 per cent below 2005 levels in 2030 to meet a credible national carbon budget.

5 The government has committed to review Australia’s climate policy framework and to consider a long-term emissions pathway in 2017. This is the first major opportunity to align Australia’s policy settings with the Paris Agreement objectives to which Australia has committed. Key outcomes from this review should include:

   • A legislated 2050 emissions reductions target, based on a carbon budget consistent with the objectives of the Paris Agreement.
   • Development of a stronger and more comprehensive domestic policy framework capable of delivering a credible emissions pathway to the 2050 target. An inclusive economic and community strategy to steadily replace our existing coal fired generation with clean energy over the next 20 years will need to be a core element of this long-term plan.
At the twenty-first Conference of Parties in Paris in 2015, over 190 governments decided to adopt the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC). The agreement has since been signed by around 180 countries, including Australia.

The objective of this agreement is:

“Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels ...”

As the recent impacts of climate change demonstrate, Australia is very exposed to climate change. If the world warms by 1.5°C, currently rare climate related extremes (extreme heatwaves, unusual dry spells, extreme rainfall, massive global coral bleaching events) would become the new normal. If global mean warming were to reach 2°C, the climate system would move into uncharted territory.

Overall, warming of 1.5-2°C would have very significant and costly impacts on Australia, its region and the world. Limiting long-term warming to around 1.5°C would reduce these risks, particularly those associated with changes to climate extremes and their impacts on communities, health systems and coral reefs. Failure to limit warming to 1.5-2°C presents unmanageable risks and costs to human health, natural systems, infrastructure and economies.

Australia’s long-term interests lie in limiting climate change in line with the Paris Agreement’s objectives. Therefore, the speedy implementation of the Paris Agreement is in our national interest. As is the acceleration of domestic policy responses in each country, including our own, to deliver on the objectives of the agreement.

### Table 1: Estimated impacts of climate change for 1.5-2°C scenarios.

<table>
<thead>
<tr>
<th>Impact</th>
<th>1.5°C</th>
<th>2°C</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coral reefs</td>
<td>Severe impacts; some potential for limited adaptation remains</td>
<td>Virtually all tropical coral reefs will be severely degraded</td>
<td>Major impacts on natural systems, regional economies and food supply</td>
</tr>
<tr>
<td>Heat extremes</td>
<td>On average, south and central Australia would experience heatwaves of two weeks of the year; heatwave length for the northern regions would be around a month</td>
<td>Extreme heatwaves are much more severe than current experience and occur annually. Heatwave length extends to about 3 weeks in south and central Australia, and around two months in the north</td>
<td>Impacts on human health as well as labour productivity</td>
</tr>
<tr>
<td>Water availability</td>
<td>Declines (~10 per cent) across most of Australia (more severe in west); up to 30 per cent reductions in some scenarios</td>
<td>Greater declines across southern Australia. Up to 40 per cent reductions in some scenarios</td>
<td>Combined with temperature changes, impacts on agricultural productivity, water supplies, and bushfire risk</td>
</tr>
<tr>
<td>Sea level rise</td>
<td>~40cms to 2100; declining rates of sea-level rise towards the end of the 21st century reduce the long-term sea-level rise commitment; risks to multi-metre increases still exist due to loss of ice from major ice sheets</td>
<td>~50cms to 2100; multi-metre sea-level rise commitment over centuries to come</td>
<td>Long-term impacts on coastal infrastructure and settlements; regional displacement of low-lying communities</td>
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In setting national emissions reductions targets, countries are expected to consider their role in limiting warming to 1.5-2°C. For example:

+ Article 3 of the agreement outlines that all countries are to undertake and communicate progressively stronger emissions reductions with a view to limiting global average temperature to below 1.5-2°C above pre-industrial levels.

+ Targets will be updated every five years and informed by the outcomes of the global stocktakes (Article 4.9).

+ These stocktakes will examine collective efforts towards limiting warming to 1.5-2°C (Article 14) and net zero emissions.

+ Beyond short-term targets, countries are expected to define long-term emissions strategies to 2050 that take into account the objectives of the agreement (Article 4.19). Australia has committed internationally to consider its long-term emissions pathway as part of the 2017 domestic climate policy review.

Further rules for the communication of national targets and how they relate to the objectives of the agreement will be developed over the coming years.

By defining a long-term temperature objective, the Paris Agreement has implicitly defined a global carbon budget. It is up to each individual country to define its fair part of this budget. However, if one country does less, others have to do more to keep total emissions within the overall objective. Countries are increasingly examining how others are contributing to global efforts. Diplomatic and economic pressure on each country to ensure it is doing its share, and not free riding on the efforts of others, can therefore only grow.

In advancing their initial post-2020 emissions targets, countries were expected to justify their targets against the objective of limiting warming to less than 2°C. Many countries did this, although others, including Australia, did not. Under its current proposal, Australia’s per capita emissions in 2030 would be around three times higher than global per capita emissions benchmarks that are consistent with Paris Agreement objectives (Figure 1).
Australia’s Paris carbon budget

Prior to Paris, a number of national carbon budgets were developed for Australia. In 2013, The Climate Institute released a policy paper to inform the development of an Australian carbon budget. The development of such a carbon budget was required as part of the Climate Change Authority’s (CCA) report on national emissions targets. The Climate Institute reviewed the various approaches to setting national carbon budgets and concluded the CCA should set a carbon budget to 2050 that is consistent with a high probability of limiting global warming to less than 2°C above pre-industrial levels. This carbon budget should also hedge against the possibility of even more ambitious action in the future (e.g. such as a commitment to the 1.5°C global goal that was under consideration within the UNFCCC at the time). This approach was largely mirrored in the CCA’s final report.

The analysis below, based on the latest research and the report by Climate Analytics, updates The Climate Institute’s recommended carbon budget for Australia and discusses the implications for the post-2020 emissions targets currently proposed by both major political parties in Australia.

**Updating Australia's carbon budgets**

In defining a carbon budget for Australia, two key questions need to be addressed:

1. **What global carbon budget should be set?**
   - This decision includes consideration of the level of probability that any given carbon budget would limit warming to a certain level. Other considerations include whether the budget should be based on all greenhouse gases or just carbon dioxide (CO₂) and what role the anthropogenic drawdown of greenhouse gases will play.

2. **What is Australia’s equitable contribution to global action?**
   - Since 1850, Australia has been the 14th largest contributor to global greenhouse gas emissions. Australia also has relatively high per person emissions when compared to other nations. This means that, individually, we contribute more to the problem than others. In addition, Australia is a wealthy, advanced economy with strong capacity to reduce our emissions. Over the last few decades, many approaches have been suggested for defining the role individual countries should take in meeting global climate objectives. These approaches take into account factors like historical responsibility for climate change, technical potential and capacity to reduce emissions, as well as other factors.

**Box 1: 1.5-2°C - Decarbonisation and the role of negative emissions**

The characteristics of energy sector transformation for scenarios that limit warming to below both 1.5°C or 2°C are similar. The major difference is that, under 1.5°C, the global decarbonisation of the energy system needs to be faster and more pronounced.

If the world is to get onto a 1.5-2°C pathway over the next 15 years, it is critical that deployment of renewable energy becomes more rapid and other low and zero emission energy supply technologies are deployed. This will also require the retirement of existing emission-intensive energy infrastructure, like coal fired generation, and upscaling highly efficient energy technologies.

Post-2030, in existing emission scenarios that achieve both 1.5°C or 2°C, technologies that remove carbon dioxide from the atmosphere will play a significant role. If the Paris Agreement’s long-term temperature goal is to be met, the physical presence of such high concentrations of greenhouse gases in the atmosphere means some level of negative emissions is virtually unavoidable at this stage, even with very rapid emissions reductions between now and 2050.

These negative emissions technologies include bioenergy with carbon, capture and storage (bio-CCS), or direct air capture. Both could directly withdraw carbon dioxide from the atmosphere and store it on geological timescales. The Climate Institute has previously assessed the role these technologies could play in meeting an Australian carbon budget. Used appropriately, this research found that negative emissions technologies, could play a significant role in Australia, with a capacity to remove and displace up to 65 million tonnes of carbon dioxide annually by 2050.

However, given the uncertainties as to whether negative emissions technologies can be deployed at the required scale, policy should aim to minimise the need for their use. It is therefore critical that the initial, and most urgent focus should be on the rapid deployment of renewable and other low or zero carbon energy systems, as well as rapid improvements in energy efficiency and the electrification of transport systems.
To define Australia’s carbon budget, The Climate Institute has:

1. Used a global carbon budget that gives a high chance (>85 per cent) of limiting warming to less than 2°C and leaves open the option of limiting warming to 1.5°C by the end of the century (>50 per cent chance). Budgets focused only on limiting warming to less than 2°C are not necessarily consistent with the totality of the Paris Agreement’s objectives: for example, a budget with a >66 per cent chance of limiting warming to less than 2°C would give a low chance of limiting warming to 1.5°C by 2100. Emissions reduction scenarios that limit warming to 1.5°C by 2100 with a higher than even chance are currently not available.

2. Used a mid-range estimate of the emissions reductions that developed nations would undertake if they were playing their part in global action to meet the objectives of the Paris Agreement. Depending on your point of view, this approach may seem overly generous or onerous for Australia. For example, this would see Australia use around 0.7 per cent of the global carbon budget. This is less than the nation’s current contribution to global emissions, but still twice Australia’s share of the global population. No single approach will give an adequate measure of the contribution a country should take to global action. In this context, using a mid-range estimate is appropriate. A more extensive range of possible approaches is outlined in the Appendix.

Together, these assumptions imply a carbon budget for Australia of around nine billion tonnes between 2015-2050. Based on current emissions projections, Figure 2 shows the linear reductions in emissions from 2020 that would achieve this carbon budget. The overall carbon budget from 2015 to 2050 is also illustrated. To play its equitable part in limiting warming to 1.5-2°C, Australia would need to achieve net zero emissions before 2050. If more credible action had been taken to limit emissions before 2020, this pathway would not be as steep.
Implications for Australia’s national emissions targets

Australia’s initial post-2020 emissions reductions target is 26-28 per cent below 2005 levels by 2030. As noted above, the government also made an international commitment to consider a longer-term target in 2017. Australia’s initial offer is not consistent with the objectives of the Paris Agreement and is out of step with our international peers.\(^8\)

As part of the process agreed to in Paris, the government will need to reconsider and resubmit its 2030 target by no later than early 2020.

The Australian Labor Party (ALP) has committed to a target of at least 45 per cent below 2005 levels by 2030 and net zero emissions by 2050. The party has also committed to set a 2025 target within a year of office. These targets are significantly more credible than the government’s, but would still exceed the carbon budget by 15 per cent.

Considering the current 2030 targets of our major political parties, the government’s target would result in nearly 90 per cent of the budget being used by 2030, while the ALP’s target would result in around 80 per cent. In both cases, due to Australia’s weak 2020 target, around 40 per cent of the budget is used over the next five years.

Figure 3 illustrates post-2030 emissions pathways that would be consistent with the Paris objectives if the government does not revisit its current 2030 target. With no access to negative emissions, post-2030 emissions need to fall to net zero emissions in around five years to stay within the carbon budget. Even with access to substantial emissions offsets, national emissions would still need to fall very sharply and reach zero in the early 2040s. After this point, national emissions would need to be negative, with around 1,600 million tonnes either sequestered in carbon stores or purchased from other countries. This is around three years of current annual emissions.

The ALP’s current target provides a more credible pathway for Australia to contribute to the objectives of the Paris Agreement (Figure 4), assuming it is revisited when the party sets a 2025 target as it has committed.
FIGURE 3
Post-2030 emissions pathways to meet a 1.5-2°C carbon budget.

FIGURE 4
ALP post-2025 emissions pathways to meet a 1.5-2°C carbon budget.
The burning of coal, oil and gas remains the largest contributor to climate change. In Australia, the carbon dioxide emitted through the combustion of these fuels accounts for around 65 per cent of national emissions. Limiting warming to 1.5-2°C requires emissions from these sources to reach zero before total greenhouse gas emissions. This is because:

1. Increases in atmospheric carbon dioxide concentrations have the largest impact on the climate system and this greenhouse gas stays in the atmosphere for a long time. It can take centuries for a tonne of carbon dioxide released today to be sequestered by natural processes and for atmospheric concentrations to fall back to more natural levels.

2. Achieving decarbonisation of the energy system, particularly electricity, is a prerequisite for achieving net zero emissions across other parts of the economy. In the absence of a zero emissions electricity system, it will be difficult to achieve net zero emissions through the transport, building and other sectors. For example, electric vehicles, buildings and aluminium smelters powered by clean energy are in themselves critical components of a net zero emissions economy.

In contrast to global trends, Australia’s current policy framework is encouraging emissions from the energy and electricity sector to increase, not decrease. For example, total energy sector carbon dioxide emissions in China and the USA have fallen in recent times.

Recent modelling by The Climate Institute examined the impact of a range of policies on electricity sector emissions and the implications of these policies for achieving an overall carbon budget. This research found that a policy package that actively supports both clean energy investment and the orderly replacement of our aging coal fired power stations can better manage a timely transition to a cleaner electricity supply.
Here we use three of the scenarios from this analysis to examine the impacts of electricity policies on Australia’s overall carbon budget:

1 **Weak carbon signal**: Government implements a weak carbon signal from 2020. This could be done by turning the current policy framework into an intensity-based emissions trading scheme. Under this scenario, the incentive to reduce emissions starts at around $17/tonne in 2020 and increases to around $40/tonne in 2030.

2 **Clean in, Carbon out**: In addition to the carbon signal, policies are put in place to ensure 50 per cent of electricity is sourced from clean energy by 2030, and the existing ageing coal-fired generators are steadily closed over the next 20 years.

3 **Clean in, Carbon out (low demand)**: Same as the above, except low grid demand is driven by the greater uptake of distributed generation and greater energy efficiency.

Figure 5 illustrates how much of Australia’s carbon budget, to 2030, each of these scenarios uses and compares this to the electricity sector’s current share of emissions. It shows that, on its own, implementing a weak carbon signal in the electricity sector would see it consume nearly 50 per cent of Australia’s allowable national emissions to 2030. This is much more than the sector’s current share of emissions (approximately one-third). To stay within the national carbon budget, other major carbon emission sources – direct combustion, transport and land use, land use change and forestry – would also need to reduce their emissions to around 40 per cent below 2005 levels by 2030. The other scenarios consume less of the overall carbon budget and therefore reduce the effort other sectors need to make to achieve overall climate objectives.
Australia’s current emissions targets and policy framework are not consistent with the Paris Agreement’s objectives. The first major opportunity to align Australia’s policy settings with the commitments we have made will be the review of the domestic policy framework and the consideration of the long-term emissions pathway the government has committed to in 2017.

Key outcomes from this review should include:

+ Based on a carbon budget consistent with objectives of the Paris Agreement, legislate a 2050 emissions reductions target. Defining a clear, and legislated, commitment to a credible long-term emissions goal, that has bipartisan support, would give companies and investors a clearer basis for long-term investment decisions. This target should:
  + consider Australia’s total contribution to global emissions over the period from 2015-2050, not just what emissions should be in 2050. Australia’s contribution to limiting warming to 1.5-2°C is determined by cumulative emissions, not emissions in a single year
  + manage scientific, technological, investment and other uncertainties by hedging against the risk that more stringent actions may be required in the future. Setting a weak target increases the risks that long-term investments become stranded as action increases through time.

This indicates that a target of net zero emissions well before 2050 is warranted. The Climate Institute’s long standing recommended national targets of -45 per cent on 2005 levels by 2025, -65 per cent by 2030 and net zero by around 2050 are consistent with this carbon budget.

+ A domestic policy framework which is fit for the long-term. To achieve net zero emissions, all sectors of the economy will have a role to play. However, accelerated decarbonisation of the electricity sector is a strategic priority because it is the biggest source of emissions, has a multitude of technological options to reduce emissions, and is a key to unlocking zero emissions in other sectors (e.g. zero emissions electric vehicles and buildings). A policy that starts to systematically retire existing high-carbon generators and facilitate their replacement with zero, or near-zero emission energy, should be central to this approach.
Endnotes

1. Climate Analytics is a climate science and policy institute based in Berlin, Germany. Its researchers have been at the vanguard of climate science and policy analysis at an international level for over a decade.

2. Note that “carbon budget” may apply to budgets exclusively of carbon dioxide or of all greenhouse gases. Both approaches are used in this paper. National budgets include all greenhouse gases. Implications for the energy sector focus on the associated carbon dioxide only budget.

3. UNFCCC, 2015, Decision 1/CP.21, Adoption of the Paris Agreement.


5. B. Hare, N. Roming, M. Schaeffer, et al., 2016, Implications of the 1.5°C limit in the Paris Agreement for climate policy, Climate Analytics, Berlin.

6. Ibid.

7. Government of Australia, 2015, Australia’s Intended National Contribution: “As a part [the 2017 policy review], the Government will consider a potential long term emissions reduction goal for Australia, beyond 2030, taking into account international trends and technology developments.”


12. The most significant difference between the two approaches was that the CCA did not recommend using a global carbon budget based on keeping open the option of limiting warming to 1.5°C by 2100. They concluded: “While limiting global warming to 1.5 degrees is clearly desirable from a climate change impacts perspective, scenarios consistent with 1.5 degrees rely even more strongly on large-scale implementation of negative emissions technology in the second half of this century. This reliance creates larger risks that the 1.5 degree target would not be met if such technologies prove infeasible. Again, this could be reviewed in light of changing circumstances when Australia considers its longer term goals.”


17. Ibid.


22. The emissions reductions pathway starts in 2020 based on the Government’s most recent emissions projections. If 2020 targets are achieved the slope of this pathway would be slightly less steep and this is reflected in Figures 3 and 4. See also: Department of Environment, 2015, Tracking to 2020. An interim update of Australia’s greenhouse gas emissions projections, Government of Australia, Canberra and Department of Environment, 2016, Tracking to 2020 - April 2016 update, Government of Australia, Canberra.


26. Based on mid-range of OECD 1990 emissions reductions under scenarios limit atmospheric concentrations of CO2e to <430 ppm. Assumes Australia reduces emissions from 2010-2050 in line with the average of all OECD 1990 countries. For points of comparison budgets based on the range of methodologies used by the Climate Change Authority are also shown in Appendix. This gives a range of Australia using between 0.3 per cent to 1 per cent of the global carbon budget. See: L. Clarke, K. Jiang, K. Akimoto, et al., 2014, op cit. and N. Höhne, M. den Elzen, D. Escalante, 2014, Regional GHG reduction targets based on effort sharing: a comparison of studies, Climate Policy, 14:1, 122-147, doi:10.1080/14693062.2014.849452

27. CCA, 2015, Comparing countries’ emissions targets, Government of Australia/Climate Change Authority, Melbourne.

28. The Climate Institute, 2016a, 2030 emissions reduction targets compared, Fact Sheet, The Climate Institute, Sydney.


34. The Climate Institute, 2016b, A Switch in Time: Enabling the electricity sector’s transition to net zero emissions, Policy Brief, The Climate Institute, Sydney.

35. This is based on a carbon dioxide only budget as this is most relevant to fossil fuel based industries. To be consistent with the other carbon budgets in this policy brief, this carbon dioxide budget is derived from the same emissions reductions scenario.
Figure 6 outlines a range of 2050 emissions pathways which are based on different approaches to sharing the global carbon budget. The mid-range equity approach is the case used in this policy brief. Others include:

1 **Low equity**: Here Australia’s per capita emissions converge to a global benchmark of 1.5 tonnes CO$_2$e/person by 2050. Under this approach, Australia uses around 1 per cent of the global carbon budget despite having only 0.3 per cent of the global population.

2 **High equity**: Australia’s share of the global carbon budget is proportional to its current share of the global population. Under this scenario, around 4 billion tonnes of negative emissions or offsets are required.

3 **High equity (no negative emissions)**: As above, but it is assumed Australia does not have access to, or use, the international trade of emissions units, or negative emissions, to achieve the overall carbon budget.