



## Climate Council of Australia

**Submission to: Western Australia's Climate Change  
Issues Paper consultation.**

Addressed to: Western Australian Department of Water and  
Environmental Regulation.

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## About the Climate Council

The Climate Council is an independent non-profit organisation funded by donations by the public. Our mission is to provide authoritative, expert advice to the Australian public on climate change.

To find out more about the Climate Council's work, visit [www.climatecouncil.org.au](http://www.climatecouncil.org.au).

## 1. Recommendations

1. The Western Australian Government should begin its process of setting emissions reduction targets not by pro rating the unjustified, unjustifiable and unscientific target of the Federal Government, but through an analysis of what is necessary for the state to play its part in limiting risks to its own citizens.
2. The Government should commission independent, expert-led advice covering the following issues:
  - a. The impacts of climate change on Western Australia and the consequences of a failure to limit global temperature increases to internationally-agreed goals.
  - b. The remaining greenhouse gas emissions budgets in line with a global emissions budget these internationally-agreed goals, and equitable allocations of global emissions budget for the state.
  - c. Necessary pathways, at a sectoral level, that meet those pathways.
  - d. Opportunities for a state with world-beating renewable resources in the low-carbon future.

This advice should be led by the scientific community and be based on the best available scientific evidence. This includes the most recent special reports of the Intergovernmental Panel on Climate Change and the considerable material that has been published recently in preparation for the IPCC's sixth assessment report.

3. This analysis should focus on the State playing its part in the global effort to hold temperatures to well below 2°C above pre-industrial temperatures, while pursuing efforts to limit 1.5°C. It should not do so because the state is a signatory to the Paris Agreement—of course it is not—but because this global goal has been shown by the IPCC to be a point beyond which the impacts of climate change will be impossible to bear for a state that is so vulnerable to climate change.
4. Whatever goal is settled upon, the Government plan for a transition. This transition can represent a net gain, in the case of an ambitious transition to a low carbon economy using Western Australia's world-beating renewable resources to create substantial economic opportunities. Alternatively, it can be a transition to manage dramatic impacts to the lives and livelihoods of Western Australians as it is hit by a string of climate change-induced crises as the state heats up and dries out.
5. The consequences of the Government's choices should be transparently and completely communicated with the Western Australian public in a manner which allows the Western Australian population to plan for either the ambition of the Western Australian Government—and inevitable rewards—or the total failure of the Government—and inevitable impacts.

## 2. Key findings

1. Western Australia is extraordinarily vulnerable to the impacts of climate change.
2. As a state with world-beating renewable resources, Western Australia could achieve deep emissions reductions in line with the goals in the Paris Agreement, but the window for doing so is rapidly vanishing.
3. Unless the Government adopts targets with a basis in science, it should not make claims about playing a role in meeting the global effort to meet the Paris Agreement's goals because this is simply untrue.
4. Even on the most extraordinarily generous allocations of the global emissions budget for well below 2°C—the upper bound contained in the Paris Agreement—Western Australia's emissions must reduce by:
  - a. 24% below 2005 levels by 2025; and
  - b. 74% below 2005 levels by 2030for the state to be considered as playing any role at all in meeting the goals outlined in the Paris Agreement.
5. Western Australia must urgently commission independent scientific advice from recognised scientific experts to determine interim climate targets and use these to frame future emissions reduction strategies. It is crucial that the Western Australian Government, after 30 years of near total inaction, begin its consideration of climate policy with an assessment of what is scientifically necessary, rather than what is politically feasible.

## 3. Western Australia's emissions performance

The *Paris Agreement* contains a central goal of limiting global temperature increase to 'well below' 2°C above pre-industrial temperatures while 'pursuing efforts' to limit global temperature increase to 1.5°C above the same benchmark (article 2.1).

This goal is set with good reason. The challenges which come from managing global temperature increases do not increase linearly as the temperature does. Even at 1°C above pre-industrial temperatures Western Australia already faces considerable challenges. As the issues paper for this review points out, water supply in the southwest of the State has declined considerably since the early 2000s, sea-level rise is increasing at twice the global average in the State, the iconic Carnaby's Black Cockatoo has suffered considerable losses to its range and population. On top of this, there are the issues of storm surge affecting local communities, a growing bushfire threat, and increased morbidity and mortality from heatwaves as well as many other issues.

The reality is that the climate impacts we are seeing today, both in Western Australia and across the world do not represent an end point, but a step on the path to a new destination. What we are seeing today is not the 'new normal' but a sign of things to come. While global temperatures have increased by 1°C above pre-industrial levels so far, as is shown below in Section 4, the global community has likely already emitted more than enough to exceed 1.5°C. Due to lags in the warming response, this temperature increase will be felt over coming decades.

It is only through deep, immediate and enduring cuts in greenhouse gas emissions that the world stands any chance at limiting global warming to 2°C, let alone the more ambitious target of 'well below' 2°C. This imperative is universally urgent, but especially so for extraordinarily large emitters like Western Australia.

The central recommendation of this submissions is that Western Australia should engage in an expert-led, independent review of the climate risks and climate opportunities. It is this form of analysis which should be used to set climate targets, rather than a pro rating of the Federal Government's entirely inadequate, unjustified and unjustifiable Nationally Determined Contribution.

The review should assess the full range of risks that the state will face under a changing climate, including both sudden-, and slow-onset losses. This review should be used to inform the selection of interim emissions reduction targets in line with Western Australia's fair share of the global emissions budget for Paris-aligned interim targets. That is, the interim targets should set the state on a path to playing its part in limiting global temperature increases to well below 2°C above pre-industrial levels, while pursuing efforts to limit warming to 1.5°C.

The analysis should also be mindful of the considerable opportunities for the western state in making such a transition. Our expectation is that that even before considering the economic detriments that will be avoided by making such the transition to a low-emissions future as part of a global effort, the benefits of action in a state with world-beating renewable resources will far outweigh the costs.

If the western state chooses to set itself on a path to a higher—and frankly more dangerous—temperature goal, then it should do so transparently, fully informing the community of the risks that it is subjecting them to. The Western Australian Government should also begin to set aside funds to deal with these future risks to the Western Australian community.

We expect the figures involved for high temperature goals, once the full scope of risks to the state are taken into account, will far exceed the currently available funds in the state. But this is the choice that the current Western Australian government has to make.

The impacts of a future climate on Western Australia need to be researched in greater detail based on the most up-to-date science. Considerable guidance can be derived from looking to trends in the recent past. However, this this is no substitute for a full analysis using up-to-date climate projections.

#### 4. Observed climate impacts in Western Australia

As the second largest sub-national jurisdiction on the planet, Western Australia is of course climatically-diverse. Predicted impacts from climate change in the north of the state will differ dramatically from those felt in the south. For the sake of brevity, this submission will focus on the most populous region in the southwest.

Before turning to this information though, it should be noted that the impacts identified here have occurred against a background of 1°C of global temperature increase since the pre-industrial period. The changes seen so far are dramatic. Absent serious ambition from all governments of the world these risks will only grow in the future. The effects seen today represent a step on the path to a new future. The destination will be determined by today's ambition.

Last year's State of the Climate report from the Bureau of Meteorology and CSIRO showed that the 1°C increase in global temperatures since pre-industrial times has led to considerable shifts in bushfire hazard through Western Australia shown in Figure 1.

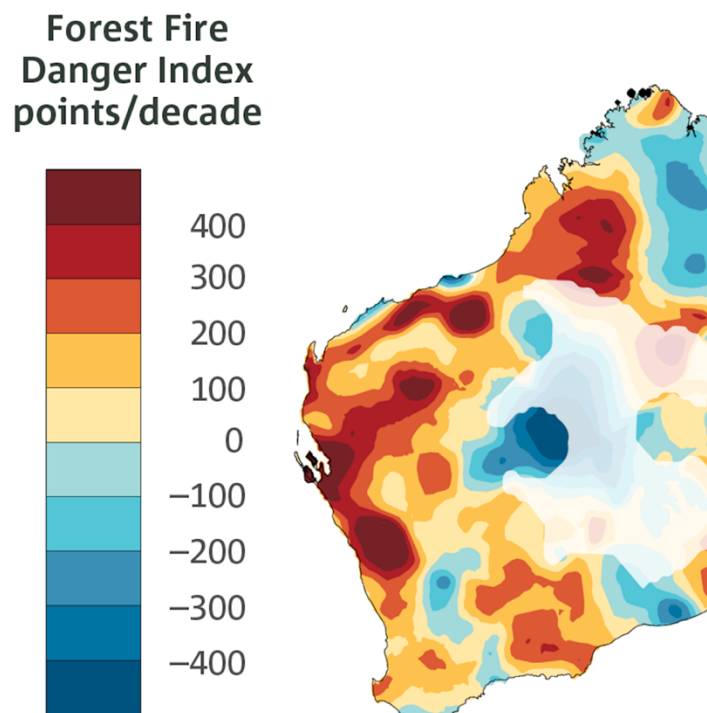


Figure 1. Trends from 1978 to 2017 in the annual (July to June) sum of the daily Forest Fire Danger Index. Figure source: CSIRO & Bureau of Meteorology (2018)

The risk to lives and livelihoods of Western Australians from this shift should be obvious. The only way to limit future increases in fire danger in the long term is to eliminate the primary cause of that change—the continued growth of greenhouse gas emissions.

Alongside this shift, in the past century, mean temperatures in the southwest increased from an average of 15.8°C in 1911–1920 to an average of 17.1°C. Most importantly, the rate of change is also increasing. The rolling average temperature anomaly is shown below in Figure 2.

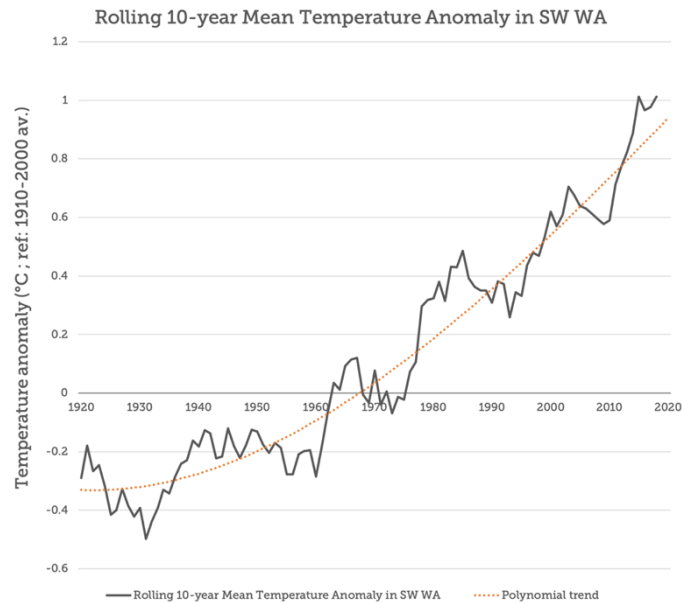


Figure 2. Data source: Bureau of Meteorology (2019)

At the same time, average annual rainfall in the region has plummeted from 710 millimetres per year in 1911–1920 to 621 millimetres per year in 2011–2018. This is a total reduction in rainfall of 12.5% across the region.

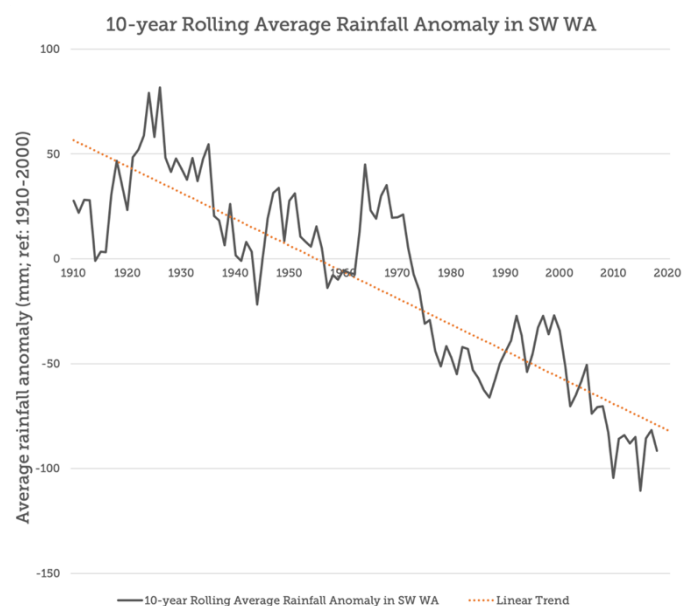


Figure 3. Data source: Bureau of Meteorology (2019)

These changes in rainfall are a core driver of the collapse in stream flows in Perth-area dams highlighted in the discussion paper for this review. This data is reproduced in Figure 4).

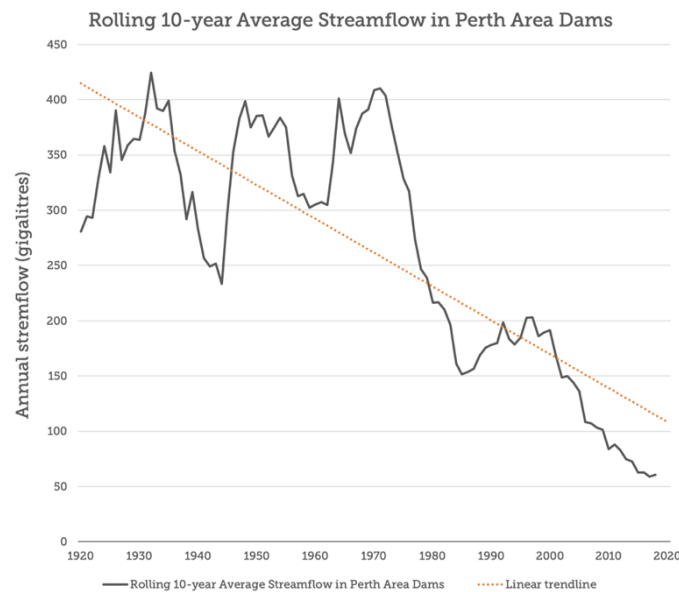


Figure 4. Data source: Water Corporation of WA (2019)

Along with these changes, global emissions are also contributing to an increase in the frequency, severity and duration of heatwaves (Climate Council 2014). This will lead to greater morbidity and mortality as a result (Climate Commission 2011).

There is no solution to the global problem of climate change while emissions from carbon-intensive regions such as Western Australia continue to not only increase, but accelerate. Western Australia must immediately, drastically and permanently reduce its emissions if the world is to meet the goals outlined in the Paris Agreement. There is no longer room for laggards.

Emissions from non-land use sectors in Western Australia increased steadily by an average of 1.48 million tonnes of CO<sub>2</sub>-equivalent greenhouse gases per year over the period from 1990–2015. This alone was enough to see the state's emissions increase by 77%, from 48.1 million tonnes per year in 1990 to 85.1 million tonnes per year in 2015 (Department of Environment and Energy 2019a).

To make a bad situation worse, between 2015 and 2016, non-land use emissions increased by 4 million tonnes per year. And between 2016 and 2017, they increased by a further 8 million tonnes per year.



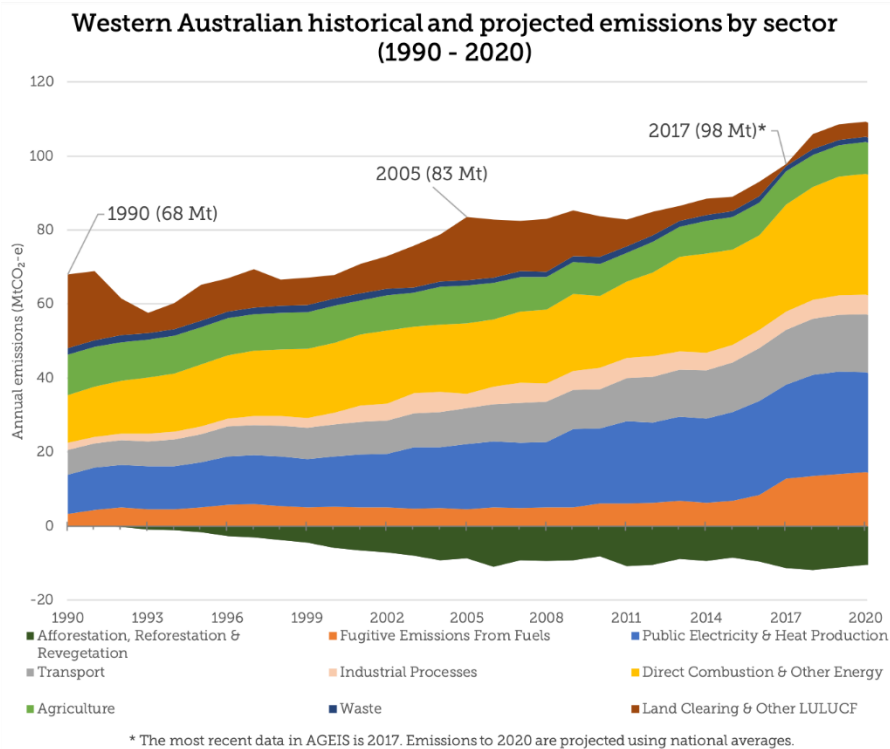


Figure 5. Data source: Department of Environment and Energy (2019a)<sup>1</sup>

It is concerning to watch the continued growth of Australia’s emissions at the national level. Emissions have increased year-on-year for five straight years since the repeal of the Federal carbon pricing mechanism in 2014 (Department of Environment and Energy 2019b).

It is indicative of the scale of historic failure in Western Australia that, if it were not for Western Australia’s accelerating emissions, the continued increase in emissions at the national-scale would not exist. The western state’s continued failure to take any reasonable steps to limit its impact on the climate is driving the entire country backward. It is time for the state to step up.

<sup>1</sup> Projections for 2017 (the most recent data available in AGEIS) to 2020 are based on applying national-scale emissions projections to Western Australia. This is likely a serious under-estimate given the recent acceleration in Western Australia’s emissions, but one that is necessary to make for the ensuing analysis. The more emissions have increased in recent times,

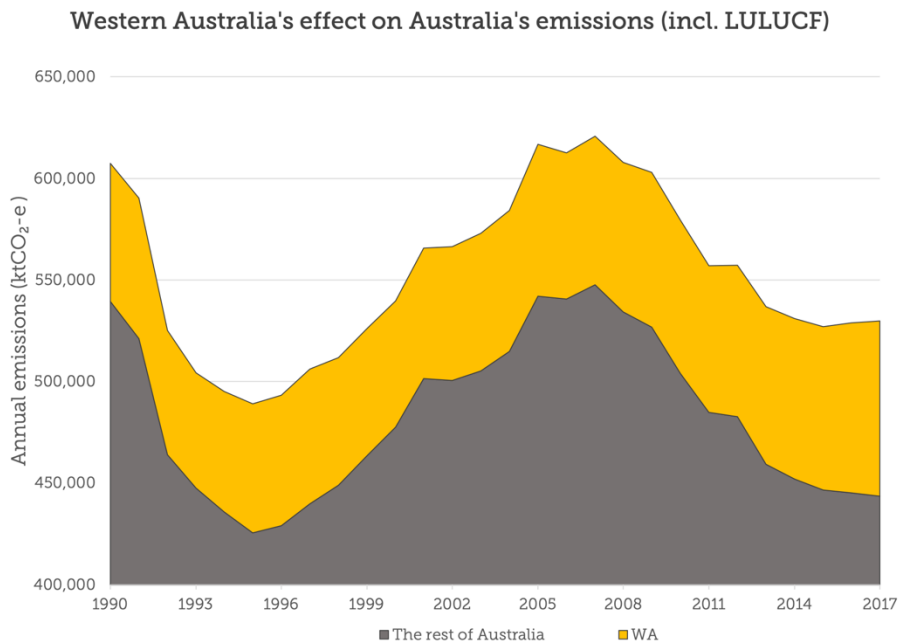


Figure 6. Data source: Department of Environment and Energy (2019a)

In 2016—the most recent year for which global data is available—Western Australia’s total emissions were higher than the annual emissions of 150 different countries (World Resources Institute 2019). The list of countries that Western Australia emitted more than in that year includes several developed countries, such as: Israel, Austria, New Zealand, Portugal, Ireland, Hungary, Finland, Bulgaria, Hong Kong and Singapore.

Australia has remarkably high emissions per person at 22.82 tonnes of greenhouse gases per person per year (World Resources Institute 2019). It is the highest per person emitter in the developed world, the highest among all large countries—where large is defined as having a population above 10 million.

Australia’s per person emissions are higher than all but seven countries. Nationally, emissions per person are three-and-a-half times the global average, and the global average emissions per person is far too high given three decades of increasing urgent scientific warnings.

Even recognising that Australia’s emissions per person are very far above an average that is itself far too high, it is especially concerning that Western Australia’s emissions per person are higher still. In 2016, Western Australia emitted 37.68 tonnes per person per year. This makes them 65% above the national average and just short of **six** times the global average.

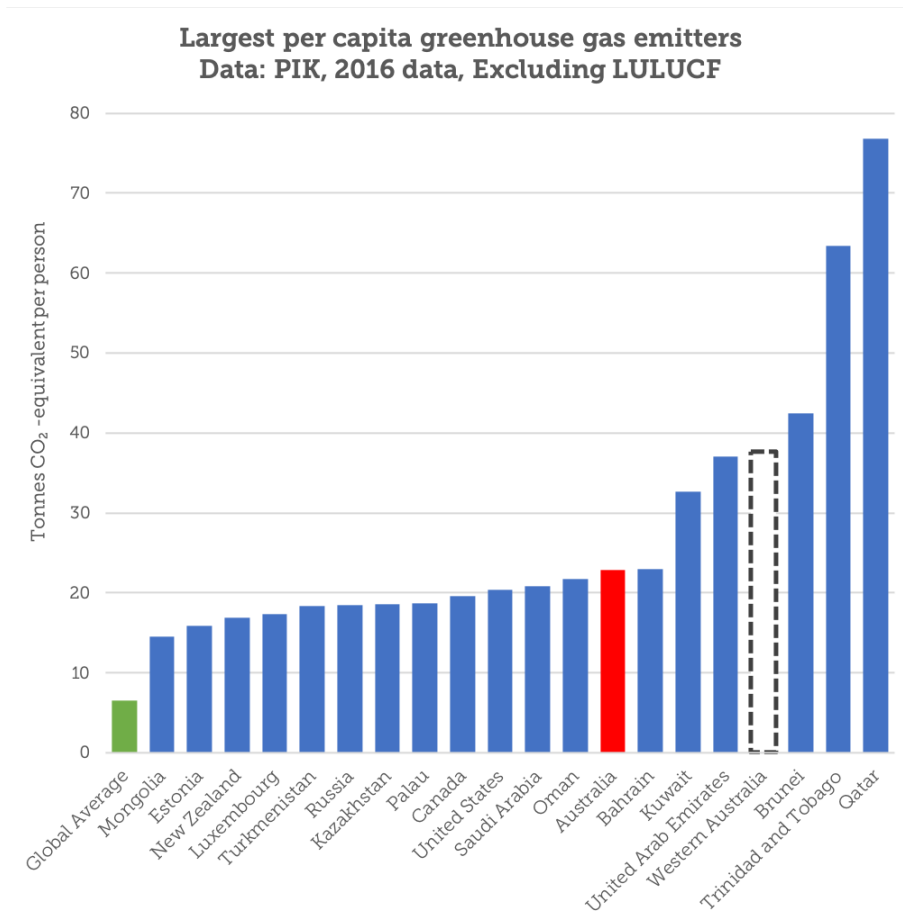


Figure 7. Data source: PIK, available via World Resources Institute (2019) and Department of Environment and Energy (Cth) (2019a)

This is a deeply irrational position for a State which is so vulnerable to climate change. There is no prospect of keeping global temperatures at less than 2°C above pre-industrial levels unless the highest emitters—a group that includes Western Australia on both an absolute and a per capita basis—reduce its emissions.

Fortunately, for Western Australia, more than perhaps any other Australian state, the opportunities that come from decarbonising are significant.

Western Australia has several regions with world-leading wind resources, particularly offshore in the southwest (Geosciences Australia 2019). It has world-beating solar resources in the northern half of the state. Even in the Perth area, the solar resource is better than all Australian capitals other than Darwin. Western Australia has considerable wave energy potential, but the development of technologies to harness it has been especially slow.

At present, the Western Australian electricity supply includes a pitiful amount of renewable generation given this potential. This is shown below in Figure 8.

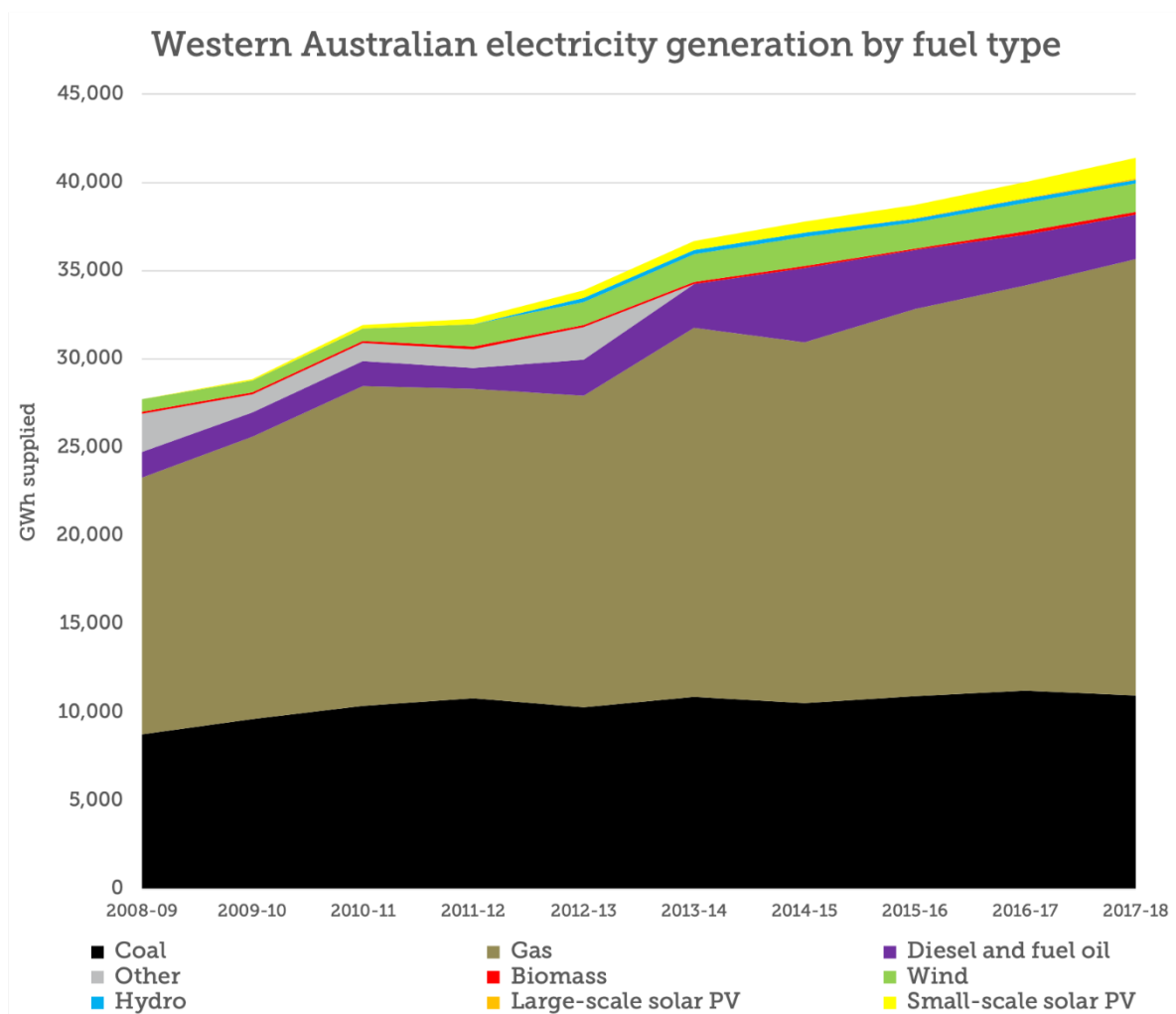


Figure 8. Data source: Australian Energy Statistics (2019)

In the 2018 calendar year, Western Australia generated a mere 8.2% of its electricity from renewables, giving it the second lowest renewable electricity share of any Australian or territory. Across three large-scale solar farms, WA has a total of 19 MW installed capacity in solar. This can be compared to Victoria, with a far weaker solar resource, on 350 MW installed capacity.

Western Australia is a constant poor performer in the Climate Council's annual renewable energy scorecards, having previously tied for last place. In our most recent report, Western Australia was second largest only because of the extraordinarily pitiful amount of effort shown by the Northern Territory.

The total absence of a renewable energy target in Western Australia is part of this. Households are stepping up with rooftop solar, and Western Australia is approaching a whopping 30% of households with panels installed (APVI 2019), but this is no substitute for large-scale wind and solar projects when it comes to decarbonising the Western Australian electricity sector.

With Western Australia's incredible renewable resource taken into consideration, the mooted pro-rating of the Federal Government's emissions reduction target of 26% to 28% below 2005 levels in 2030 is manifestly insufficient. First, the Federal Government's target is manifestly insufficient even using older assessments of the global emissions budget (Climate Change Authority 2014). Second, the precipitous decline in the cost of new renewable generation means that electricity is now by far the simplest sector in which to reduce emissions, making it the most cost-effective sector in which to reduce emissions. Serious emissions reduction targets require serious emissions reductions in the electricity sector. Third, again, Western Australia has world-beating renewable resources in both wind and solar energy potential giving it a massive leg up even above the rest of Australia—the sunniest and windiest inhabited continent on the planet.

Fully realising this potential means that Western Australia will not only reduce its own emissions, but will drive emissions reductions overseas.

Simultaneously, Western Australia must electrify as much of its energy use as possible and also ensure that the rate of renewable build is sufficient to meet not only today's demand, but tomorrow's. This will allow for considerable economic opportunities for the state.

For example: Western Australia could not compete with powerhouses like China in the processing of iron ore to make steel using conventional means. However, in a carbon-constrained world, other countries are increasingly feeling the pinch of their emissions reduction goals and will be looking for opportunities to purchase low carbon products to feed their own manufacturing sectors. There is a future for Western Australia which sees Western Australian iron ore turned to Western Australian steel using Western Australian green hydrogen as a feedstock. But this opportunity is non-existent until Western Australia's grids become 100% renewable. There is no option for this form of climate-sensitive reindustrialisation before this point and no market for conventional steel in which Western Australia could compete.

Further details of the potential for Western Australia are contained in Beyond Zero Emissions' recent report, *Collie at the Cross-roads: Planning a future beyond coal*. We recommend that the Western Australian Government seriously engage with this impressive effort by the Beyond Zero Emissions team both in relation to the community of Collie specifically, and more broadly throughout the state (Beyond Zero Emissions 2019).

This once-in-a-generation opportunity cannot be permitted to slip away, both for the Western Australian economy, and for the global climate.

## 5. The global greenhouse gas emissions budget

The initial warnings about the dangers of global temperature increase due to human induced release of greenhouse gases was first made by the Intergovernmental Panel on Climate Change to the world's governments in 1990. This is when action on reducing emissions should have begun. Three decades later, Western Australia has not even begun.

The unrelenting nature of the growth in emissions from Western Australia is rare among developed nations. Even in a world where international efforts to reduce emissions have been insufficient to meet agreed international goals, Western Australia sits at the back of the pack. The acceleration of annual greenhouse gas emissions from Western Australia means that the state faces difficult choices. It is all well-and-good for the issues paper to name-check the global goals in the Paris Agreement, but Western Australia can play no role in meeting those goals while its emissions continue to increase. It is frankly misleading to suggest otherwise.

Thirty years of delay in stemming this growth means that the state is pushing up against hard limits. These are not negotiable if the Western Australian Government has a desire to protect its population, its agricultural sector, and its future prosperity in a changing climate.

Even if the clock is reset to ignore past emissions, this three-decade delay means that the pathway between Western Australia's emissions today, and a science-based emissions reduction target for Western Australia simply has no room for anything other than deep, enduring and immediate emissions reductions.

## 6. Western Australia's fair share of the global emissions budget

The charts below follow broadly the same methodology as used in the advice of Meinshausen, Robiou du Pont and Talberg in the commissioned advice they provided to the Victorian Government's Independent Expert Panel on Interim Emissions Reduction Targets (Meinshausen, Robiou du Pont & Talberg 2019). This advice formed the basis of Victoria's proposed interim target setting process under that state's *Climate Change Act*. The advice provided to the Victorian panel was in turn based on the work of the Intergovernmental Panel on Climate Change in its special report *Global Warming of 1.5°C* released last year (Rogelj et al. 2018).

We recommend that the Western Australian Government seek its own independent analysis from suitably qualified members of the scientific community. We would be happy to assist in finding relevant experts should the government wish to do so.

The analysis contained in this submission begins with the carbon dioxide emissions budgets contained in chapter 2 of the IPCC's special report on 1.5°C, and makes certain adjustments using information contained in the same report.

Assumptions used are deliberately neutral and include:

- An assumed net-neutral effect from non-CO<sub>2</sub> anthropogenic emissions, where warming gases such as methane are balanced out by coolants such as the aerosols (0 GtCO<sub>2</sub>/CO<sub>2</sub>-e deducted from the global budget).
- Considering the feedback effect of Arctic permafrost melt, where methane is released from frozen lands as the planet warms (100 GtCO<sub>2</sub>-e deducted from the global budget).

The analysis in this submission builds upon that commissioned by the Victorian Panel. There, Meinshausen, Robiou du Pont and Talberg included in their considerations, the difference between the average global temperature of the period between 1850 and 1900—used as a proxy for 'pre-industrial temperatures' in the IPCC's work—and temperatures as they would have been before the industrial revolution—which began in the early-1700s, rather than the late-1800s. The contribution of anthropogenic greenhouse gas emissions in this period was small, but was not zero. The advice provided to the Victorian Expert Panel assumed that emissions in this first century of industrialisation were sufficient to raise global temperatures by 0.1°C. We feel that this is an unreasonably high estimate. In the interests of using only neutral assumptions, our analysis has factored in half of this temperature increase, or +0.05°C. This results in a 90 Gt reduction of the global budget, rather than the 180 Gt reduction used to inform the Victorian Government's purposes.

Finally, in a departure from both the IPCC and the advice to the Victorian Government, we account for the climate change-reinforcing feedback from the dieback of the Amazonian and boreal forests. At the time that the IPCC was finalising its special report, the warming potential of this feedback had not been quantified. However, Steffen et al. (2018) has now made such an assessment. Factoring it into the analysis, again using mid-range estimates, results in a total of 198 Gt being deducted from the global emissions budget.

This results in the following global emissions budgets for given temperature goals. The statistical probabilities—67% of 50%—are an indication of the number of IPCC-referenced climate models that successfully stay below the temperature goal for a given quantity of greenhouse gas emissions.

These figures indicate the remaining greenhouse gas emissions budget for a 67% or 50% chance of limiting global temperature goal between 1 January 2018 and the date of zero emissions.

For context when reading these figures, 47.2 gigatonnes of carbon dioxide-equivalent greenhouse gas was released in 2016 (World Resources Institute 2019). This means that the remaining emissions budget for a 67% chance of limiting global temperatures to 1.5°C was exhausted part way through 2018.

Table 1: Total remaining emissions budgets for temperature goals between 1.5°C and 2°C above pre-industrial levels

		Percentage chance of meeting temperature goal	
		67% chance	50% chance
Global temperature	1.5°C	32 Gt CO <sub>2</sub> -e	192 Gt CO <sub>2</sub> -e
	1.6°C	182 Gt CO <sub>2</sub> -e	382 Gt CO <sub>2</sub> -e
	1.7°C	332 Gt CO <sub>2</sub> -e	567 Gt CO <sub>2</sub> -e
	1.8°C	482 Gt CO <sub>2</sub> -e	747 Gt CO <sub>2</sub> -e
	1.9°C	632 Gt CO <sub>2</sub> -e	927 Gt CO <sub>2</sub> -e
	2.0°C	782 Gt CO <sub>2</sub> -e	1,112 Gt CO <sub>2</sub> -e

From these global totals, it is possible to derive an equitable allocation of the global emissions budget for nations, and states and provinces around the world (Robiou du Pont & Meinshausen 2018). There are, however, diverse methods for doing so. These range from 'equal cumulative per capita' which divides the global emissions budget between nations based on the share of the global population alone, through to the form of 'contraction and convergence' applied in the Ross Garnaut's climate policy reviews performed for the Federal Government (Garnaut 2008, 2011).

Consistent with the process used for Victoria, here we apply the global budget to the sub-national scale as a two-stage process. First, we calculate an equitable allocation for Australia. Second, we calculate Western Australia's equitable allocation of the Australian emissions budget.

As shown in Table 1, the emissions budget for limiting global temperature increase to 1.5°C is likely unachievable without extraordinarily large deployment of negative emissions technologies in the latter half of the century which are capable of drawing greenhouse gas emissions out of the atmosphere at a one-to-one scale. That is, in order to have temperatures be 1.5°C above pre-industrial levels in 2100, every tonne of greenhouse gas emitted since part way through 2018 must be permanently removed from the atmosphere before century's end.

These negative emissions technologies will likely be necessary between now and 2100 to restore past damage in order reach even the upper range of the Paris Agreement's goal ('well below 2°C'). That said, we do not feel that it is realistic to assume that they will be deployed this scale.

With that in mind, our analysis sets its sights on the upper end of the Paris Agreement's goals ('well below 2°C') and so aims at a global emissions



budget with a 67% chance of limiting global temperatures to 1.8°C below pre-industrial levels. This is another departure from the advice provided to the Victorian Government. There, a well below 2°C budget was defined as a 67% chance of limiting global temperatures to 2°C. This approach is common in the scientific literature, but—with respect to the authors of the advice to the Victorian Government—there are enough known unknowns in the scientific literature that a one-in-three chance of exceeding a given temperature goal cannot be said to be a reasonable interpretation of being ‘well below’ that same goal.

In this submission, the global emissions budget is allocated to Australia using the modified form of contraction and convergence used in Professor Ross Garnaut’s advice to the Federal Government in his 2008 review of climate policy options for Australia (Garnaut 2008). This represents the highest valid approach to determining Australia’s equitable fair share of the global emissions budget.

More generous allocation methods exist for Australia, such as ‘greenhouse development rights’ or the ‘constant emissions ratio’/‘grandfathering’ as defined in Robiou du Pont (2016). These cannot be applied to Australia while maintaining fidelity to the United Nations Framework Convention on Climate Change (‘UNFCCC’). In the former instance (‘greenhouse development rights’), it is invalid to apply this method to a fully developed country. In the latter instance (‘grandfathering’), the UNFCCC makes express mention of the need for developed economies to be early movers: presuming high emitting nations or regions remain proportionately high emitting all the way to zero—violates this term in our international commitments.

Australia’s total allocation, using the modified form of contraction and convergence in Garnaut, is then allocated to Western Australia using the ‘Emissions per Gross State Product’ method as calculated for all Australian states and territories in the advice provided to the Victorian Government.

This approach sees Western Australia receive an allocation of the global emissions budget which is well above the mean of all equitable approaches, and even well above the mean of all approaches under modified contraction and convergence.

The full spread of equitable allocations for Western Australia is shown in Table 2 with the approach used in this analysis highlighted in orange and the average of all allocation methods highlighted in green.

Table 2: Comparison of equitable allocations of the global emissions budget for a 67% chance of limiting global temperatures to 1.8°C above pre-industrial temperatures

National State	Garnaut contraction & convergence	Equal per capita 2040 convergence	Capability (Emissions per GDP)	Equal cumulative per capita	Mean of National approaches
Relative status quo maintained	734 MtCO <sub>2</sub> -e	552 MtCO <sub>2</sub> -e	515 MtCO <sub>2</sub> -e	394 MtCO <sub>2</sub> -e	549 MtCO <sub>2</sub> -e
Contraction & convergence (2050)	720 MtCO <sub>2</sub> -e	542 MtCO <sub>2</sub> -e	505 MtCO <sub>2</sub> -e	386 MtCO <sub>2</sub> -e	538 MtCO <sub>2</sub> -e
Capability (Emissions per GSP)	706 MtCO <sub>2</sub> -e	531 MtCO <sub>2</sub> -e	496 MtCO <sub>2</sub> -e	378 MtCO <sub>2</sub> -e	528 MtCO <sub>2</sub> -e
Contraction & convergence (2030)	659 MtCO <sub>2</sub> -e	496 MtCO <sub>2</sub> -e	462 MtCO <sub>2</sub> -e	353 MtCO <sub>2</sub> -e	493 MtCO <sub>2</sub> -e
Equal cumulative per capita	547 MtCO <sub>2</sub> -e	412 MtCO <sub>2</sub> -e	383 MtCO <sub>2</sub> -e	293 MtCO <sub>2</sub> -e	409 MtCO <sub>2</sub> -e
Mean of State approaches	673 MtCO <sub>2</sub> -e	507 MtCO <sub>2</sub> -e	472 MtCO <sub>2</sub> -e	361 MtCO <sub>2</sub> -e	503 MtCO <sub>2</sub> -e

The combined generosity here sees Western Australia receive an extraordinarily large allocation of the global emissions budget for a 67% chance of limiting global temperature increases to 1.8°C above preindustrial levels over the period from 2018 to 2050. Western Australia has 0.034% of the world's population, and under our approach receives 0.152% of the global emissions budget: this is the highest of all approaches, and four-and-a-half times the share of the global emissions budget that the state deserves based on population alone.

As such, while under some definitions the allocations of the global emissions budget used here might be considered equitable (Robiou du Pont & Meinshausen 2018), these allocations grant Western Australia a considerable advantage for being a relatively high-emitting State in an extraordinarily high-emitting country. While the pathways here might seem ambitious, they should be considered the *minimum permissible* level of ambition for Western Australia if it is to play a role in meeting the global goals in the Paris Agreement. Beyond this, Western Australia can no longer be said to be a responsible actor on the international, or even national, stage.

The numbers produced by this process are understandably confronting. This is not an artefact of the analysis, but is instead an artefact of the fact that Western Australia has had the better part of three decades to start the hard work of reducing emissions. In this time, it has done worse than nothing. It has continually engaged in a game of climate brinkmanship as it continues to permit more and more fossil fuel developments.

Figure 9 shows an indicative sectoral pathway between Western Australia's emissions as they are today and where they need to be to play a role in staying within a global emissions budget for 1.8°C above pre-industrial temperatures.

It is not necessary for sectors to follow this pathway precisely, but if any one sector is slow to reduce its emissions, some other must take up the slack.

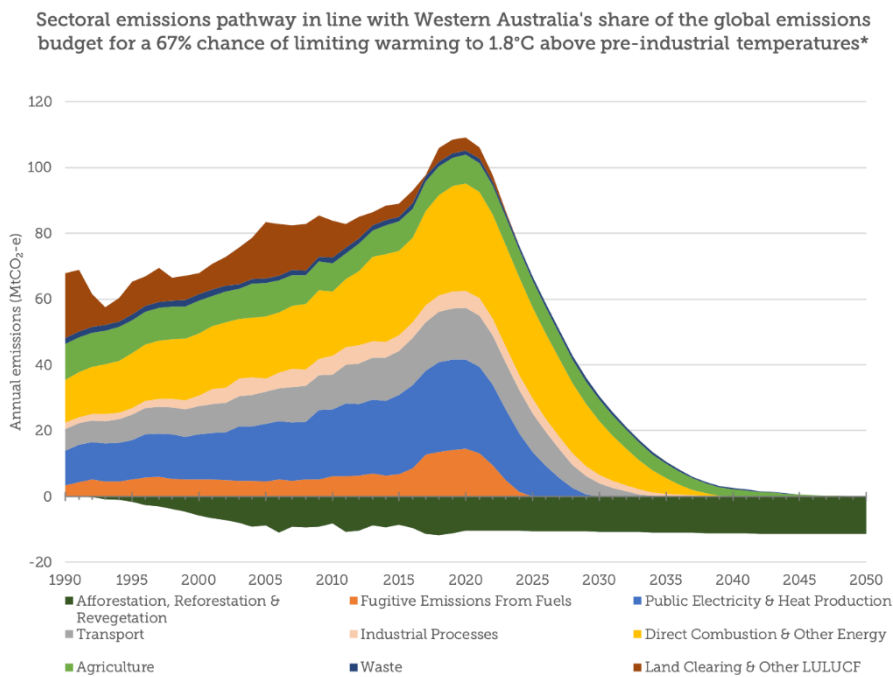


Figure 9. Data sources: Department of Environment and Energy (2019a) (historical emissions); Department of Environment and Energy (2018) (projections to 2020); original analysis (emissions to zero).

This pathway allows time for emissions to be reduced in harder to abate sectors, but it cannot be said that it allows a lot of time for this to occur.

Should Western Australia fail to meet these goals, then it must begin preparations for an unfamiliar world. It cannot be assumed that other nations, or other states, will act altruistically to pick up the slack for the Western Australian Government's failure to implement effective emissions reduction policies. Following this pathway requires net emissions to be 24% below 2005 levels in 2025, and 74% below 2005 emissions in 2030, as well as requiring 15.7 million tonnes of sequestration activity to occur.

The net position of this pathway is shown in Figure 10. It is worth noting that the negative emissions which occur through land restoration—that is, through afforestation, reforestation and revegetation—are not 'offsetting'. Emissions from the continued consumption of fossil fuels and sequestration in vegetation is not equivalent.

These negative emissions are instead a last-ditch effort to repair past harm done by the Western Australian Government for a failure to act through decades of warnings.

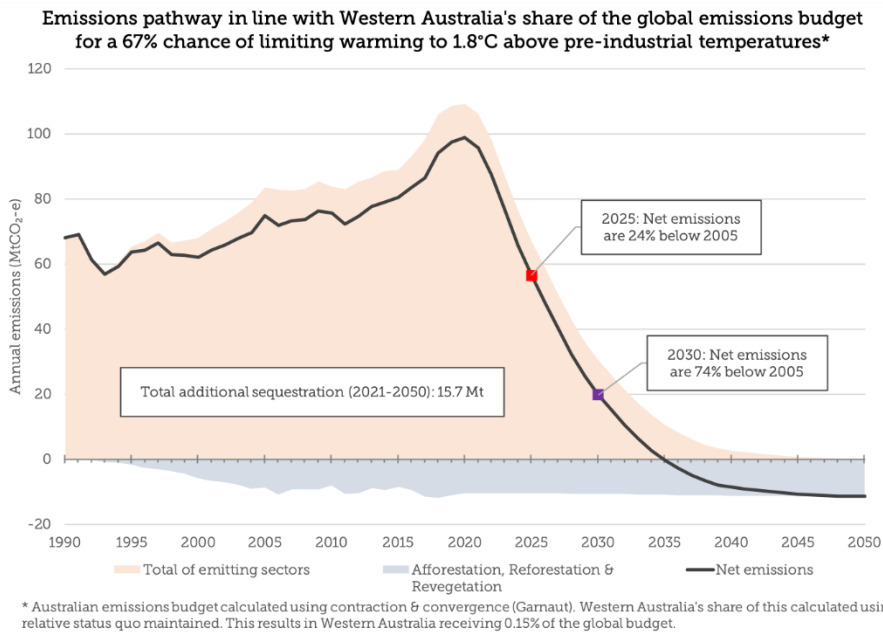


Figure 10. Data sources: Department of Environment and Energy (2019a) (historical emissions); Department of Environment and Energy (2018) (projections to 2020); original analysis (emissions to zero).

It is the responsibility of the Western Australian Government to show leadership in bringing about emissions reductions such as these in order to protect its citizens. The consequences of failure are simply too high for a state which is as vulnerable as Western Australia.

At the same time, there are immense opportunities for Western Australia to play a role in reducing emissions in line with the Paris Agreement.

These opportunities will not exist for long.

## 7. References

- APVI 2019, 'Mapping Australian photovoltaic installations', accessed from <<https://pv-map.apvi.org.au/historical#4/-26.67/134.12>>.
- Beyond Zero Emissions 2019, *Collie at the Crossroads: Planning a future beyond coal*, accessed from <<https://bze.org.au/wp-content/uploads/Collie-at-the-Crossroads.pdf>>.
- Bureau of Meteorology 2019, 'Trends and extremes', *Climate Change*, accessed November 19, 2019, from <<http://www.bom.gov.au/climate/change/#tabs=Tracker&tracker=timeseries>>.
- Cane, J, Cacho, L & Nicholas, D 2013, *Supporting Evidence-based adaptation decision-making in Western Australia: A synthesis of Climate Change Adaptation Research*, NCCARF and AECOM, accessed from <[https://www.nccarf.edu.au/sites/default/files/attached\\_files\\_publications/AECOM\\_2013\\_Synthesis\\_report\\_for\\_WA.pdf](https://www.nccarf.edu.au/sites/default/files/attached_files_publications/AECOM_2013_Synthesis_report_for_WA.pdf)>.
- Climate Change Authority 2014, *Reducing Australia's Greenhouse Gas Emissions – Targets and Progress Review*, accessed from <<http://www.climatechangeauthority.gov.au/reviews/targets-and-progress-review-3>>.
- Climate Commission 2011, *The Critical Decade: Western Australia climate change impacts*, accessed from <<https://www.climatecouncil.org.au/resources/climate-change-impacts-for-western-australia/>>.
- Climate Council 2014, *Heatwaves: Longer, Hotter and More Often*, accessed from <<https://www.climatecouncil.org.au/uploads/9901f6614a2cac7b2b888f55b4dff9cc.pdf>>.
- CSIRO & Bureau of Meteorology 2018, *State of the Climate 2018*, accessed from <<http://www.bom.gov.au/state-of-the-climate/State-of-the-Climite-2018.pdf>>.
- Department of Environment and Energy 2018, *Australia's emissions projections 2018*, accessed from <<http://www.environment.gov.au/climate-change/publications/emissions-projections-2018>>.
- Department of Environment and Energy 2019a, 'Australian Greenhouse Emissions Information System (AGEIS): State Greenhouse Gas Inventory', accessed from <<http://ageis.climatechange.gov.au/SGGI.aspx>>.

Department of Environment and Energy 2019b, 'Quarterly Update of Australia's National Greenhouse Gas Inventory for March 2019', *Department of the Environment and Energy*, accessed October 4, 2019, from <<http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/publications/quarterly-update-australias-nggi-mar-2019>>.

Garnaut, R 2008, *The Garnaut climate change review: final report*, Cambridge University Press.

Garnaut, R 2011, *The Garnaut review 2011: Australia in the global response to climate change*, Cambridge University Press, Port Melbourne, Vic.: New York.

Geosciences Australia 2019, 'Australian Energy Resources Assessment', accessed from <<http://aera.ga.gov.au>>.

Meinshausen, M, Robiou du Pont, Y & Talberg, A 2019, *Greenhouse Gas Emissions Budgets for Victoria*, accessed from <<https://www.climatechange.vic.gov.au/reducing-emissions/interim-targets>>.

Robiou du Pont, Y, Jeffery, ML, Gütschow, J, Rogelj, J, Christoff, P & Meinshausen, M 2016, 'Equitable mitigation to achieve the Paris Agreement goals', *Nature Climate Change*, vol. 7, no. 1, pp. 38–43.

Robiou du Pont, Y & Meinshausen, M 2018, 'Warming assessment of the bottom-up Paris Agreement emissions pledges', *Nature Communications*, vol. 9, no. 1, p. 4810.

Rogelj, J, Shindell, D, Jiang, K, Fifita, S, Forster, P, Ginzburg, V, Handa, C, Khesghi, H, Kobayashi, S, Kriegler, E, Mundaca, L, Séférian, R & Vilariño, MV 2018, 'Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development', in V Masson-Delmotte, P Zhai, H-O Pörtner, D Roberts, J Skea, PR Shukla, A Pirani, W Moufouma-Okia, C Péan, R Pidcock, S Connors, JBR Matthews, Y Chen, X Zhou, MI Gomis, E Lonnoy, T Maycock, M Tignor, & T Waterfield (eds), *Global Warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, World Meteorological Organization, Geneva, Switzerland, accessed from <<https://www.ipcc.ch/sr15/>>.

Steffen, W, Rockström, J, Richardson, K, Lenton, TM, Folke, C, Liverman, D, Summerhayes, CP, Barnosky, AD, Cornell, SE, Crucifix, M, Donges, JF, Fetzer, I, Lade, SJ, Scheffer, M, Winkelmann, R & Schellnhuber,

HJ 2018, 'Trajectories of the Earth System in the Anthropocene',  
*Proceedings of the National Academy of Sciences*, vol. 115, no. 33,  
pp. 8252–8259.

Water Corporation of WA 2019, 'Streamflow Historical', accessed  
November 19, 2019, from  
<<https://www.watercorporation.com.au/water-supply/rainfall-and-dams/streamflow/streamflowhistorical>>.

World Resources Institute 2019, 'Climate Watch', accessed November 2,  
2019, from <<https://www.climatewatchdata.org/ghg-emissions>>.