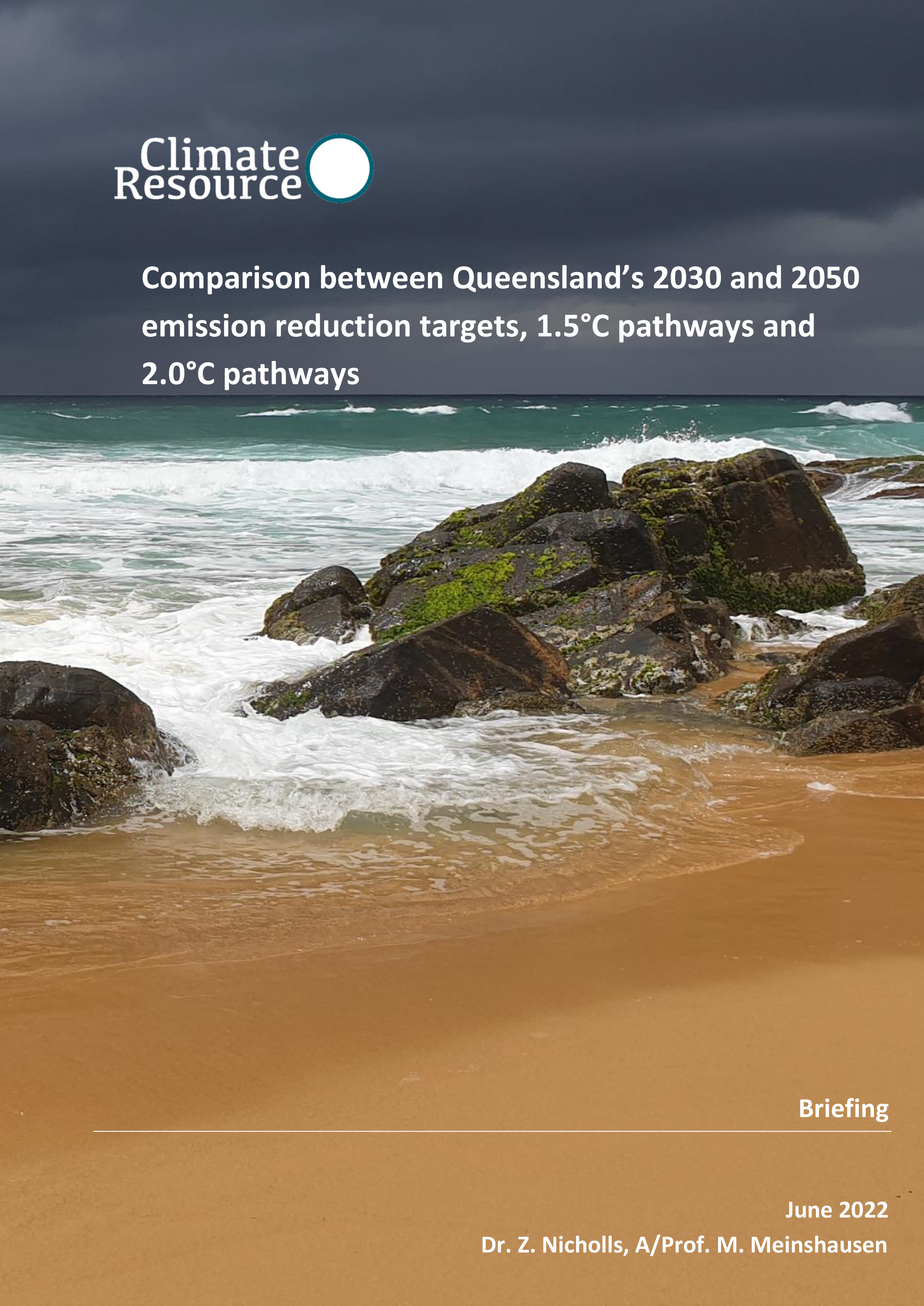

Climate Resource

Comparison between Queensland’s 2030 and 2050 emission reduction targets, 1.5°C pathways and 2.0°C pathways

Briefing

June 2022

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About the authors

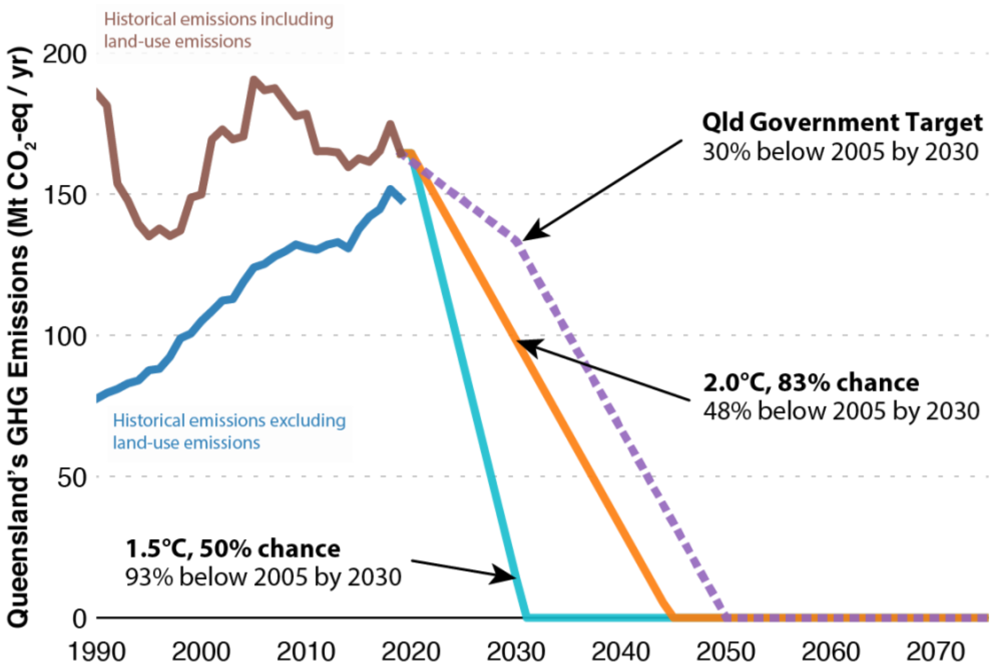
A/Prof. Malte Meinshausen is a Lead Author of the Working Group 1 (the physical science) of the IPCC’s Sixth Assessment Report (AR6), an author of the IPCC AR6 Assessment Report Synthesis Report (due to be released in September 2022) and has long-standing international expertise on carbon budgets, the Paris Agreement and national and subnational emission targets.

Dr. Zebedee Nicholls was a Contributing Author to 5 chapters in Working Group 1 of AR6 and was closely involved in the preparation of the carbon budget numbers. Dr. Zebedee Nicholls is also providing temperature assessments of thousands of emission scenarios to Working Group III (mitigation of climate change) of the IPCC, providing a link to the latest science on emissions reductions pathways and their warming implications.

Image: M. Meinshausen
This report was commissioned by WWF-Australia.

SUMMARY

The Queensland Government's emissions reduction targets lead to cumulative emissions of 2.9 $GtCO_2$-eq[1] between 2020 and net zero (2050), almost triple Queensland's emissions budget for a 50% chance of staying below 1.5°C of 1.0 $GtCO_2$-eq and around 40% greater than Queensland's emissions budget for an 83% chance of staying below 2.0°C of 2.1 $GtCO_2$-eq. A 2030 emissions reduction target of 93% (relative to 2005 emissions) and net zero in 2031 is consistent with Queensland being in line with a 50% chance of limiting warming to 1.5°C based on current scientific understanding. A 2030 target of 48% below 2005 levels and net zero by 2045 is consistent with an 83% chance of staying below 2.0°C.



[1] Emissions in this report are provided in gigatonnes of CO_2 equivalent ($GtCO_2$-eq) and megatonnes of CO_2 equivalent ($MtCO_2$-eq) as is appropriate for the context. One gigaton is one thousand megatonnes, also equal to one billion tonnes. One megaton is one million tonnes. CO_2 equivalent emissions are emissions which have been converted to their equivalent amount of CO_2 emissions (rather than being reported in their native units e.g., megatonnes of methane).

1. THE IMPORTANCE OF 1.5°C

Climate change is a global challenge, with ongoing warming leading to greater impacts and risks for humanity. With high confidence, the IPCC's Special Report on 1.5°C (SR1.5)[2] concluded that, "Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C". The difference between 1.5°C and 2°C is stark for coral reefs: declines of 70-90% are expected at 1.5°C of warming and declines of more than 99% are expected at 2°C of warming. More recent literature suggests that things could be even worse than in SR1.5, with even 1.5°C of warming being incompatible with saving most of the world's coral reefs[3].

2. KEY RESULTS

- **Queensland's current 2030 target is out of line with the latest climate science.** The Queensland Government's 2030 target of reducing emissions by 30% relative to 2005 emissions levels and plan to reach net-zero by 2050 are not in line with pursuing efforts to limit warming to 1.5°C.
- **Pathways for 1.5°C require much faster reductions over the next decade to reach net-zero in the early 2030s.** For a 50% chance of limiting warming to 1.5°C, a 2030 emissions reduction target of 93% (compared to 2005 emissions levels) and net zero by 2031 is consistent with the latest climate science[4], based on previously used approaches to determining Australia's share of global emissions budgets and Queensland's share of Australia's emissions budget[5]. For a greater than 50% chance of limiting warming to 1.5°C, reductions even stronger than those presented here are required.
- **Pathways for 2.0°C also require a significant increase in the pace of emissions reductions to 2030, and reaching net-zero by the mid 2040s.** For a target of well below 2.0°C (here taken to mean an 83% probability of remaining below 2°C), a 2030 emissions reduction target of 48% (compared to 2005 emissions levels) and net zero by 2045 is consistent with the latest climate science[6], based on previously used approaches to determining Australia's share of global emissions budgets and Queensland's share of Australia's emissions budget[7]. For a greater than 83% chance of limiting warming to 2.0°C, stronger reductions are required.
- **Even faster emissions reductions are required if Australia's fair share of the emissions budget is based on an equal allocation per capita.** The required emissions reductions given above are calculated based on the assumption that Australia's fair share of global emissions is 0.97% (from 2013 to 2050)[8]. Such a share is high given Australia's high GDP[9]. A 0.97%

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[2] https://www.ipcc.ch/sr15/chapter/spm/

[3] https://doi.org/10.1371/journal.pclm.0000004

[4] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter_05.pdf

[5] https://www.climatechangeauthority.gov.au/sites/default/files/2020-06/Target-Progress-Review/Targets%20and%20Progress%20Review%20Final%20Report.pdf

[6] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter_05.pdf

[7] https://www.climatechangeauthority.gov.au/sites/default/files/2020-06/Target-Progress-Review/Targets%20and%20Progress%20Review%20Final%20Report.pdf

[8] https://www.climatechangeauthority.gov.au/sites/default/files/2020-06/Target-Progress-Review/Targets%20and%20Progress%20Review%20Final%20Report.pdf

[9] https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0016/421702/Greenhouse-Gas-Emissions-Budgets-for-Victoria.pdf

share also means that Australia receives a higher per capita share than other nations (Australia's share would be 0.33% if all countries received the same emissions per capita). Allocating a smaller share to Australia would result in a smaller budget for Queensland too, requiring faster emissions reductions and increasing the inconsistency between the Queensland Government's current targets and pathways in line with international agreements to limit temperature rise such as the Paris Agreement.

- **The Queensland Government's emissions reduction targets exceed Queensland's emissions budget.** If Queensland meets the current targets, it will lead to cumulative emissions of 2.9 $GtCO_2$-eq between 2020 and net zero, almost triple Queensland's emissions budget for a 50% chance of staying below 1.5°C of 1.0 $GtCO_2$-eq. Further, 2.9 $GtCO_2$-eq is around 40% more than Queensland's emissions budget for an 83% chance of staying below 2.0°C of 2.1 $GtCO_2$-eq.
- **The 2030 target must be strengthened, the net zero year brought forward, or both, for Queensland to be in line with international agreements to limit temperature rise, given the science.** Leaving the 2030 target unchanged requires the net zero year to be greatly brought forward, given that Queensland has a limited emissions budget. This increases the burden on future generations to make much more rapid emissions reductions than this generation[10].
- **Updated science results in a larger 2°C emissions budget, but a similar 1.5°C budget to that reported by the Climate Targets Panel (2021)[11].** For 1.5°C, the latest IPCC global carbon budgets are slightly larger, while our estimate of the temperature rise between 1750 (pre-industrial) and 1850-1900 (early pre-industrial) has also increased. The net effect of these two changes is almost zero, leading to emissions reductions targets for 1.5°C that are very similar to those presented by the Climate Targets Panel[12]. However, for 2.0°C, the budgets used by the Climate Targets Panel are smaller than the latest IPCC global carbon budgets[13]. As a result, the emissions reduction targets for 2.0°C are less stringent than the targets that would be derived under the Climate Targets Panel's global carbon budget assumptions.

[10] https://www.climatecollege.unimelb.edu.au/files/site1/docs/%5Bmi7%3Ami7uid%5D/Climate%20Targets%20Panel%20Report%20-%20March%202021.pdf

[11] https://www.climatecollege.unimelb.edu.au/files/site1/docs/%5Bmi7%3Ami7uid%5D/ClimateTargetsPanelReport.pdf

[12] https://www.climatecollege.unimelb.edu.au/files/site1/docs/%5Bmi7%3Ami7uid%5D/ClimateTargetsPanelReport.pdf

[13] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter_05.pdf

3. FURTHER DETAILS

Table 1 Emissions budgets (also known as cumulative greenhouse gas emissions), 2030 reductions and net zero years under different emissions pathways for Queensland.

Pathway	Emissions budget from 1st Jan 2020 ($GtCO_2$-eq)	2030 reduction (relative to 2005)	Net zero year
1.5°C, 50% chance	1.0	93%	2031
2.0°C, 83% chance	2.1	48%	2045
Queensland Government Target	2.9	30%	2050

In the summary figure, we show total historical emissions and historical emissions excluding land-use change emissions. We do this to highlight that Queensland's total emissions are overall dropping, but only because land-use change emissions are dropping. Queensland's emissions are rising and have increased since 2005, if we exclude emissions reductions from the land-use sector which have a high degree of uncertainty due to issues related to natural variability, measurement, verification and permanence. 2019 was the first year that Queensland's emissions excluding the land-use sector have dropped since 2015. For an interactive examination of Queensland's sectoral emissions, see https://opennem.org.au/emissions/au/.

The results given here are subject to the same assumptions and caveats as those used in the previous report on Australia's emissions budgets[14] (with minor improvements to the methodology for consistency with the wider literature). The one additional caveat is that a choice is made about Queensland's fair share of Australia's emissions budget. This is a subjective choice. Here we follow the quantification of Meinshausen et al.[15], using their average of multiple methods excluding 'equal cumulative per capita'. Other choices could be made and these would lead to different results. However, the sensitivity analysis explored by Meinshausen et al. [16] shows that the approach used here is at the high end of the range: other effort sharing approaches would be likely to lower Queensland's emissions budgets, increase the required mitigation action and lead to a need for tighter targets.

[14] https://www.climate-resource.com/reports/wwf/WWF_March2022_a.pdf

[15] https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0016/421702/Greenhouse-Gas-Emissions-Budgets-for-Victoria.pdf, see Table 'Relative emission shares of Australian budgets for states and territories 2017-50'

[16] https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0016/421702/Greenhouse-Gas-Emissions-Budgets-for-Victoria.pdf, see Table 'Relative emission shares of Australian budgets for states and territories 2017-50'

We follow the methodology of Meinshausen et al.[17] (see their work for full details), with the addition of a step to account for results from Grassi et al.[18] For clarity, the other assumptions and caveats are briefly described below. Firstly, there is uncertainty in the remaining carbon budget. Secondly, while the concept of a carbon budget strictly applies to CO_2 only, here we use a correlation between CO_2 and greenhouse gas emissions found in cost-optimal scenarios to convert IPCC carbon budgets into all greenhouse gas emissions budgets. As discussed in Meinshausen et al. [19], the correlation is appropriate for assessing peak warming, transparent, simple to apply and is built on the wide range of emission reduction options explored in the cost-optimal scenarios considered by the IPCC. The correlation comes with an uncertainty of ± 100 $GtCO_2$-eq (compared to a total, global greenhouse gas budget of approximately 800 $GtCO_2$-eq from the start of 2020 onwards for a 50% chance of 1.5°C), although variations within this uncertainty don't change the broad conclusions of the analysis presented above. Thirdly, we also account for a difference in land-use emissions accounting methodologies between country-reported emissions and international modelling exercises based on Grassi et al.[20], ensuring that the targets presented are compatible with emissions as reported by the Queensland government. Fourthly, we further assume that Australia's 0.97% share of the global carbon budget for 2013 to 2050 equally applies to carbon budgets from 2013 to net zero, as most cost-optimal 1.5°C scenarios reach net zero around 2050. Finally, for global historical emissions we use Nicholls et al.[21] (based on Gidden et al.[22]), assuming that emissions from 2015 - 2019 follow the SSP2-4.5 scenario. For Australian and Queensland emissions we use the Australian Government emissions compilations as reported to the UNFCCC[23].

[17] https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0016/421702/Greenhouse-Gas-Emissions-Budgets-for-Victoria.pdf
[18] https://doi.org/10.1038/s41558-021-01033-6
[19] https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0016/421702/Greenhouse-Gas-Emissions-Budgets-for-Victoria.pdf
[20] https://doi.org/10.1038/s41558-021-01033-6
[21] https://doi.org/10.5194/gmd-13-5175-2020
[22] https://doi.org/10.5194/gmd-12-1443-2019
[23] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-2019

APPENDIX A: CALCULATION OF QUEENSLAND'S FAIR SHARE EMISSIONS BUDGET

This appendix outlines the steps applied to calculate Queensland's fair share of the global remaining emissions budget from 1st January 2020. It should be read in conjunction with Section 3, Further Details.

We note that results are rounded as appropriate. Small differences in sums and products may occur as a result. Greater precision than shown is carried in the actual calculations so where there is a conflict, the final numbers (right-hand columns) take precedence.

Step 1: Global remaining carbon budget

Converting the global remaining carbon budget from 2020 for temperatures relative to 1850-1900 into a global remaining carbon budget from 2013 for temperatures relative to pre-industrial.

Temperature level and likelihood of staying below	**Global remaining carbon budget from 2020 ($GtCO_2$)**	**Enlarging budget to account for global emissions between 2013 and 2020 ($GtCO_2$)**	**Reducing the carbon budget to make it relative to true pre-industrial (1750), rather than early pre-industrial (1850-1900) ($GtCO_2$)**	**Global remaining carbon budget from 2013 relative to pre-industrial ($GtCO_2$)**
<1.5°C with 50%	500	277	-222	555
<2.0°C with 83%	900	277	-222	955

The IPCC's remaining carbon budgets are calculated for warming relative to 1850-1900. The IPCC's Sixth Assessment Report (Cross-chapter Box 1.2) assesses the warming between 1850-1900 and the period around 1750 (before industrialisation i.e. true pre-industrial) to be 0.1°C, with a likely range of 0.0°C - 0.2°C. Our reduction of the budgets reflects the fact that the Paris Agreement text clearly states that the targets are relative to pre-industrial. The adjustment also reflects our expert judgement that it is most appropriate to take a conservative approach to the contribution of non-CO_2 emissions.

Step 2: Emissions budget

Converting a global remaining carbon budget into a global remaining emissions budget.

Temperature level and likelihood of staying below	Global remaining carbon budget from 2013 relative to pre-industrial ($GtCO_2$)	Additional non-CO2 greenhouse gas emissions until peak warming ($GtCO_2$-eq)	Global remaining emissions budget from 2013 relative to pre-industrial ($GtCO_2$-eq)
<1.5°C with 50%	555	323	877
<2.0°C with 83%	955	420	1375

Step 3: Handling differences in LULUCF accounting

Adjusting the carbon budget to account for differences in accounting differences between national inventories and remaining carbon budget calculations. For further details, see Grassi et al. (2021)[24].

Temperature level and likelihood of staying below	Global remaining emissions budget from 2013 relative to pre-industrial ($GtCO_2$-eq)	Adjustment to CO2 part of emissions budget to account for different CO2 sink accounting in IPCC methodology for national inventories and IPCC methodology for remaining carbon budget (see Grassi et al., 2021) ($GtCO_2$)	Global remaining emissions budget from 2013 relative to pre-industrial after LULUCF adjustment ($GtCO_2$-eq)
<1.5°C with 50%	877	-83	794
<2.0°C with 83%	1375	-143	1232

[24] https://doi.org/10.1038/s41558-021-01033-6

Step 4: Downscaling the global budget to a national budget

Calculating Australia's remaining emissions budget based on its assumed share of the global budget from 2013.

Temperature level and likelihood of staying below	Global remaining emissions budget from 2013 relative to pre-industrial after LULUCF adjustment ($GtCO_2$-eq)	Australia's share of the remaining emissions budget from 2013 (%)	Australia's remaining emissions budget from 2013 ($GtCO_2$-eq)
<1.5°C with 50%	794	0.97	7.7
<2.0°C with 83%	1232	0.97	11.9

Step 5: Downscaling the national budget

Calculating Queensland's remaining emissions budget based on its assumed share of Australia's budget from 2017.

Temperature level and likelihood of staying below	Australia's remaining emissions budget from 2013 ($GtCO_2$-eq)	Reducing budget to account for Australia's emissions between 2013 and 2017 ($GtCO_2$-eq)	Australia's remaining emissions budget from 2017 ($GtCO_2$-eq)	Queensland's share of Australia's remaining emissions budget from 2017 (%)	Queensland's remaining emissions budget from 2017 ($GtCO_2$-eq)
<1.5°C with 50%	7.7	-2.2	5.5	26.9	1.5
<2.0°C with 83%	11.9	-2.2	9.8	26.9	2.6

Step 6: Calculating Queensland's budget from 2020

Calculating Queensland's remaining emissions budget from 2020.

Temperature level and likelihood of staying below	Queensland's remaining emissions budget from 2017 ($GtCO_2$-eq)	Reducing budget to account for Queensland's emissions between 2017 and 2020 ($GtCO_2$-eq)	Queensland's remaining emissions budget from 2020 ($GtCO_2$-eq)
<1.5°C with 50%	1.5	-0.5	1.0
<2.0°C with 83%	2.6	-0.5	2.1