Belém Mission to 1.5

Submission by COP Universities Alliance

The Paris Agreement's 1.5°C temperature threshold remains the central benchmark for international climate action. It has recently been reaffirmed as the Paris Agreement's "agreed primary temperature goal" by the International Court of Justice. At COP30, in the Global Mutirão decision, parties also reiterated their continuing "resolve to pursue efforts to limit the temperature increase to 1.5°C [and] to limit both the magnitude and the duration of any temperature overshoot."

Based on the best available science, including reports of the Intergovernmental Panel on Climate Change ('IPCC'), limiting warming to 1.5°C now most likely requires temporary overshoot of this temperature limit, followed by net-negative emissions to achieve a gradual reversal of global warming. However, overshoot pathways entail considerable risks and uncertainties and raise major equity, feasibility and governance challenges.

The lowest risk strategy remains pursuing deep emissions cuts to limit exceedance of 1.5°C as much as possible, and setting the conditions for a future return to 1.5°C or lower global average temperature levels. This understanding of the best available science, including risks and uncertainties associated with overshoot, should inform efforts under the Belém Mission to 1.5 to strengthen international cooperation in order to enhance ambition and enable the effective implementation of NDCs and NAPs.

Introduction

The COP Universities Alliance ('COPUA') welcomes the opportunity to make a submission to "inform discussions and to help jointly shape the Belém Mission to 1.5." The COPUA is a collaboration across more than 25 leading Australian and Pacific universities to coordinate the efforts and contribution of the Australia-Pacific higher education and research sector towards COP31 and beyond. The COPUA has a particular goal to provide the scientific and research evidence base for evaluating options and proposing ambitious climate policy.

The COPUA understands that the aim of the Belém Mission to 1.5 is to enable ambition and implementation of nationally determined contributions ('NDCs') and national adaptation plans ('NAPs') and to reflect on accelerating the implementation, international cooperation and investments in NDCs and NAPs across mitigation and adaptation (Global Mutirão decision, para. 42).

This submission focuses on developments in the available scientific evidence that will affect opportunities, barriers and actionable solutions to keep 1.5°C within reach and strengthen adaptation and resilience in a changing world. In particular, the submission provides a summary of what is known in the scientific literature about overshoot of 1.5°C (part A), the attendant risks and uncertainties (part B), and pathways for return to 1.5°C or lower levels of global warming (part C). Drawing on this evidence base, the submission also offers recommendations on what is required to further strengthen international cooperation to enhance ambition and enable effective implementation of NDCs and NAPs (part D).

A. Science on 1.5°C overshoot and return

A.1 Context

The Paris Agreement's 1.5°C temperature threshold remains the central benchmark for international climate action.

The Paris Agreement articulates parties' goal to "pursue efforts to limit the temperature increase to 1.5°C above preindustrial levels" (Art. 2(1)(a)). In decisions at recent Conference of the Parties ('COP') meetings, parties have committed to "keep 1.5°C within reach." At COP30 in November 2025, in the Global Mutirão decision, parties reiterated their continuing "resolve to pursue efforts to limit the temperature increase to 1.5°C [and] to limit both the magnitude and the duration of any temperature overshoot" (para. 7).

The 1.5°C temperature goal was a hard-won outcome of many years of climate diplomacy by Pacific nations and other small island developing states, for whom global warming of more than 1.5°C represents an existential threat.

In 2025 – following a resolution from the United Nations General Assembly ('UNGA') spearheaded by Vanuatu and other Pacific states – the International Court of Justice ('ICJ'), in its Climate Advisory Opinion, unanimously found that, as a matter of international law and state responsibility, "the 1.5°C threshold" is "the parties' agreed primary temperature goal for limiting the global average temperature increase under the Paris Agreement" (para. 224).

On 20 May 2026, the UN General Assembly voted to adopt a resolution welcoming the ICJ's Advisory Opinion and urging states "in the context of the Paris Agreement and their different national circumstances, pathways and approaches, to implement measures to achieve the collective temperature goal of holding the increase in the global average temperature to 1.5 degrees Celsius above pre-industrial levels, in keeping with the best available science."

A.2 What is 1.5°C overshoot?

Overshoot in climate science describes a temporary exceedance of 1.5°C before a subsequent decline.

'Overshoot' is the term used by climate scientists to describe temporary exceedance of the Paris Agreement's 1.5°C temperature goal before a subsequent decline back below a specified peak warming level (IPCC 2018; Reisinger et al 2025). In accordance with IPCC practice, global warming levels are measured based on a 20-year average to smooth out natural climate variations.

With exceeding global warming of 1.5°C now imminent, attention is turning to questions of by how much and for how long this level is exceeded, the associated climate-related risks, and the policy and governance consequences. The systematic exploration of so-called overshoot pathways that temporarily exceed a targeted global warming limit before drawing temperatures back down to safer levels has thus become a priority for science and policy (Schleussner et al 2024).

Figure 1 below illustrates, in general terms, the difference between overshoot (exceed and decline) pathways versus pathways that remain below 1.5°C throughout, or pathways that exceed 1.5°C and then stabilise temperature at some higher level.

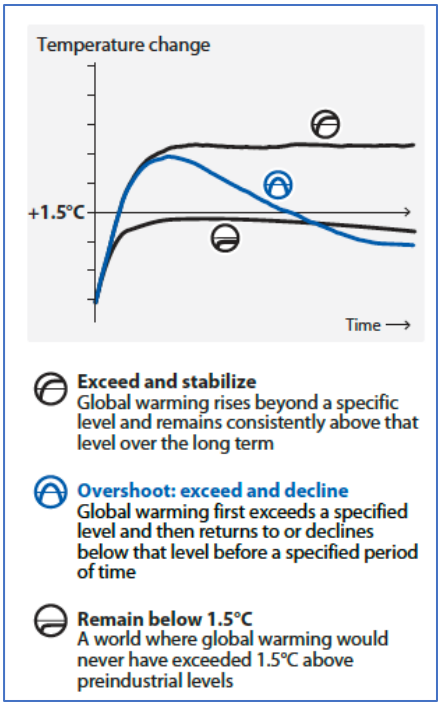

Figure 1: Illustrative temperature pathways including overshoot (exceed and decline) (from Reisinger et al 2025, p. 189)

A.3 Key findings on 1.5°C and overshoot from IPCC AR6

Climate change risks and impacts increase with every increment of warming. Staying below 1.5°C (or with limited overshoot) requires immediate and deep emissions reductions across all sectors.

The Sixth Assessment Report ('AR6') was the first set of IPCC assessment reports to consider overshoot scenarios from the physical science perspective (Working Group I) and the mitigation perspective (Working Group III), as well as key risks at global average temperatures above 1.5°C (Working Group II).

Important findings from the AR6 assessment (IPCC 2023) included:

1. Global warming is expected to reach 1.5°C by the early 2030s, even in the most ambitious category of assessed mitigation scenarios, and rise further to 1.6°C by mid-century, as the best estimate. (These assessed pathways assumed rapid concerted reductions in global greenhouse gas ('GHG') emissions from 2020 – a pathway the world has not followed.)
2. Changes in climate extremes and climate-related risks increase with every increment of warming.
3. While noting gaps in available literature, risks to natural and human systems, including irreversible impacts, and related losses and damages, increase if global warming exceeds 1.5°C rather than if it remains below this level.
4. Climate-related risks will be less severe for lower and shorter-duration 'temporary' overshoot pathways.
5. Warming beyond 1.5°C increases the likelihood of irreversible losses such as warm water coral reef collapse.
6. Limiting warming to 1.5°C, or with limited overshoot, relies on rapid and transformational changes in all sectors to reach net-zero CO_2 emissions in the 2050s, with every year of delay increasing the amount by which 1.5°C will be exceeded. At current emission rates, every 5-year delay adds about 0.1°C to peak warming.

A.4 Current temperature trajectories and modelling of return pathways

Overshoot of 1.5°C is now likely inevitable. Reversing warming will require policies and action for net-negative emissions.

The remaining carbon budget to limit global warming to 1.5°C with 50% probability from January 1, 2025, was 130 Gt CO_2, or less than 4 years of current CO_2 emissions (Forster et al 2025).

Box 1: Understanding the Global Carbon Budget and Decarbonisation Rates

A common understanding and agreement for the remaining global carbon budget is essential for the 1.5°C target.

According to the definition provided in IPCC (2021), the "science-based target" for a 1.5 °C pathway, in terms of the global carbon budget between 2020 and 2050, is set between 400 Gt CO_2 (67% likelihood) and 425 Gt CO_2 (60% likelihood).

In 2021, a global decarbonisation pathway – the IEA Net-Zero by 2050 (IEA, 2025) – with a 500 $GtCO_2$ carbon budget leading to a 50% likelihood was launched, with updates in 2023 and 2025, each time with an increased carbon budget of around 5%, adding up to 550 $GtCO_2$ for the last edition. Furthermore, national pathways, with sectoral pathways for specific industries, have developed detailed technical and economic pathways that demonstrate (with a high degree of probability) that implementation is possible (Teske et. al 2019; Teske & Pregger 2022; Noels & Jachnik 2022).

Slow global action in implementing emissions reductions since publication of the IPCC's carbon budget, makes adhering to the CO_2 budget of under 550 $GtCO_2$ per year more difficult. Therefore, an annual decarbonisation target must be defined to support proposed electrification goals, such as that of 35% by 2035 announced by the COP31 presidency.

The global 1.5°C pathways share the common requirement that the annual decarbonisation must be between 10% and 15% (i.e., approximately 2.5 $GtCO_2$ per year) until 2035 increasing to 15% or 1.5 $GtCO_2$ annually.

The decarbonisation rate defines the speed of decarbonisation and not whether the 1.5°C target will be achieved and hence is helpful for communicating ambitious mitigation pathways.

In the absence of a historical precedent or scenario from global integrated assessment models whereby emissions would reduce sufficiently rapidly to keep global emissions within this remaining carbon budget, overshoot is by now considered inevitable (Reisinger et al 2025).

Warming will decline when carbon dioxide ('CO_2') emissions become net-negative, that is when global carbon dioxide removal ('CDR') outweighs remaining gross CO_2 emissions. Hence, reversing warming back to 1.5°C requires net-negative CO_2 emissions, coupled with further reductions in non-CO_2 emissions.

Higher emissions in the near term imply higher and longer-lasting overshoot and would need to be followed by greater net-negative CO_2 emissions to return to the same warming limit.

The vast majority of scenarios assessed in IPCC AR6, and produced since, that return to 1.5°C by 2100 have peak warming of no more than 1.8-1.9°C as their upper limit (high overshoot pathway).

The magnitude and consequences of overshoot depend not only on biophysical characteristics and model assumptions but equally on scenario design and social and institutional factors.

Consequently, a new generation of models and scenarios that strengthen interactions between physical and socio-economic processes (including climate impact feedbacks and constraints on mitigation capacity) will likely be needed for supporting robust climate strategies in a world of overshoot (Tavoni et al 2026).

B. Risks and uncertainties of overshoot

B.1 Physical climate risks

It remains uncertain how much different climate risks could be reversed following 1.5°C exceedance but emerging evidence shows that a world with overshoot will be different from one that avoids it.

While, in theory, physical climate risks will decline as the world moves back to 1.5°C (or lower temperature limits) after temporary overshoot, it remains uncertain how much a subsequent decline in temperature would reverse different climate risks in relevant timeframes as some may be very long-term (millennia timescales) or likely irreversible (Reisinger et al 2025). For instance, sea levels are projected to continue to rise for many hundreds of years even if emissions are stabilised in decadal timescales.

It is also unclear how risks incurred after a return to 1.5°C compare to risks had the 1.5°C threshold never been exceeded. Emerging evidence shows that global and regional climate change and associated risks after an overshoot are different from a world that avoids it, with asymmetry in climate–carbon cycle response to positive and negative CO_2 emissions (Zickfield et al 2021).

In addition, temperature reversal could be undercut by strong Earth-system feedbacks, resulting in high near-term and continuous long-term warming (Schleussner et al 2024).

B.2 Tipping point risks

Many tipping point risks are vulnerable to overshoot with some Earth system elements like warm coral reef virtually certain to tip above 1.5°C.

Tipping point risks with fast response times, such as warm-water coral reefs, are especially vulnerable to overshoot whereas those with slow response times, such as polar ice sheets, may be less sensitive to temporary overshoot (Ritchie et al 2026).

Multiple tipping elements of the Earth system could have their tipping point below 2°C of global warming, and some below 1.5°C (Lenton et al 2025).

Even under the most optimistic emission scenarios of stabilising warming at 1.5°C without any overshoot, it is considered as likely as not (33%–66% probability) that three Earth system elements will tip with one of these elements being the warm water coral reefs, which are virtually certain (>99% probability) to tip, given the upper range of their tipping point is 1.5°C (Ritchie et al 2026).

In addition, potential interactions between tipping elements and additional human pressures, such as deforestation in the Amazon or pollution and overfishing of coral reef habitats, may further lower tipping points, narrowing the range of overshoot trajectories that can still avoid those risks (Ritchie et al 2026).

B.3 Irreversible risks

Some risks associated with exceeding 1.5°C are likely to be irreversible, including sea level rise.

Some risks will be likely be irreversible such as sea level rise (Dodds 2025), ocean warming and glacier loss (Schuster et al 2025).

Fundamental changes to food webs and tropic cascades in ecosystems are very unlikely to reverse to their former state after a period of disruption from excess temperatures (Reisinger et al 2025).

In addition, the socio-economic capacity of human society to manage risks could take many human generations to recover even if all climate hazards could be fully reversed (Al Khourdajie et al 2026).

It is now critical we focus on the irreversible impacts of exceeding 1.5°C, which we will hit around 2030 if not earlier.

B.4 Adaptation and loss and damage

The impacts of increased climate risks will not be felt evenly and require renewed attention to adaptation and loss and damage needs and costs, and equity considerations.

The prospects of potential long-term impact reversibility may have limited relevance in most adaptation decision-making contexts, indicating that it might be peak warming, rather than a long-term outcome, that determines adaptation needs and costs (Theokritoff et al 2025).

Other scientists urge that overshoot scenarios need to be included in adaptation planning because they fundamentally alter overall priority setting, costs and benefits, and implementation timing of adaptation options (Martyr et al 2026).

Overshoot generates significant distributional consequences, particularly in terms of the geographical and temporal allocation of emission reductions, technology deployment, and social and economic impacts resulting from increased climate risks (Tavoni et al 2026).

Limited studies of overshoot pathways, particularly in the adaptation and policy literatures, means there remain considerable uncertainties regarding the feasibility of exceed and decline pathways in the real world. However, it is clear that every year of delayed emissions reduction, and every increment of warming, causes harm, exacerbating the extent of climate-related loss and damage.

B.5 Responding to overshoot risks

The lowest risk strategy in response to overshoot risks remains pursuing rapid, near-term emissions reductions to keep 1.5°C within reach.

Given significant risks and uncertainties associated with 1.5°C exceedance and return, most scientists warn we cannot be confident that temperature decline after overshoot is achievable within the timescales expected today (Schleussner et al 2024; Ganti et al 2026).

To hedge against high-risk outcomes, a high preventative CDR capacity may be needed although this could face technical, economic and sustainability barriers and CDR deployment carries its own inherent and cascading risks (Dooley & Kartha 2018).

Only rapid, near-term emissions reductions offer confidence for their effectiveness in reducing climate-related risks. In the energy sector, this requires a rapid transition away from fossil fuels toward renewables, storage and economy-wide electrification, as well as enhanced energy efficiency.

Overshooting 1.5°C does not mean we need change the Paris Agreement's goals, but rather double down on their implementation (Al Khourdajie et al 2026). The pursuit of efforts to limit warming to 1.5°C is, and remains, a critical part of the Paris Agreement, directing efforts in mitigation, adaptation, and broader climate governance (Rogelj & Rajamani 2025).

C. Returning to 1.5°C

C.1 Overshoot duration and peak warming

Halting global warming and stabilising the climate begins with reaching peak warming of no more than 1.8-1.9°C.

The magnitude and duration of overshoot depend on the emissions profile up to and after exceeding 1.5°C. The 'peak' warming level will largely be determined by cumulative net CO_2 emissions up to that point. Reducing short-lived climate forcers like methane ('CH_4') will also help limit peak warming (Geden & Reisinger 2025).

There are few analyses of stabilised climates, and a lack of model experiments to address the need for understanding the implications of the Paris Agreement (King et al 2024). While there is a focus in the scientific literature and public discussion around climate changes under net-zero CO_2 emissions on global mean temperature after emissions cessation, less attention has been paid to long-term impacts such as sea level rise and subsurface ocean warming which are likely to persist even if rapid decarbonisation is achieved (King et al 2025).

Climate stabilisation also requires protecting existing terrestrial carbon stocks in primary forests and other carbon-dense ecosystems. Regrowth forests take decades to recover the carbon density and biodiversity of intact forests, making the loss of primary forests irreplaceable on timescales relevant to the Paris Agreement (Pan et al 2024).

Based on the science, peak warming would need to be in the 1.7°C-1.8°C range to take account of warming that is already locked in while maintaining a reasonable chance of return to 1.5°C (Geden & Reisinger 2025). The State of CDR Report (under development) may add 0.1°C to these estimates (so a range of 1.8°C-1.9°C) but includes several optimistic assumptions about CDR deployment.

C.2 Return pathways and net-negative emissions

Returning to 1.5°C before the end of the century requires sustained net-negative emissions.

A subsequent decline in global warming to return to 1.5°C requires sustained net-negative emissions with total removals outweighing residual emissions of all long-lived GHGs.

The central scientific estimate is that ~220Gt of net-negative emissions (equivalent to about 5 years of current annual emissions) would be necessary to reduce global temperatures by 0.1°C.

Gross amounts of CDR would need to be even greater since it is impossible to reduce CO_2 emissions fully to zero (Geden & Reisinger 2025).

However, there are significant uncertainties around this estimate, with some indications that the response of the climate system may not be fully symmetric between emissions and removals (Zickfeld et al 2021). This implies that this figure of ~220Gt should be regarded as minimum requirement rather than a best estimate.

C.3 Risks associated with CDR

CDR carries its own associated risks and tradeoffs and some proposed solutions are not proven at scale.

Most CDR currently takes the form of conventional afforestation and reafforestation activities; other novel methods like bioenergy combined with carbon capture and storage (BECCS) and direct air capture are only in the early stages of development (Geden & Reisinger 2025).

Some proposed solutions are not proven at scale, may come with serious risks of their own, and may entail trade-offs with other climate and sustainability goals (Dooley et al 2024).

A high proportion of scenario development relies on risky levels of CO_2 removal in terms of impacts on land use, food security and biodiversity (Deprez et al 2024).

D. Enhancing ambition and implementation

D.1 Addressing overshoot in international cooperative efforts

International cooperation to address overshoot and facilitate return pathways to keep 1.5°C in reach needs to tackle issues like the peak warming level and political responsibilities and policies for net-negative emissions.

As part of the international climate negotiations process, there has so far been little discussion of, or agreement on, overshoot and return pathways, including questions of peak warming level, political responsibilities and future policy responses, although some consideration is taking place in expert forums such as the 2025 overshoot conference (Carbon Brief 2025).

While net-zero GHG emissions do imply a temperature decline and could thus be seen as consistent with an overshoot, peak and decline pathway, global net-zero GHG emissions result only in about 0.3°C temperature decline per century (IPCC 2018). This implies that if net-zero GHG emissions remain as the global objective and warming were to peak at, say, 1.8°C, it would take until the second half of the 22nd century for warming to return to 1.5°C.

Accordingly, if 1.5°C is to be kept 'within reach' – consistent with its status as the core temperature goal of the Paris Agreement – then net-zero emissions may no longer be seen as an end-point but merely a transition point to be followed by net-negative emissions, especially for developed countries.

With a rapidly shrinking carbon budget for 1.5°C and in line with the UNFCCC's guiding principles, parties may call for, or need to consider, the initiation of negotiations around net-negative emissions targets as part of NDCs (Mohan et al 2021), including limits to and the feasibility of CDR (Deprez et al 2024).

Notably, in its Climate Advisory Opinion the ICJ found that with "the increased urgency of the climate crisis," the international customary law duties of prevention and cooperation "constitute a legal standard for determining whether any existing forms of co-operation, including treaties and their implementation, still serve their purpose and whether further collective action must be undertaken, including the establishment of further treaty-based obligations" (para. 307).

Clearly, this will require substantial new thinking about policy frameworks and approaches to deliver sustained net-negative emissions, which go beyond polluter-pays and co-benefit narratives (Bednar et al. 2021).

Although it remains controversial, there is also growing interest in, and recognition of, the likely need for some form of solar radiation management ('SRM') as part of overshoot and return pathways (McDonald 2023; Simon et al 2025). Private sector R&D happening this space poses a significant risk and there are substantial uncertainties surrounding the governability of larger-scale interventions.

D.2 Recommendations for the way forward

Enhancing the ambition and implementation of climate action in NDCs and NAPs requires attention to issues of overshoot.

The best available science supports emissions reduction as the lowest-risk, proven pathway for keeping 1.5°C in reach and minimising risks associated with overshoot. Hence in their NDCs, governments should prioritise intense, short-term emissions reductions, including through implementing measures such as phase-out roadmaps to transition away from fossil fuels in energy systems and other sectors of the economy.

Emissions reduction strategies in NDCs should be coupled with CDR, though guided by feasibility and sustainability constraints and appreciating that many technologies are not known to be safe, are not proven at scale or may entail trade-offs with other climate and sustainability goals.

Policies articulated in NDCs and NAPs should integrate equity and burden-sharing between those affected, at local, national and international levels. This is particularly important in a context of overshoot where associated climate risks and impacts are likely to vary considerably across regions and timescales. Equity relies on the collection, analysis, dissemination, management, and use of gender- and age-disaggregated data and gender analysis, taking into consideration multidimensional factors.

Parties to the Paris Agreement should consider what policy frameworks and incentives, including NDCs and NAPs, would enable them to achieve sustained net-negative GHG emissions, noting this will likely pose new challenges and require a different framing than policies for net-zero that ultimately can draw on the polluter-pays principle as an overarching framing.

The potential for long term and ongoing climate risks – even with implementation of 1.5°C return pathways – will require continued and most likely enhanced policy attention to adaptation and loss and damage.

Clear public messaging around overshoot and the risks of exceeding 1.5°C will be crucial for building understanding and public support, with the potential to draw on research across the social sciences and in the area of climate communication to strengthen communication and engagement strategies included as part of NDCs and NAPs.

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