

DISCUSSION PAPER

What does exceeding the 1.5°C limit mean?

At the UN Climate Change Conference in Belém in November 2025, one major topic dominated the agenda: ten years of the Paris Agreement – and therefore ten years of the 1.5°C limit. What also became clear in 2025, however, is that governments have not managed to curb emissions fast enough, and our climate is changing ever more rapidly. As a result, it has become practically impossible to limit global warming to 1.5° C. Yet there remains a chance to temporarily overshoot this threshold before returning to a path of limiting global warming to 1.5° C or even below that by the end of the century.¹

This paper² summarises the latest academic findings in this context and offers guidance on the key questions:

1. [Where do we stand on the 1.5°C limit?](#)
2. [Why is the 1.5°C limit still relevant even in an overshoot scenario?](#)
3. [What are overshoot scenarios?](#)
4. [What should the political response now be?](#)

1 What is the status quo?

In scientific terms: The fight against global warming is also a race against the clock. The quicker emissions reductions are achieved, and the more ambitious those efforts are, the less drastic the need for measures later on this century. In turn, this means that the failure to reduce emissions effectively since the Paris Agreement is forcing us to step up our efforts in this regard even more, both now and in the future.

According to the [Potsdam Institute for Climate Impact Research](#), ‘global greenhouse gas emissions should have peaked before 2020 to keep warming below 1.5°C’. Instead, emissions continued to rise, and it remains to be seen whether 2025 will mark the year in which they topped out. It is highly likely that we will also breach the 1.7°C³ global warming threshold. To keep to this limit, we would have to reduce global emissions by 5% annually – a trend that is simply not being observed, particularly in view of the outcomes from the most recent COP. In plain and simple terms, exceeding the 1.5°C long-term temperature goal⁴, at least temporarily, is now inevitable, likely as early as the start of the 2030s. This means that climate change is progressing more rapidly than has previously been assumed on the basis of moderate scenarios.

¹ This is referred to as climate overshoot and means temporarily exceeding the temperature limit in order to reduce the atmospheric CO₂ concentration again at a later date by taking appropriate measures.

² See also the policy brief published in June 2025: [1.5°C to stay alive: Why we need the 1.5°C limit](#), on which this publication is partly based.

³ The German Federal Administrative Court has defined ‘well below 2°C’ as between 1.5 and 1.7°C.

⁴ Even though the 1.5°C threshold was exceeded in terms of the annual average back in 2024, this does not equate to a breach of the 1.5°C temperature goal as defined in the Paris Agreement. This threshold is based on [an increased in the long-term average temperature](#), in other words over a period of approximately 20 years.

The following scientific findings emerged in 2025:

- [The year 2024 was the warmest ever recorded](#) (with an average temperature of 1.55°C) and the last ten years were the ten hottest since records began.
- The first climate tipping point has been reached with the [widespread mortality of warm-water coral reefs](#) while Iceland views the [risk of the collapse of the Atlantic Meridional Overturning Circulation](#) (AMOC – another tipping point) as an [existential threat](#).
- Every further five-year delay in halving global carbon emissions – by 2040 instead of by 2035, for instance – [could cause a further 200 billion tonnes of CO₂ emissions and warm the planet by an additional 0.1°C](#).
- In order to reduce now practically unavoidable global warming from 1.7°C to 1.5°C, roughly [400 gigatonnes \(Gt\) of CO₂ would have to be removed from the atmosphere by means of negative emissions](#) (more in the next chapter).
- At the start of 2025, [the remaining carbon budget](#) to stay below the 1.5°C threshold amounted to just four years (based on current annual emissions estimates).

Both the [UN Emissions Gap Report](#) and the [Climate Action Tracker](#) (CAT) project global warming at between 2.2 and 2.6°C by 2100 under the current political framework, with the most optimistic scenario standing at 1.9°C. Estimates vary because future temperature increases are determined by the actions we take now. It is still theoretically possible to keep to the 1.5°C limit with limited overshoot measures, but this would only be viable if we were to [more than halve emissions compared to 2019 levels by 2030](#). Against the current political backdrop, and particularly after the outcomes of the last UN Climate Change Conference in Belém, this scenario is extremely unlikely. However, a closer examination of the various pathways also shows that the extent to which temperatures ultimately increase depends on the actions taken by the world's governments. Every tenth of a degree of global warming must be avoided, not only because fewer overshoot measures will be necessary, but also because the impact of climate change will be much less severe and potentially irreversible tipping points will be able to be prevented. However, we must realistically assume that both the 1.5°C and the 1.7°C thresholds will be breached in the coming years.

In political terms: Alongside its three long-term goals⁵, the Paris Agreement is also founded on a cycle of increasingly ambitious climate actions consisting of nationally determined contributions (NDCs) and the [Global Stocktake](#) (GST). The GST tracks the progress of countries around the world in their efforts to meet the goals of the Paris Agreement, sheds light on areas in need of improvement, and identifies the actions that need to be taken. These are then incorporated into the NDCs as part of the regular update process that takes place every five years. The first GST was concluded at COP28 in Dubai at the end of 2023 and found that current actions to mitigate climate change were not sufficient to limit global warming to 1.5°C. In specific terms, it was determined that the signatory parties should triple renewable energy capacity and double energy efficiency by 2030. There was also a resolution to transition away from fossil fuels.

These findings were supposed to be incorporated into the next round of updated NDCs, which had to be submitted in 2025, with ramped-up 2030 goals, ambitious targets for 2035, and clearly defined implementation pathways. In reality, governments only partially delivered on their promises. Before the COP, not enough countries had submitted updated NDCs. While some did meet their obligations during the summit itself (with the number of NDCs submitted by early December up to 122), the NDCs of some 75 other states remain conspicuous by their absence. All in all, the NDCs fall significantly short of the required improvements. Although the [emissions gap has been reduced by 3.4 Gt of CO₂ equivalent \(Gt CO₂e\) by 2035](#) according to the NDC Tracker, [there is still a shortfall of 16.8 Gt CO₂e to remain below 2°C and 27.8 Gt CO₂e to stay under 1.5°C](#).

⁵ [The three long-term goals of the Paris Agreement](#): 1) Limit global warming to well below 2°C, if possible, to 1.5°C. 2) Increase the ability to adapt to the adverse impacts of climate change. 3) Make finance flows consistent with climate goals.

According to the Climate Action Tracker, only [the United Kingdom and Norway have presented 1.5°C-compatible NDCs](#).

There is one glimmer of hope, namely that the renewable energy, [electrification, and energy storage](#) technologies are seeing faster annual growth than was previously assumed, for example in forecasts by International Energy Agency experts. This means that there is a greater chance that countries will exceed their NDCs. However, there are also a number of nations – led by the United States, Russia and Saudi Arabia – that are taking great care to protect the interests of the fossil fuel industry, as reflected by the global impact of the failure of the UN Plastics Treaty and the IMO’s net zero shipping framework, as well as the pushback at COP30 in Belém.

The reality is that the NDCs were not submitted by the required deadline and only make up a small portion of the ambition and implementation gaps. As a result, an important opportunity to inject renewed momentum into efforts to reduce emissions was missed. Nevertheless, the rapid pace of global technological change does give rise to the chance for many states to overdeliver on their NDCs. Yet a powerful alliance of states looking to prolong the fossil fuel industry has formed with the aim of thwarting this opportunity.

The 1.5°C limit was again the subject of debate at the UN Climate Change Conference (COP30) in Belém in November 2025. In the closing text (known as the [Mutirão decision](#)), the states recognised that achieving the 1.5°C pathway without climate overshoot is only possible through ‘deep, rapid and sustained reductions in global greenhouse gas emissions [...] and reaching net zero carbon dioxide emissions by 2050’. They also emphasised that the risks and impact of climate change are much higher at a temperature increase of 2°C compared to a 1.5°C scenario. Realistically, these statements must now be understood to mean that the goal is to return to the 1.5°C limit by the end of the century, after a period of overshoot that is kept as brief as possible. A [Global Implementation Accelerator](#) and the [Belém Mission 1.5°C](#) were also agreed as measures to support implementation.

In legal terms: The 1.5°C limit is legally binding and was confirmed at the highest level of jurisdiction in the world in July 2025. According to the [advisory opinion issued by the International Court of Justice](#) (ICJ), states have the primary obligation under broader international law to prevent significant harm to the climate system and the environment – regardless of whether they are signatory parties to climate agreements or not. States are required to submit NDCs that reflect their ‘highest possible ambitions’, are based on the ‘best available science’, and show ‘best efforts’ from an implementation standpoint. The ICJ reaffirmed that states are not just required to prepare, communicate, and maintain successive NDCs, but that these NDCs must also fulfil the states’ obligations under the Paris Agreement, which means that they must be in line with achieving the 1.5°C limit. The ICJ also confirmed that inadequate NDCs are a violation of international human rights law. In other words, if a state submits an NDC not capable of making an adequate contribution to achieving the temperature goal, a court with the relevant jurisdiction could order the state in question to issue an updated NDC that is ‘in fulfilment of its obligations under the Paris Agreement’.

The ICJ’s advisory opinion is at the heart of a trend whereby, in the face of insufficient political action, human rights case law is playing an increasingly prominent role in driving calls for effective climate mitigation measures. But instead of waiting for the next court ruling, [‘governments should now take steps to uphold the rule of law and assume responsibility for confronting the climate crisis’](#).

2 Why does the 1.5°C limit remain relevant?

Even if we fail to keep to the 1.5°C limit, we must stick with this target so that we can return to it, or even dip back below it, in the future.

1.5°C as a physical boundary: The 1.5°C limit is a **safety rope for human civilisation**. It marks the threshold beyond which the risks to humanity, ecosystems, and social stability, though already severe, can still be mitigated with some degree of probability. This means that, even if we do exceed the limit temporarily, we return to it with the help of overshoot pathways. However, what is also clear is that a world that returns to global warming of 1.5°C will be drastically different and significantly damaged compared to a world that never breaches this threshold in the first place. Some of the changes we experience will be irreparable, including [the loss of biodiversity, changes in marine biogeochemistry, and irreversible melting of major glacial masses](#).

The IPCC has clearly shown that **every tenth of a degree of warming above 1.5°C** leads to an enormous exacerbation of the frequency and intensity of extreme weather events, permanent ecosystem loss, food insecurity, health risks, and social inequality. Beyond the 1.5°C threshold, there is a greater risk of Earth system **tipping elements**⁶ and **non-linear, virtually uncontrollable climate impacts** that could exceed the bounds of human adaptability. Rather than being an 'ideal target', the 1.5°C limit is much more a **risk management backstop** to limit the worst of the damage and maintain scope for adaptation, development, and peace. To put things into perspective, if the temperature of the planet were to increase by 1.5°C, [14% of the global population would be expected to suffer at least one severe heat wave every five years –with this figure rising to 37% under a 2°C global warming scenario](#).

1.5°C as a political, social and economic guardrail: The 1.5°C limit is more than just a physical target, it is an important political, social and economic guardrail (see also Chapter 3 of the [1.5°C paper](#)). It offers a clear scientific framework serving as a basis for national and international climate policy. At the same time, it offers guidance to economic stakeholders. A focus on the 1.5°C limit also means a focus on human rights and human security, as well as the preservation of global livelihoods.

The higher the rise in temperatures, the greater the need to adapt to climate change and deal with climate-related loss and damage. [Scientists estimate](#) that climate change caused USD 2.8 trillion of damage between 2000 and 2019. This figure will only continue to rise in the future, and by a significant margin too. Corresponding adaptation measures beyond the 1.5°C limit must not only begin earlier; they must also be more robust and potent in order to absorb more substantial impacts from climate change. This means that states have to develop adaptation strategies that are more flexible and geared more towards the long term. Transformative adaptation is what is needed, not short-term responses. However, this greater need for adaptation – and therefore the growing adaptation gap – at a temperature increase in excess of 1.5°C comes at a higher cost. It requires climate financing and investment to be stepped up not just nationally, but internationally too. At the same time, it will also lead to a broadening of both the technological gap (e.g. with improved early warning systems) and the institutional gap (e.g. in adaptation planning or crisis management). If these gaps are not closed, the threats to human security and issues of global justice will become more prominent. Global warming acts as another risk catalyst that exacerbates the vulnerabilities and forced migration caused by the climate crisis even further.

⁶ Global warming in excess of 1.5°C gives rise to the possibility of [likely six to ten tipping points](#) occurring. These include the breakdown of the Greenland and West Antarctic Ice Sheets, the death of coral reefs and widespread permafrost thawing.

1.5°C as an international law boundary: Germany and all other signatory parties to the Paris Agreement have made a commitment under international law to restrict global warming to between 1.5 and 1.7°C (according to the German Federal Administrative Court’s definition of ‘well below 2°C’). In its advisory opinion in 2025, the ICJ stated that, in view of new scientific findings, the 1.5°C limit is to be considered legally binding under international law. In 2021, the German Federal Administrative Court – in line with the Paris Agreement – established climate action contributing towards limiting global warming to between 1.5 and 1.7°C as a human rights obligation. In the current geopolitical context, adherence to international law and treaties is particularly crucial in reinforcing the credibility and stability of a values-based multilateral system. Those who undermine the Paris Agreement weaken not only climate action but also trust in international cooperation and the rule of law.

Every tenth of a degree of global warming increases the risk to human security and the environment significantly while also giving rise to the need for costly and laborious measures to bring the climate overshoot back under control.

3 Overshoot scenarios

The concept of climate overshoot, whereby global warming has to be brought back down to 1.5°C, has long been the subject of debate. The most recent IPCC report contains a variety of such overshoot scenarios. In the past, it has not been clear whether such strategies would be required and, if so, to what extent. However, this year it has become clear that climate overshoot is our only viable pathway to remaining under the 1.5°C limit.

On the face of it, this is good news: it is still possible to limit global warming to 1.5°C, in other words after bringing temperature back down to this level, as overshooting means temporarily exceeding the 1.5°C limit. However, this option by no means gives us a free ride on global warming. For such a scenario to be feasible, a great deal still needs to be done to reduce emissions as quickly as possible. That is because climate overshoot is expensive, first and foremost. Not only that, it also requires an enormous amount of energy and, as already outlined in the first chapter, leads to significantly more climate change impacts. What’s more, according to the IPCC, with scenarios peaking above 1.8°C, there would not be enough time to [return to 1.5°C by means of overshoot measures this century](#).

Another issue with climate overshoot is that we are relying on technologies that are not fully mature or are not endlessly scalable. Overshoot measures require CO₂ emissions to be removed from the atmosphere and stored elsewhere, which is where [carbon dioxide removal](#)⁷ (CDR) comes into play. Natural CDR measures include afforestation, reforestation, and the rewetting of moors, while technological approaches include DACCS (direct air carbon capture and sequestration) and BECCS (bioenergy with carbon capture and storage).

There is a limit on natural CDR measures because ever-advancing climate change is hampering the capacity of forests to store carbon and the amount of space available for afforestation is finite. Technical CDR measures, on the other hand, have not yet reached a stage at which they can be rolled out on a widespread basis. [Experts](#) currently believe that this won’t be the case until the end of the century. Of course, it remains to be seen whether there will be any unforeseen technological breakthroughs in the coming years and decades that will open the door to large-scale, comprehensive overshoot measures. However, it is worth considering that the limited number of secure storage facilities, lack of social acceptance, and questions over economic feasibility mean that there is an [upper limit on such solutions](#).

⁷ CDR can be used not only to correct a temporary overshoot of emissions, but also to compensate for unavoidable residual emissions and fulfil the legal requirements for net negative emissions in Germany and the EU. This arises in the context that other countries will probably need longer than 2050 to reduce their emissions to zero.

This means that the reliance on overshoot measures must be kept to a minimum. Rapid and comprehensive action to reduce emissions means less risk but also lower future dependency on expensive, complex, and unproven CDR measures. Should emissions not decrease by a huge margin in the coming years ([a reduction of more than 50% by 2030 compared to 2019 levels](#)), overshoot of more than 0.1°C will be inevitable. [Experts](#) believe that some 220 Gt of net negative emissions are required to reduce the average global temperature by 0.1°C. By way of comparison, [global emissions totalled 57.7 Gt CO₂e](#) in 2024 alone.

As outlined above, in view of current political processes, we are on target for global warming of between 2.2 and 2.6°C by the end of 2100, even if we meet climate goals and don't consider the possible knock-on effects of climate change. The technical, economic, and social pathway towards reducing global warming by up to 1.1°C is entirely unknown. The question of who is going to foot the bill for these measures (should they even be possible) also remains unanswered. Governments should therefore introduce mechanisms under which companies – particularly major emitters – can be held accountable for past and future climate damage and enforce effective regulation to prevent them from causing further damage. In its advisory opinion, the ICJ makes it clear that states must regulate their fossil fuel sectors and hold them accountable for climate damage – or assume responsibility themselves.

4 What needs to happen now?

There's no doubt that the 1.5°C limit must continue to guide our actions. Permanently exceeding this threshold means entering an [area of high risk](#), not only in terms of the possible impacts of climate change (including extreme heat, drought, water shortage, flooding, and land degradation) but also regarding the increasing likelihood of reaching irreparable tipping points in the Earth's climate system.

The most effective and unavoidable means of combating climate change is the rapid reduction of global greenhouse gas emissions. That's why the following actions are required now:

- **We must place phasing out fossil fuels at the forefront of political debate.** Instead of pursuing any further expansion of coal, oil, and gas infrastructure, there must be a concerted push to transition away from fossil fuels.
- **We must continue to drive the expansion of renewable energies and the associated infrastructure.** Fossil fuels must be systematically replaced by renewable energies. There has been exponential growth in renewables in the past few years, raising hopes that fossil fuels can actually be abandoned for good. In 2024, renewables accounted for [92.5% of global power additions](#).
- **We must push for widespread electrification.** Electrification massively reduces the amount of primary energy that is required. Electric cars and heat pumps, for instance, use around four-fifths of their energy to provide the service they are designed for (driving, heating, or cooling), whereas combustion engines and conventional heating systems lose roughly the same amount of energy as waste heat. Electrification is also crucial in the ability to utilise renewable energies in various sectors of the economy (such as power, transportation, industry, or building facilities). It is feasible in the vast majority of industries but requires a comprehensive overhaul of such systems. The quicker this happens the better.⁸

As a critical benchmark for avoiding dangerous climate change, the 1.5°C limit has been internationally agreed and recognised at the highest level of jurisdiction in the world. This means:

- **Despite climate overshoot, the 1.5°C limit must remain at the forefront of all negotiations and discussions.** The UN Climate Change Conference in Belém showed that the 1.5°C limit remains an important reference point, particularly when it comes to considering whether climate

⁸ More information on which electrification measures have to be implemented in which sector can be found [here](#) (Chapter 2).

action is sufficient to remain on track for the 1.5°C target. It could become relevant for compensation claims further down the line too.

- **Multilateralism must be strengthened further.** This also includes [reforming the international climate policy process](#). Ten years after the Paris Agreement, the first steps were taken to develop the architecture of the process in Belém. Now that the Paris rulebook has been fully agreed, attentions must turn to effective implementation and pushing for powerful coalitions to take the lead on the issue, systematic monitoring, and robust accountability mechanisms. The most effective way to achieve such a reorientation would be through genuine reforms, including revising decision-making structures – particularly the principle of consensus – and adjusting the frequency and format of negotiations to ensure that the process is fit for purpose. Given how unlikely it is for consensus to be reached on such reforms within the framework of the UNFCCC, it should be investigated whether the UN General Assembly can pass resolutions by majority and introduce the necessary reforms in that way.
- **Countries taking the lead on climate change must come together.** In the first week of COP30 Belém, some 90 states joined forces to come up with a roadmap to phase out fossil fuels within the next two years. Although this commitment was not included in the final decision text (thanks predominantly to efforts led by Saudi Arabia and Russia to stymie the move), it still provides a glimmer of hope, particularly if the momentum generated as a result can be acted on and the target defined at the summit can have an impact outside of UN climate conferences.
- **Adequate financing packages must be created.** Vulnerable states must receive financial support as they transition to an environmentally friendly energy system and transform their economy, particularly when it comes to dealing with the ever-increasing impact of climate change. Responsibility for providing this assistance primarily lies with countries with (historically) high emissions and income levels. [Adequate climate financing](#) is also the basis for poorer and less developed nations being able to pursue an environmentally friendly pathway and adapt to the effects of advancing climate change.

Temporarily exceeding the 1.5°C limit means improving climate risk management and placing a greater focus on effective climate adaptation. An early warning system should be established to detect when tipping points are crossed, coupled with effective response measures for relevant institutions to implement.

The realisation that the 1.5°C limit cannot be met without climate overshoot must now lead to decisive and comprehensive action to reduce emissions and adapt to the situation. We therefore find ourselves at a critical juncture. The actions we take now will have a huge impact on what happens in the future. In turn, half-hearted efforts to reduce emissions will mean a greater impact on the climate and high costs for adaptation and overshoot measures.

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Edited by: Nikola Klein

Suggested citation: Uhlich, T. et al., 2025, What does exceeding the 1.5°C limit mean?, Germanwatch, www.germanwatch.org/en/93461.

Download this document at: www.germanwatch.org/en/93461

December 2025

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Financially supported by Klima-Allianz. Responsibility for the content rests with Germanwatch.

