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PROVIDE

Policy brief

The Risks of Temperature Overshoot

Carl-Friedrich Schleussner, Sylvia Schmidt, Uta Klönne

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Current policy trajectories are inadequate to stay below 1.5°C

We need to peak emissions before 2025 on the way to roughly halving GHG emissions by 2030 to minimise the risk of overshooting the Paris Agreement's 1.5°C limit. However, current policies and pledged Nationally Determined Contributions (NDCs) are inadequate achieve any of these milestone[i]. Urgent and stringent action is needed.

If 1.5°C was surpassed, any 'overshoot', needs to be limited, and global temperature must be brought back down again in the long term in line with the Paris Agreement. Scenarios which illustrate such a trajectory in which warming peaks slightly above 1.5°C before descending below again, are referred to as climate overshoot scenarios.

To meet the Paris Agreement, any potential overshoot above 1.5°C must remain "well below 2°C". Which can be interpreted as peak temperatures (best estimate) should not rise beyond around 1.6°C milestone[i].

Every fraction of a degree matters – and this is true for overshoot too. This is because relatively small differences in warming rates over the next decades, and in absolute warming, would have significant climate impact implications[i].

While there is no doubt that stringent mitigation in the near-term is our best chance to limit or even avoid any temperature overshoot, even the most stringent mitigation pathways may result in a temporary overshoot.

Key levers to reduce overshoot risks

To limit overshoot risks, stringent emission reductions before 2030 are essential. Key levers to reduce the risks of overshoot include:

Stringent reductions in near-term emissions

Emissions reductions before 2030 are decisive to limit overshoot risks. The IPCC Sixth Assessment Report (AR6) provides emission reduction benchmarks for no or limited overshoot pathways that limit both the probability and the potential magnitude of an overshoot.

They require peaking in global greenhouse gas emissions before 2025 and rapid, deep and sustained reductions in global greenhouse gas emissions thereafter.

By 2030, global greenhouse gas emission would need to be reduced by 43 per cent by 2030 and 60 per cent by 2035 relative to the 2019 level. Net zero CO2 emissions need to be reached by 2050 and emissions of all greenhouse gases shortly thereafter, around the early 2070s[ii].

Reduction of non-CO2 gases

Stringent near-term mitigation of non-CO2 GHGs like methane play a critical role in limiting and delaying temperature overshoot. Due to the short lifetime of methane in the atmosphere, reducing methane would have a rather direct effect on the warming trend over the next 20 years, and counter-acting any warming effect of reduced air pollution[i].

Emission reductions in line with 1.5°C pathways require a reduction of at least about 34% below 2019 levels in 2030 and about 40% by 2035[i]. The more stringent methane emissions are reduced, the more effective near-term warming can be reduced.

Sustainable carbon dioxide removal

In order to bring down temperatures we will need to scale up carbon dioxide removal to achieve net-negative emissions, which would lead to long-term temperature decline[iii]. But there is a limit to how much CDR we can feasibly deploy with competing needs like food production. That's why CDR can't be used to offset a lack of emissions reductions – we will need it for hard to abate emissions.

The amount of CDR needed to achieve net zero CO2 strongly depends on the stringency of emission reductions. More stringent emission reductions can effectively limit the reliance on CDR[iv].

The other factor is how our climate responds – which isn't 100% certain. Achieving net zero greenhouse gases would hedge against the risks of temperatures increasing if the Earth's response to emissions is on the stronger end of the assessed range[v].

Adaptation implications

Any overshoot – no matter how temporary - would strain human and natural systems, and ultimately reduce our abilities to adapt to climate change[vi].

Slowing down the pace of warming offers additional time for adaptation and climate resilient development, with or without overshoot[i]. In that time, certain natural systems would have a better chance of adapting to higher temperatures.

Long-term adaptation planning needs to take into consideration that some impacts that are triggered at higher temperatures will be irreversible. So while we might be able to draw down temperatures, you would leave behind a permanently changed world. This is particularly true for sea-level rise[vii].

Loss and Damage implications

Climate overshoot would significantly increase loss and damage in the next 30 years[viii]. For instance, if global temperatures rose by 1.7°C rather than 1.5°C by 2050, the additional 0.2°C warming could increase the number of people exposed to heatwaves by around one third in several countries across the world. Meanwhile, if warming reached 1.8°C in 2050, the additional 0.1°C temperature rise could increase these numbers by 10% or more[i].

Reducing global temperature after an overshoot will not re-establish previous environmental conditions. Crossing certain temperature thresholds would cause irreversible impacts. For example, glacial loss would lower seasonal water availability, resulting in droughts, crop failure, food insecurity, heatwaves, and possibly subsequent migration, which could affect billions in the Upper Indus Basin[vi]. Temperature overshoot would also lead to irreversible loss in marine ecosystem habitability[ix].

Reference notes

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