

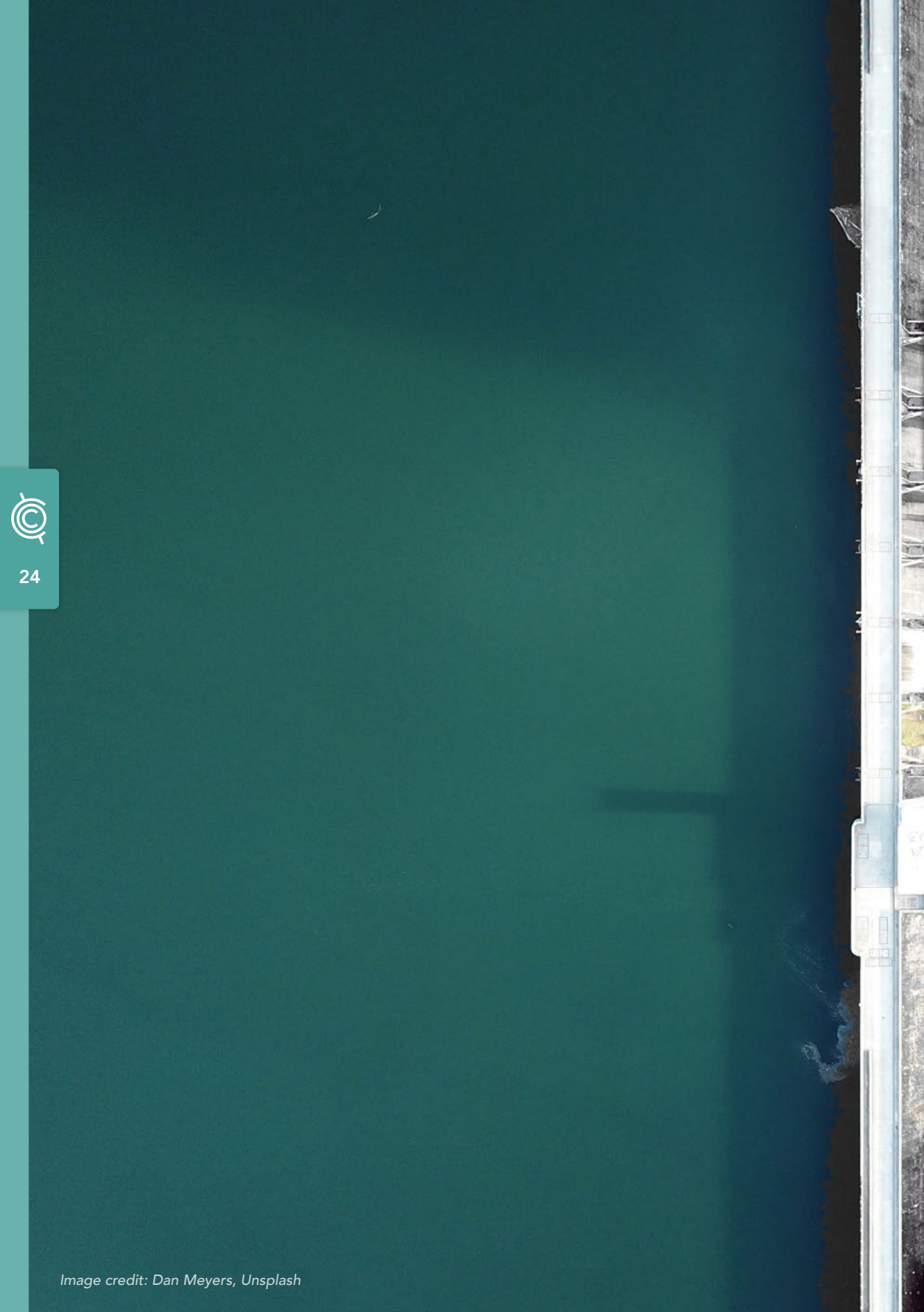


REDUCING THE RISKS OF
CLIMATE OVERSHOOT

Climate Overshoot

02

SEPTEMBER 2023





1. Introduction



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Key messages

- ✓ Limiting warming to 1.5°C remains an essential goal, but the risks of overshoot are high and rising.
- ✓ Governments, the private sector and civil society need to take action to reduce the probability, magnitude, and duration of any overshoot.
- ✓ Cutting emissions is the clear priority for action, but complementary approaches should be pursued.

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It was a historic moment. On 12 December 2015, after two weeks of intense negotiations in Paris, world leaders at the twenty-first United Nations (UN) Climate Change Conference of the Parties (COP21) reached a breakthrough: the Paris Agreement. This is a legally binding international treaty that includes an overarching long-term goal to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels” and pursue efforts “to limit the temperature increase to 1.5°C above pre-industrial levels.”¹ It was hailed as a landmark achievement, a sign of hope and solidarity in the face of a common threat. Since the Paris Agreement, the world’s scientists have provided ample evidence that 2°C warming would present profound risks, and the priority must therefore be to avoid breaching 1.5°C.²

The global climate conversation has dramatically changed since then. International negotiations have continued on the rules and how to implement them. But eight years later, warming continues too rapidly. The global temperature has already risen by about 1.2°C,³ and the UN Environment Programme (UNEP) warns that current policies will lead

to a 2.6°C temperature rise by the end of the century.⁴

So, humanity faces a question. Can we summon the pragmatic spirit of Paris and succeed in limiting temperature rise? There are numerous opportunities before us, which could not only curb the impacts of global warming but also help usher in a more just and equitable international system.

At the same time, there is no doubt as to the magnitude of the task – and the urgency of getting it right.

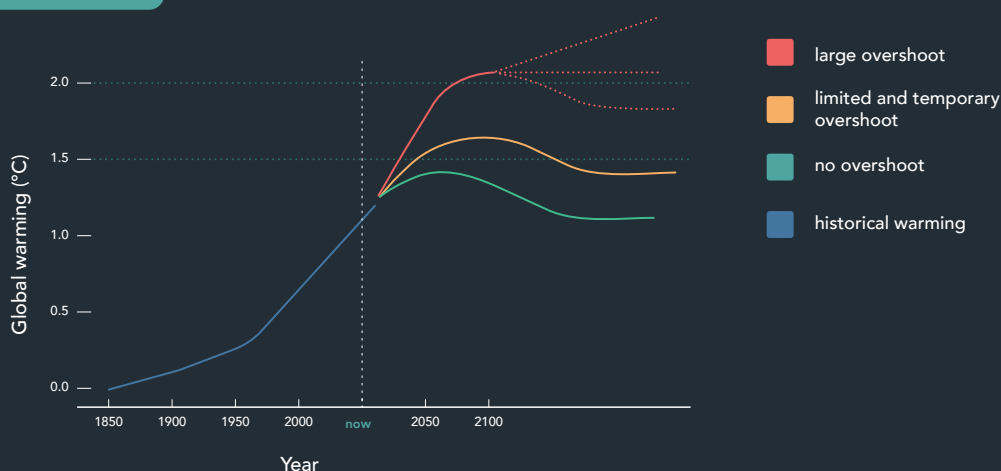
The 1.5°C goal is not just a number. The international community set this limit to signal the point beyond which it considers the risks of climate change to be unacceptable. The Climate Overshoot Commission understands “climate overshoot” to mean crossing this threshold. (See Figure 1.)

No country is being spared from the harm that climate change is already causing or from the increased risks that would come from additional warming. However, the least industrialized countries are generally more vulnerable and hence will suffer the most, even though



FIGURE 1

The concept of climate overshoot.



they have contributed the least to the problem. That is why climate change is an issue of justice. Because failure to act today would exacerbate future risks, it is also an intergenerational issue. And because impacts undermine the full enjoyment of human rights, climate change is a human rights issue.

Even at warming of 1.2°C, climate change is already having an impact everywhere: ice caps are melting, seas are rising, and weather extremes such as droughts, floods and fires are worsening.⁵ These are jeopardizing billions of lives and livelihoods, especially in the most vulnerable and marginalized communities.

These risks will only intensify as the planet warms further and could trigger cascading and potentially irreversible harm to ecosystems, human health, food security, water availability, and social stability.

None of this is inevitable. The world has a wealth of tools with which to fight climate change; what is needed is the political will to apply them. The responsibility of policy makers is to show the benefits that climate action would bring and to help summon that

will, while putting the interests of the poor first. Those who have contributed the least to the problem should not pay the highest price for it.

This is the starting point for the Global Commission on Governing Risks from Climate Overshoot – the “Climate Overshoot Commission” – an independent group of global leaders who have come together to consider the potential benefits, opportunities, and risks of a wide range of climate action approaches to minimize further increases in global temperatures and to reduce and manage the heightened risk of overshoot.

With this report, the Commission offers an integrated strategy for reducing the probability of breaching the Paris Agreement’s goals, and limiting and managing the risks brought about by an overshoot should it take place.

At the most basic level, the world must do much more to cut greenhouse gas emissions as quickly and as deeply as possible, in order to avoid an overshoot. Every fraction of a degree matters.

Emissions continue to rise, however, and the remaining carbon budget for limiting warming to 1.5°C is shrinking, despite more than 30 years of effort and progress in some areas, and despite the manifest benefits of decarbonization. (See Figure 2.) The Commission recognizes that the risk of climate overshoot is significant and imminent and requires us all to act now.

That is why the Commission examines all the potential tools in the toolbox, including those that were not significantly discussed when the Paris Agreement was negotiated.

As a starting point, this requires understanding what the approaches are, evaluating their potential, their limitations and their interdependencies, and exploring policies to maximize their benefits. Not all will be adopted, and some may be rejected as impractical, too costly, or too risky. All should be considered, however.

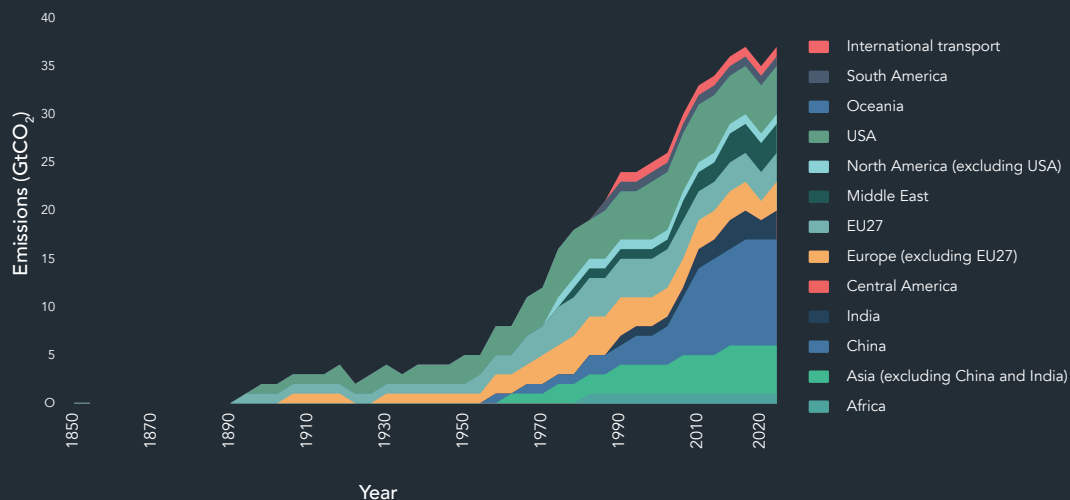
None of these questions are simple or straightforward. In many cases, decisions go well beyond technical expertise, and enter the realms of politics, ethics and philosophy. What kind of a world do we want? What lines must we not cross? In all cases, finding answers requires listening to a wide range of viewpoints often poorly represented in policy discussions. And governance structures – some novel – should be created to do so meaningfully and effectively.

The Commission embraces these complexities, as negotiating them is the only route to effective, just, and equitable action that benefits all people and the planet.

There is a better world on offer, should we choose to grasp it. But getting there will require faster, deeper, and better governed climate action, and a focus on what is doable. The Commission hopes this report highlights the dramatic benefits such action would bring and inspires a new way of acting to safeguard our shared future.

FIGURE 2

CO₂ emissions to date.⁶



2. The Origins of Climate Overshoot



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Key messages

- ✓ Thirty years of climate policy and action have brought about significant progress but have also fallen short in key areas and produced insufficient results.
- ✓ The primary reason for climate change – and the growing risk of overshoot – is a continued reliance on fossil fuels.
- ✓ Climate change has contributed to growing international tensions.
- ✓ Finding the requisite political will to fight climate change requires new approaches and action grounded in justice and equity.

The story of our collective lack of sufficient action on climate change is complex, involving politics, economics, justice, and more. It is also one of missed opportunities and vested interests.

It is a story that reveals the limits of our current institutions to deal with a problem that transcends borders and generations, as well as a collective failure to adequately envisage the healthier and happier world that concerted action could achieve.

The first part of the story is about recognition of the problem and attempts to solve it.

The UN Framework Convention on Climate Change (UNFCCC), adopted in 1992, remains the foundational international treaty on the issue. It set out the objective of stabilizing greenhouse-gas concentrations in the atmosphere at a level that would prevent dangerous harm. It also recognized the principle of “common but differentiated responsibilities,” meaning that developed countries should take the lead in reducing emissions and provide financial, technological, and capacity-building support to developing countries.⁷ These tenets still hold today.

The UNFCCC treaty has been followed by yearly rounds of negotiations and agreements, with important steps taken in meetings in Copenhagen in 2009 and Cancún, Mexico, in 2010, culminating with the Paris Agreement in 2015. The Paris Agreement functions as a “regime complex,” where the global objective of holding temperature rise to well below 2°C works as the umbrella and is part of the “top-down” dimension. It is based on national pledges – Nationally Determined Contributions (NDCs) – that gradually ratchet up in ambition. Although the pledge-making process is legally binding, meeting those pledges is not, and individual countries deter-

mine the content of their NDCs (subject to an expectation that ambition will rise). This arrangement is complemented with legally required regular processes for transparency and stocktaking.

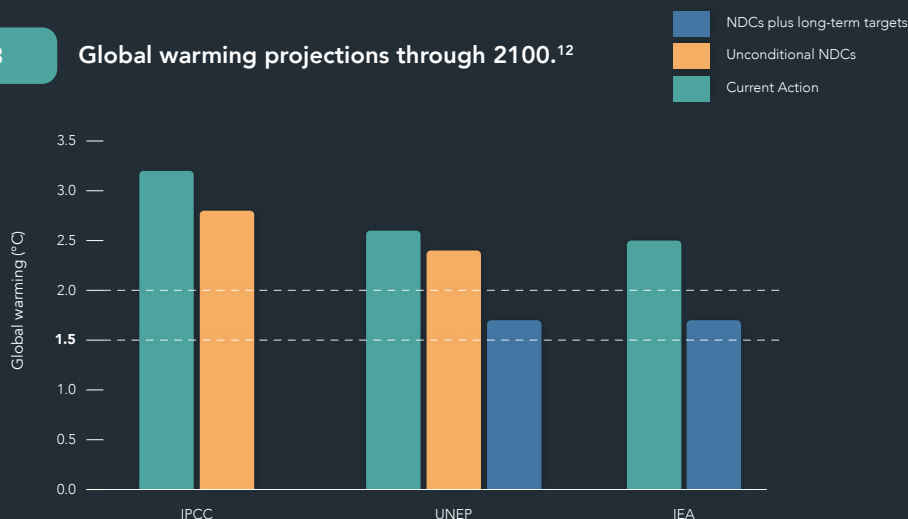
The second part of the story is about the insufficient progress in implementing these commitments.

Since 2015, the world has witnessed a remarkable shift in the direction and momentum of climate action. Many countries are strengthening their commitments, with nearly all industrialized countries having committed to achieve “net zero” emissions, mostly by 2050 and – to varying extents – through binding laws.⁸ An increasing number of countries – including most high-income countries – are succeeding in lowering their emissions even while their economies continue to grow.⁹ Some countries are industrializing in ways that are less emissions-intensive than in the past.

New initiatives have been undertaken, such as the alignment of the portfolios of multilateral development banks (MDBs) with the Paris Agreement, International Maritime Organization negotiations to reduce emissions from shipping, and further reductions in hydrofluorocarbon use through the Kigali Amendment to the Montreal Protocol. Additional action has come from informal coalitions such as the Network of Central Banks and Supervisors for Greening the Financial System and the Glasgow Financial Alliance for Net Zero. Indeed, global emissions may have recently peaked.

Expected global warming by 2100 has fallen from a projected 3°C to 4°C increase – an apocalyptic scenario that was still plausible a few years ago – to a rise of 2°C to 3°C.¹⁰ But that is still far too high. (See Figure 3.) On World Meteorological Day 2023 the UN Secretary-General, António Guterres, warned:

FIGURE 3

Global warming projections through 2100.¹²

“Every year of insufficient action to keep global warming below 1.5°C drives us closer to the brink, increasing systemic risks and reducing our resilience against climate catastrophe.”¹¹ We must heed this warning and maintain the pressure for more action. The world is probably not going to stop acting altogether but cannot afford to be complacent.

The world needs more – and quicker – progress. The unfortunate fact is that the chance of overshoot is high and increasing. The Intergovernmental Panel on Climate Change (IPCC) concludes that even under the most optimistic scenarios, it is “more likely than not” that we will exceed 1.5°C.¹³ A resilient, liveable future is still available to us, but there is a rapidly narrowing window for humanity to take decisive action. Reaching our targets is made more challenging by the fact that humans’ otherwise harmful aerosol pollution in the lower atmosphere actually cools the planet and masks some warming, estimated to be 0.7°C globally.¹⁴ As we reduce this pollution, this suppressed warming will be unveiled.

The third part of this story is about the opportunities and challenges of implementing climate change solutions.

The opportunities are massive. Innovation has dramatically lowered the cost of alternatives to fossil fuels, especially solar and wind energy, making them competitive with or cheaper than fossil fuels in many markets. Between 2010 and 2021, the cost of solar projects fell by 88 percent and the cost of onshore wind by 68 percent.¹⁵ China has been a driving force behind these cost reductions.¹⁶ As a result, global renewable energy capacity has been forecast to grow by almost 75 percent between 2022 and 2027, accounting for more than 90 percent of global electricity capacity expansion over that period.¹⁷ China is also leading the world in its deployment of electric vehicles.

Countries are also taking enormous strides in improving energy efficiency. India’s Unnat Jyoti by Affordable LEDs for All program, for instance, is now the world’s largest zero-subsidy domestic lighting program, addressing high electrification costs and high emissions from inefficient lighting. The program has distributed nearly 370 million LEDs since 2015 and helped reduce the cost of LED bulbs by 85 percent.¹⁸



“

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The European Union (EU) and the United States (US), with their FitFor55 and Inflation Reduction Act legislation, have put in place comprehensive – yet different – policies to accelerate the transition to clean energy.

The benefits that could be derived from a low-carbon economy have become clearer, as many authoritative bodies have emphasized, including the New Climate Economy Commission.¹⁹ These benefits include not only avoiding the worst impacts of climate change, but also creating jobs, improving health, reducing inequality and enhancing resilience.

The climate movement has steadily been growing. Constituencies – especially young people – are energized and putting pressure on governments all around the world. The urgency is shared at all levels of development and across geographies. India, for instance, is the prime mover behind the International Solar Alliance to promote solar power in tropical countries. Climate change is central to the international agenda.

Yet the gap between goals and reality remains. Key issues to address include:

✓ The collective action problem:

Climate change is a global problem that requires global action and cooperation. The Kyoto Protocol “top-down” efforts to advance emissions reduction commitments from countries fell short in terms of participation and had little impact on emissions.²⁰ The commitments that countries were willing to make were too weak, the prospect of noncompliance led to Canada’s withdrawal and the US, a key player, refused to join.

The hybrid approach pursued by the Paris Agreement – a mix of top-down and bottom-up – sought to reverse this dynamic. The Agreement and its temperature goal became the reference point for all actors around the world, from national governments to cities, private finance, corporations, and others. The Paris Agreement serves as the umbrella under

which institutions outside of the UNFCCC and different sectors can identify the agreements, pathways and tools necessary for them to meet the Paris goal. This is complemented by the Paris Agreement's mandated regular cycle (the "ratchet process") of NDCs to become more ambitious over time, as economies, technologies and societies advance.

The Paris Agreement was a big step forward, with a strong collective decarbonization commitment. Nevertheless this should be a living and learning framework. It has to be completed under this overarching umbrella by adequate mechanisms, continuing to strengthen existing ones such as amendments to the Montreal Protocol, the International Maritime Organization, the Financial Stability Board, and the climate chapters of the different summits; and new ones, such as methane agreements, or treaties on forest or ocean protection.

✓ **The lock-in effect:**

Industrialization has been driven by fossil fuels that were cheap only because their full environmental and social costs were not apparent for many years, and because governments had subsidized them. Over time, fossil fuel use became deeply embedded in modern production processes and consumption patterns, creating path dependencies that resist change. Fossil fuel companies are powerful and highly mobilized to push back against climate action. They have significant organizational and political advantages compared to the general public as well as strong incentives to oppose measures that would put a price on carbon or otherwise constrain fossil fuel use. They frequently succeed in blocking strong national climate policies by lobbying governments and officials and producing misleading public communications, weakening global climate action. In addition, governments seeking to

phase out public subsidies often face stiff resistance.

✓ **The equity gap:**

Developed countries have contributed more to the problem and are less vulnerable to its impacts – even if they are not immune. Developing countries have contributed less and are more vulnerable, while having less capacity to adapt or cut emissions. The interests of the most industrialized countries disproportionately drive the agenda, while those of low- and middle-income countries are frequently overlooked, ignored or treated as less important. Despite their financial means, industrialized countries have not made it a priority to meet the least industrialized countries' critical need for climate finance. The poorest countries, with limited financial resources, feel that they have to choose between cutting emissions and other pressing issues such as reducing poverty.

Large emitters and industrialized countries across the North and the South who have the capacity to do more must not escape their responsibility to reduce emissions more quickly. Failures to fully address the needs and responsibility of all countries have contributed to an erosion of trust within international climate negotiations and made climate cooperation even more difficult to achieve. As economic growth has increased in large parts of the developing world, global agreement on differentiated burden-sharing has become more difficult.

✓ **Behaviour and lifestyles:**

The choices that people have made, individually and collectively, especially consumers in developed countries, have contributed to the climate crisis. But we can make choices that are more sustainable and help reduce emissions. Initiatives that motivate people





Image Credit: Vincent ma janssen, Pexels

to adopt environment-friendly behaviour and take simple yet meaningful actions in their daily lives to reduce their environmental impact should be encouraged. Public policies can provide positive incentives, appropriate infrastructure and institutions, and market opportunities.²¹

The final part of this story is yet to be written.

It will depend on whether the world can overcome the barriers and challenges that have prevented stronger action thus far. And it will depend on summoning the political will to act, and mobilizing the necessary public support, financial resources, and technological innovation.

There are some reasons to be optimistic. It is not a small achievement that, in the years following the Paris Agreement, public policies around the world have moved, even if insufficiently, in a better direction.

This may be the first time in human history that a global agreement has triggered such multifaceted and distributed policy changes and provides some grounds for optimism. Let us not underestimate what has been achieved, even while recognizing how much yet needs to be done, and how quickly.

How do we wish to be remembered? As the generation that shied away from the challenge, and the opportunity, of our age? Or as leaders who, when tested, lived up to the moment and laid the groundwork for a better future?

We know more action is possible and that the problem in front of us is solvable. The Climate Overshoot Commission challenges those in positions of responsibility and leadership, in government, in business, in civil society, to seize the opportunity and act.

3. Expected Impacts from Climate Overshoot



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Key messages

- ✓ Climate impacts and risks are already severe at 1.2°C warming, and they are increasing.
- ✓ Heat-related impacts, extreme weather events, and sea level rise pose direct threats to the health, security, and economic well-being of all countries and communities.
- ✓ The damage caused by an overshoot will depend on its size and its duration. Every tenth of a degree matters. The greater the overshoot, the worse the impacts.

In August 2022, a month after a record-breaking heat wave scorched southern Pakistan, the skies opened up and unleashed a torrent of rain. The monsoon season, which usually brings replenishment to the parched land, turned into a nightmare. The rain was too much, too soon. The Indus River overflowed its banks, dams were breached, drains clogged and burst, and the water swept away everything in its path: houses, crops, roads, bridges, cars, animals, people. One-third of the country was submerged.



The floods were the deadliest and costliest in Pakistan's history, claiming more than 1,700 lives, displacing millions of people, and destroying crops and infrastructure worth roughly 30 billion USD.²² They were partly caused by a combination of factors that were influenced by climate change: higher temperatures, more moisture in the atmosphere, more variable rainfall patterns, and more extreme weather events.²³

Since the Climate Overshoot Commission was launched in early 2022, many members have witnessed first-hand the wrath of a warming planet. As the Commission completed its report, several days in July and August exceeded multiple global temperature records on the planet.²⁴ If anyone doubted the potential costs of climate change, those doubts have been increasingly difficult to maintain.

In different combinations, more frequent and more intense heat waves, droughts, wildfires, crop failures, storms, and disease are all affecting every region of our fragile planet.²⁵ They form an alarming pattern of increasing climate variability and extremes that will only worsen as the world continues to warm, posing rising threats to human health, food security, water security, economic growth, social stability, and ecosystem integrity.²⁶

The impacts of overshoot would depend on how much and for how long we exceed temperature goals. The impacts of greater warming, such as 2°C, would be substantially more severe.²⁷ In all cases, they would be felt most directly at the local level, where communities and habitats would suffer in different ways depending on their location, vulnerability, and capacity to adapt. Climate change would undermine all of the Sustainable Development Goals (SDGs).²⁸

This section explores some of these expected impacts across six dimensions: **heat, extreme weather events, public health, ecosystems, and possible irreversible and catastrophic changes in natural systems** – called tipping points by some.²⁹

The aim is not to preach doom but to illustrate the likely consequences of our collective choices and actions. The climate crisis was not inevitable; it is a result of human decisions and behaviours. Humanity still has the time and opportunities to change course. But we need to act fast, and decisively.





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Image credit: Hasanuzzaman Himel, Unsplash

Heat

The most direct and significant impact of climate overshoot, is excess heat. The ramifications of rising heat harms those in already warmer climates - most countries are not prepared for a hotter world.

Extreme heat and heat waves pose direct threats to people, causing heat stroke and exacerbating respiratory and cardiovascular diseases. People who are already vulnerable are particularly at risk. Extreme heat events can be fatal.

More heat would cause serious harm to food production and security, especially in regions where crops are already near their thermal limits. It would raise water demand for irrigation and increase evaporation, exacerbating water stress in many regions.

An increase in global electricity demand for indoor cooling would put added strain on grids and push up electricity prices, especially in developing countries.

More heat would also affect economic productivity and growth. Outdoor workers in sectors such as agriculture, construction, and tourism would face reduced working hours and increased health risks. School would be more difficult to attend.

Here again, the gap between rich and poor countries is likely to rise. Within countries, people living in marginal areas with limited access to resources and services would suffer most – from heat-related illness and death, food insecurity, water scarcity, and income loss.

Hotter conditions tied to overshoot would increase the likelihood of large-scale inter-group conflicts, including civil wars, in Africa and elsewhere.³⁰ For instance, climate change is driving desertification in the Sahel, reducing the availability of water and land for agriculture and pastoralism. Scarcity of resources has led to conflicts between farmers and herders – conflicts that terrorist and non-state armed groups have exploited. These clashes in turn have displaced millions of people, creating humanitarian emergencies and undermining political stability and governance.

Areas currently on the margins of human habitability may become uninhabitable as increased wet-bulb temperature – a measure of combined heat and humidity – forces people to adapt or if that is not a feasible option, to migrate. Ecosystems currently experiencing heat stress may not survive in their present form.

Rising sea levels would erode coastlines, cause flooding and salinization, and damage infrastructure and ecosystems. People on small islands face existential risks from sea level rise that threatens their islands' habitability and their economic foundations, confronting them with the unwelcome prospect of migration. (See Box 1.)

Ocean warming, which contributes to sea level rise via thermal expansion, will also intensify tropical cyclones, disrupt marine ecosystems and increase the risk of coral bleaching. People will suffer economic dislocation and food insecurity caused by disruptions to fisheries.

Extreme weather

Overshoot would entail more extreme weather events such as storms, heavy rain, drought, wildfires, and coastal flooding.

Small islands, which already suffer damage from tropical cyclones, would face an even greater threat from more intense storms. Increasing drought conditions would plague Africa as well as Central and South America, aggravating water scarcity, reducing crop yields and making fisheries less productive. Flooding would pose growing threats to inland and coastal communities in Asia. Increased flooding and droughts would also cause harm in Europe and North America. Lost livelihoods and the related economic harm would exacerbate poverty.

Again, these shocks would be felt unevenly across the world but most severely in the poorest countries and regions. Developing countries are more physically exposed to climate hazards, as many are located in regions with higher temperatures, more variable rainfall, and lower elevation. They are also more economically vulnerable to climate risks and less able to adapt to climate impacts, lacking the financial, technical, and technological resources needed to reduce

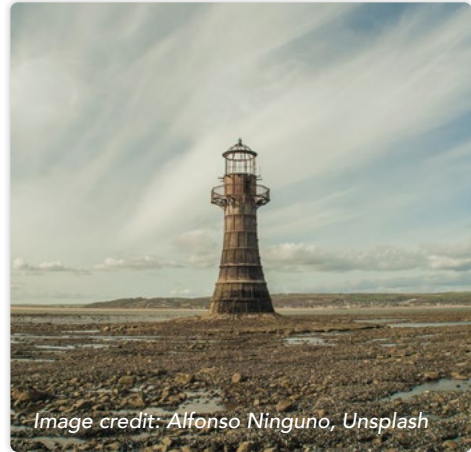


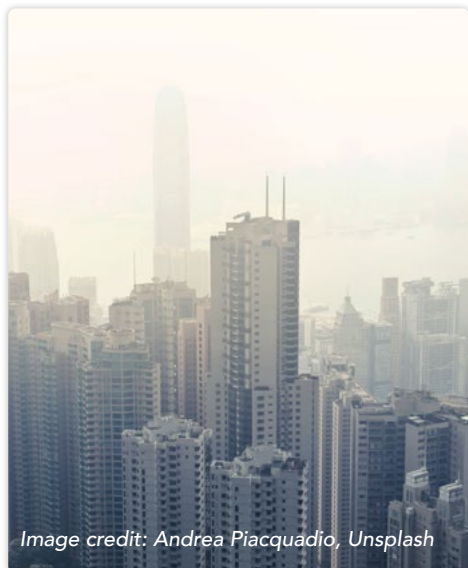
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their exposure and vulnerability, enhance their resilience, and recover from shocks.

Developed countries would not be spared the impacts of climate overshoot, however. They are also exposed to climate hazards such as worsening heat waves, droughts, floods, and storms. In Europe, increased coastal and inland flooding would cause damage and disruption, and increasing droughts would reduce water availability and food production. Worsening droughts in North America would pose growing risks to water, food, and energy security. This year, wildfires in Canada have cost billions of dollars and blanketed large swathes of North America with polluted air. Increased fire risk has already made many Californian homes uninsurable.³¹

While the greater adaptive capacity of developed countries would enable them to cope with climate harm more readily than their counterparts in the South, rich countries also have limits and barriers to adaptation. Their economies are vulnerable to climate risks and extreme events that can disrupt complex and interconnected systems on which they rely. Overshoot would curb economic growth and cost jobs throughout the North.³² Developed countries would also face increasing pressures from migration, conflict, and humanitarian crises.

Public health

These same climatic trends would threaten global public health, increasing people's exposure to infectious diseases, malnutrition, mental stress, and air pollution.

The conditions for disease transmission would worsen. People in Central and South America and Africa would be at increased risk of epidemics including malaria, dengue, and other mosquito-borne diseases. People in North America and Europe would be at increased risk of Lyme disease.



The global population at risk of undernutrition would increase, posing a threat especially to children and pregnant women in low-income countries, where food insecurity is prevalent and climate sensitive. More extreme weather events like heat waves, wildfires, storms, floods, and droughts would jeopardize public health and safety. Wildfires, for instance, produce smoke and haze that can travel long distances and harm large populations.

Stalled development caused by exceeding 1.5°C warming would also undermine public health indirectly by compromising healthcare systems and eroding socioeconomic conditions necessary to public well-being. The global population at risk of mental distress would increase, affecting especially those who are directly or indirectly exposed to climate impacts such as extreme events, displacement, migration, and poverty.

Natural ecosystems

The world already faces a biodiversity crisis triggered by human activity, with many species becoming extinct and others disappearing locally. Overshoot would pose even greater danger to unique and fragile ecosystems around the world.

In general, ecosystem degradation and biodiversity loss would accelerate globally if 1.5°C is exceeded. Climate stressors for terrestrial, freshwater, and marine ecosystems would increase and multiply, causing additional habitat loss as well as habitat shifts. Biodiversity hotspots, located primarily in developing countries, would come under even greater pressure.

Disrupting ecosystems would also weaken the contributions they make to human well-being (known as ecosystem services), such as coastal protection provided by coral reefs. More species would go extinct. Ultimately, damage to ecosystems would further undermine societal resilience and people's welfare.

Marine ecosystems are also vulnerable. The oceans absorb 25% of CO₂ emissions and 90% of the excess heat from elevated greenhouse gases.³³ The dissolved CO₂ acidifies marine waters. Both acidification and warming harm marine ecosystems. Coral reefs, among the most vulnerable ecosystems, are at risk of being lost even under optimistic scenarios.³⁴

Oceans also play an important role in several responses to climate change. Not only do they naturally absorb a large share of emissions, but they can be the site of marine-

based carbon dioxide removal (CDR), such as “blue carbon,” and marine cloud brightening, a proposed solar radiation modification (SRM) method – see Sections 7 and 8.

Irreversible and catastrophic changes

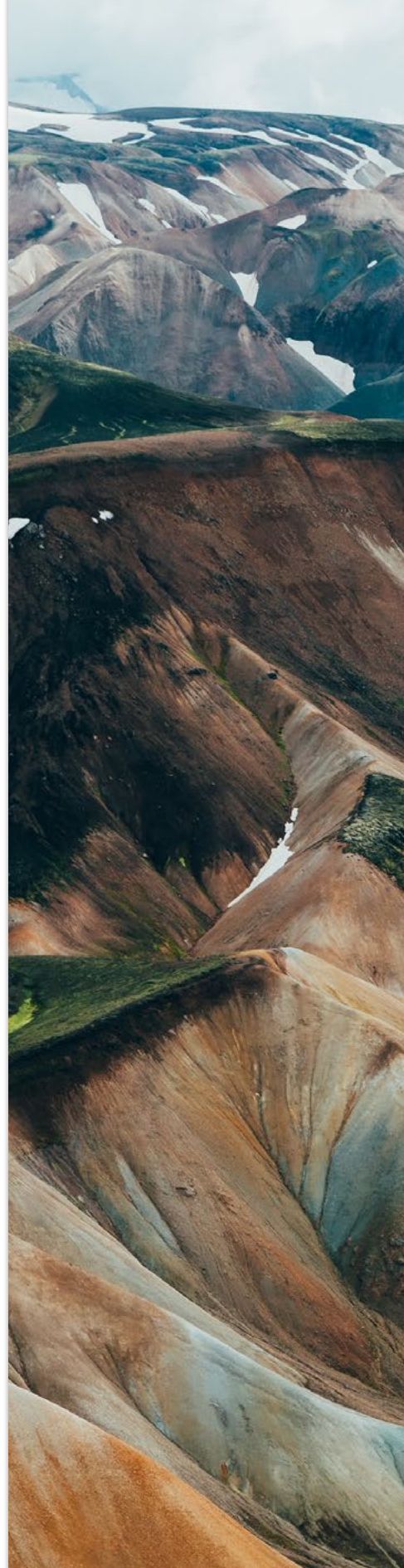
Beyond the risks outlined above, scientists have concluded that several natural systems contain thresholds – sometimes referred to as “tipping points” – which, if crossed, could lead to nonlinear effects that may not be reversible.

Among the most cited examples are the West Antarctic Ice Sheet and similar formations. These are massive reservoirs of frozen water that influence sea level, ocean circulation, and climate. Warming can cause the ice sheets to melt, to calve – creating icebergs – and to collapse. If a critical temperature threshold is crossed, whose exact value is uncertain, they could enter a state of irreversible retreat, leading to meters of sea level rise over centuries or millennia.

Thresholds at some risk of being crossed at less than 2°C of warming include abrupt loss of Barents Sea ice, abrupt thaw of boreal permafrost, collapse of the Labrador Sea/subpolar gyre, low-latitude coral reef die-off, drying of the Amazon to a savannah-like state, and collapse of the Greenland and West Antarctic ice sheets.³⁵

The likelihood of crossing such thresholds would increase in proportion to the magnitude of overshoot. Crossing these could have widespread consequences for human and natural systems – unparalleled in modern human history – as well as cascading effects that could be irreversible on human timescales. This means that the changes could not be undone even if warming is reduced or reversed.

While scientists have not established that any global-scale systems have this nonlinear characteristic, crossing multiple thresholds might result in regional effects that, when aggregated, could cause great harm to the entire world.





Endnotes

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