E3G

REPORT September 2022

LIVING ON THE EDGE

HOW CLIMATE TIPPING POINTS WILL RESHAPE GEOPOLITICS

TAYLOR DIMSDALE, CAROLINA CECILIO & INES BENOMAR

E3G

About E3G

E3G is an independent climate change think tank with a global outlook. We work on the frontier of the climate landscape, tackling the barriers and advancing the solutions to a safe climate. Our goal is to translate climate politics, economics and policies into action.

E3G builds broad-based coalitions to deliver a safe climate, working closely with like-minded partners in government, politics, civil society, science, the media, public interest foundations and elsewhere to leverage change.
www.e3g.org

Berlin
Neue Promenade 6
Berlin, 10178
Germany
+49 (0)30 2887 3405

Brussels
Rue du Commerce 124
Brussels, 1000
Belgium
+32 (0)2 5800 737

London
4 Valentine Place
London SE1 8QH
UK
+44 (0)20 7038 7370

Washington
2101 L St NW
Suite 400
Washington DC, 20037
United States
+1 202 466 0573

Copyright

Cover image
Cover image by Filippos Sdralias published on December 6 of 2018 under the Unsplash License shows a North American P-51 Mustang fighting a wildfire in Varnavas, Greece.

E3G

REPORT September 2022

LIVING ON THE EDGE

HOW CLIMATE TIPPING POINTS WILL RESHAPE GEOPOLITICS

TAYLOR DIMSDALE, CAROLINA CECILIO & INES BENOMAR

E3G

Our partners

Mistra Geopolitics
This project has received funding from MISTRA GEOPOLITICS, which is funded by MISTRA – the Swedish Foundation for Strategic Environmental Research. This work reflects the authors' views and does not commit donors.

Acknowledgements

The authors would like to express their appreciation to Lucy Hayes, Carne Ross and Lisa Fischer from E3G, André Månberger from Lund University, and Timothy Lenton from Exeter University, for their valuable input to this report, and to the Communications team at E3G for their overall support.

E3G

CONTENTS

E3G

LIST OF FIGURES AND TABLES

E3G

EXECUTIVE SUMMARY

Climate impacts are growing more frequent and severe as global temperatures rise. Climate and weather-related disasters have increased five-fold over the past half-century and in many cases are already testing the adaptation capabilities of vulnerable communities. If emissions follow the trajectory set by current country targets, there is a less than 5% chance of keeping global average temperatures well below 2 °C above pre-industrial levels.[1] The chance of temporarily overshooting the 1.5 °C target set by the 2015 Paris Agreement in the next five years is 48%.[2]

At the same time, scientific understanding of climate risk has advanced. This includes the growing risk of breaching irreversible tipping points like the melting of the Greenland and Antarctic ice sheets or breakdown of the Gulf Stream. These kinds of impacts cannot be measured in economic terms alone, or perhaps at all; but they would unquestionably have dire consequences for human society and international security.

Climate change already shapes geopolitics. But to date this has largely been the result of major economies positioning themselves to exploit new economic opportunities from a relatively slow transition to cleaner energy sources, while at the same time working to protect their continued access to fossil fuels. Climate risk itself has barely featured in geopolitics and diplomacy. It can be characterised mainly by the failure of developed countries to deliver finance they have promised to the global south to help them adapt to climate impacts.

However, the new era of extreme climate risk, along with better understanding of climate tipping points, is likely to reshape these geopolitical dynamics. The relative importance of protecting fossil fuel access and reserves is likely to fall, while the relative importance of deep decarbonisation of energy systems to avoid worst-case temperature scenarios will rise. As a result, the political costs of acting on climate will fall, while the costs of not acting will rise.

[1] Liu, P.R., Raftery, A.E., 2021, **Country-based rate of emissions reductions should increase by 80% beyond nationally determined contributions to meet the 2 °C target**. Commun Earth Environ 2, p. 29.

[2] Vaughan, A., 2022, **We have a 48% chance of breaching 1.5°C target by 2026, says Met Office.** New Scientist.

E3G

The effects of such a shift are not clear. It could prompt a renewed push for international cooperation and deeper economic integration of clean energy markets and standards. It could result in significantly scaled up international finance for adaptation and loss and damage for vulnerable countries. Or it could lead to geopolitical fragmentation where countries choose to "go it alone", for example by deploying untested geoengineering technologies to alter the climate. In this report we identify five potential drivers.

The first is **technology**. One response to tipping point risk will be the temptation to deploy geoengineering solutions – such as solar radiation management, which cools the planet by reflecting sunlight back into the atmosphere – or technologies that remove carbon dioxide from the air. However, geoengineering is untested and has a risk of unintended consequences that could be unevenly distributed geographically. Climate models suggest that some level of carbon removal will be necessary to maintain a safe temperature. However, some of these approaches currently lack appropriate governance mechanisms.

The second is international climate **finance**. Only about one-fifth of this is for adaptation – most financial support is currently for mitigation. And only a small percentage of adaptation finance is reaching the poorest countries. No money is currently provided specifically to address losses and damages that are already occurring. Negotiations over finance for climate adaptation and loss and damage are already contentious; this will become more urgent as the risks increase.

The third is **food** security. Agricultural productivity is already threatened by rising temperatures in many parts of the world and the risk of multiple breadbasket failures occurring in a single year is increasing. If countries become more concerned about extreme temperature scenarios and cascading risks from tipping points, one possible response could be food export bans like those seen in 2010 following a major drought. These kinds of resource shocks can contribute to political and social instability.

The fourth is **energy** security. The transition to renewable energy, including growing demand for rare-earth elements or bioenergy, will change the balance of power between energy producers and consumers that was previously driven by oil, gas, and coal reserves. Crash mitigation programs launched to avoid tipping points or extreme temperature scenarios would speed this transition up significantly. This may leave some medium and large fossil exporters unprepared, while giving early investors in batteries and other clean technologies new levers of influence.

E3G

The fifth is **migration**. As impacts get worse more people will move, both internally and across borders. Several Pacific islands have already disappeared due to sea level rise, and more will follow. Unexpectedly rapid melting of the ice sheets would speed up sea level rise, exacerbating this problem. But migration is also an example of a potential "social" tipping point, where people make decisions due to perceptions of changes as much as due to climate impacts themselves. In either case, large movements of people across borders can cause geopolitical tensions.

Neither governments nor international institutions are currently prepared for a dramatic change in the urgency of managing climate risk, or the wider consequences that could result from such a shift. Some countries and institutions are integrating climate risk assessments into their planning, but most are only considering mid-range temperature scenarios. We have found no examples of tipping point risk being seriously considered. Some countries use tools that are appropriate for extreme scenarios, like strategic foresight, to inform their policymaking, but most of these are found in just a few major economies in the Global North. Even in these cases climate change is not being systematically integrated in these exercises.

We offer several recommendations to help avoid future geopolitical tensions that could arise from national responses to the risk of tipping points.

Data and risk assessment

> The IPCC should produce **a Special Report on tipping points** and their possible cross-sectoral impacts by the end of 2024.

> The creation of a global **Climate Risk Observatory** under the UN could facilitate exchange, help address the transboundary nature of climate risk, and contribute to a goal of having early warning systems in place by 2027.

Decision making and finance

> Governments should fully **integrate climate change risk management into economic and security planning and decision making**. This should include the full range of potential temperature scenarios, including threat assessments of tipping points, as well as the widespread use of strategic foresight.

E3G

> International financial institutions need to **integrate climate extreme risk as a financial risk**. This would help mainstream risk management in the long term in both the private and public sector and contribute to global resilience.

> Developed countries should scale up their **international adaptation finance commitments** and should provide **finance for loss and damage** either through new or existing mechanisms. Innovative sources of private finance for addressing impacts should be agreed.

> Developed countries should also **increase humanitarian assistance** provided for people forcibly displaced by climate events.

Dialogue and cooperation

> An international **taskforce on geoengineering** should be created. This could potentially be housed in the UN but should be composed of representatives from governments, civil society, and the private sector.

> Countries should **develop more formal and informal dialogues on extreme risk** between the major emitters and most vulnerable countries. This should be done in classical climate fora (for example have extreme risk as a recurrent topic in UNFCCC discussions) but should not be limited to them.

> Multilateral engagement is needed on climate-related migration to ensure that **legal protections are assured for climate migrants**. As a first step, the International Organisation for Migration (IOM) and UN High Commission on Refugees (UNHCR) should co-facilitate a Task Force on reducing the risks of displacement in the context of climate-driven disasters. This could build on existing government-led efforts like the Migrants in Countries in Crisis (MICIC) Initiative.

> The G7 should establish a **platform for working with middle-income countries and major energy exporters** on net zero transition plans. The platform should include a working group on social protection.

E3G

INTRODUCTION

Climate change is now a diplomatic and geopolitical priority, with implications for the future of the global economy, international cooperation, and security. In the latest Global Risks report from the World Economic Forum,[3] "extreme weather" and "climate action failure" are the top risks in the short, medium, and long term. Beyond the United Nations Framework Convention on Climate Change (UNFCCC), climate now features prominently in multilateral venues like the G7 and G20 and is a cornerstone of many bilateral diplomatic relationships.

However, climate's impact on geopolitics to date has largely been the result of major economies positioning themselves to exploit new economic opportunities from a relatively slow transition to cleaner energy sources, while simultaneously working to safeguard their access to fossil fuels. Solar energy and electric vehicles are two examples. The cost of solar photovoltaics has fallen rapidly, due in part to R&D investment and supportive policies for example in Germany and China.[4] Western countries have imposed tariffs on certain Chinese and Indian solar products, accusing them of dumping and of human-rights violations, which has impacted geopolitics and trade relations.[5] The growing market for electric vehicles (EVs) has also increased export competition, with several of the world's largest economies having identified EVs as a strategic priority. China is restricting access to foreign cars and batteries, and Europe is trying to become a world exporter.[6]

Growth markets in renewable energy, batteries and EVs that are key to the energy transition all require critical mineral commodities like lithium, cobalt, copper, and manganese. Today, China is the lead exporter for many of these commodities, making supply chains highly concentrated. With increasing prices and geopolitical ties to the extraction and export of these materials, Western countries including the US and EU are looking to diversify their suppliers to other continents, shifting trade partnerships and international dynamics. These moves and countermoves in the competition over clean energy have been the dominant force driving the geopolitics of climate change in recent years. At the same time, most countries have strongly resisted commitments to phase out the use of fossil

[3] World Economic Forum, 2022, **Global Risks Report 2022.**

[4] Chandler, D.L., 2018, **Explaining the plummeting cost of solar power.** MIT News.

[5] World Economic Forum, 2022, **These 4 charts show the state of renewable energy in 2022.**

[6] International Energy Agency, 2021, **Trends and developments in electric vehicle markets.**

E3G

fuels in their economies, mandatory emission reductions, or international carbon pricing mechanisms.

A deeper understanding and recognition of climate risk itself has barely featured in geopolitics and diplomacy to date. It can be characterised mainly by the failure of developed countries to deliver finance promised to countries in the Global South to help them adapt to and recover from climate impacts. According to the IPCC WGII report, 3.3 to 3.6 billion people are already dealing with climate impacts.[7] For those countries, many of which still produce a fraction of overall emissions, financing provided by wealthy countries to help them address extreme weather, drought, heatwaves and sea level rise are a key priority.

Tensions over the lack of adequate support for vulnerable countries – that have done the least to cause the climate crisis – have led to multiple efforts to reform the financial mechanism of the UNFCCC.[8] One of the most contentious negotiating items during COP26 was over whether and how the world's wealthiest nations, which are disproportionately responsible for global warming to date, should compensate or provide technical and financial support to poorer nations to help them adapt to impacts or address losses and damages that are already occurring.

In negotiations over climate adaptation and finance, vulnerable developing countries have emphasised that there are hard and soft limits to adaptation. Hard limits to adaptation include the level of heat and humidity that human beings can tolerate, or the ability of some small islands to address sea level rise. Soft limits include the administrative hurdles many countries face in accessing finance or the complexity of systemic risk that cannot be addressed solely at the project level.

In short, while there is now greater attention on the opportunities and risks related to the clean energy transition, far less attention has been given to the geopolitical implications of the physical risks of climate change. Physical risk has largely been treated by major economy governments as a concern for future generations. Climate policy decisions have been informed by the use of high discount rates that make it seem like the costs of acting in the present outweigh any future benefits making it harder to justify more aggressive policy or

[7] IPCC, 2022, **Climate change 2022: Impacts, Adaptation and Vulnerability – Summary for Policy Makers.**

[8] Streck, C. and Terhalle, M., 2013, **The changing geopolitics of climate change**. Climate Policy, 13:5, 533–537.

E3G

regulation. There are some exceptions, such as the UK, which uses declining discount rates for long-term and uncertain events.[9]

However, we are entering a new era of extreme risk. Climate impacts are growing more frequent and severe as global temperatures rise. Climate and weather-related disasters have increased five-fold[10] over the past half-century and in many cases are already testing the adaptation capabilities of vulnerable communities. If emissions follow the trajectory set by current country targets, there is a less than 5% chance of keeping average global temperatures well below 2 °C above pre-industrial levels.[11] The chance of temporally overshooting the 1.5 °C target set by the 2015 Paris Agreement in the next five years is 48%.[12] If current policies are scaled back or are not met, there is a 10% chance of reaching a global temperature increase of 7 °C.[13]

At the same time, scientific understanding of climate risk has advanced, including the growing risk of breaching irreversible tipping points like the melting of the Greenland and Antarctic ice sheets or breakdown of the Gulf Stream. Such impacts cannot be measured in economic terms alone, or perhaps at all; but they would unquestionably have dire consequences for human society and international security.

The combination of extreme impacts and better understanding of the risk of tipping points is likely to have a significant impact on climate change as a geopolitical driver. The relative importance of safeguarding fossil fuel assets is likely to fall and the relative importance of deep decarbonisation to avoid worst-case scenarios is likely to rise. But the effects of such a shift are not clear. It could prompt a renewed push for greater international cooperation and deeper economic integration of clean energy markets and standards. It could result in significantly scaled up international finance for adaptation and loss and damage for vulnerable countries. Or it could lead to geopolitical fragmentation where countries choose to "go it alone", for example by deploying untested geoengineering technologies to alter the climate.

[9] UK Government, 2022, **The Green Book.**

[10] Pavlinovic, D., 2021, **Climate and weather related disasters surge five-fold over 50 years, but early warnings save lives - WMO report.** UN News.

[11] Liu, P.R., Raftery, A.E., 2021, **Country-based rate of emissions reductions should increase by 80% beyond nationally determined contributions to meet the 2 °C target**. Commun Earth Environ 2, p. 29

[12] Vaughan, A., 2022, **We have a 48% chance of breaching 1.5°C target by 2026, says Met Office.** New Scientist.

[13] Quiggin, D. et al., 2021, **Climate change risk assessment 2021.** Chatham House.

E3G

This report assesses how deeper understanding and experience of climate risk, and the measures to avoid breaching tipping points, could shape international geopolitics. Chapter 1 provides an overview of the latest science and understanding of climate risk and tipping points. Chapter 2 considers how tipping point risk could impact five critical drivers: technology, finance, food, energy, and migration. Chapter 3 reviews what governments and institutions are currently doing to address extreme climate risk. Chapter 4 concludes with recommendations to governments and the international community on how to better prepare for this shift and avoid geopolitical tensions.

E3G

CHAPTER 1
THE STATE OF THE SCIENCE ON CLIMATE RISK

Summary

> There are three categories of climate-related hazards: extreme weather events; slow-onset events; and tipping points.

> Climate hazards are hitting harder and earlier than expected worldwide. Some tipping points are already flashing warning signs, such as the Greenland ice sheet and the Atlantic meridional overturning circulation.

> Climate risks are not limited by borders; their effects are transboundary and are accompanied by economic and social impacts. Crossing a tipping point means increasing global socio-economic and financial risk.

According to the OECD[14] and the IPCC,[15] there are three categories of climate-related hazards:

> **Extreme weather events**, which include heatwaves, droughts, and floods, are generally short-lived. Their frequency has increased significantly in the last 20 years.[16]

> **Slow-onset events** are detected over a long period, as their development occurs gradually over time. Sea-level rise is an example of this category.

> **Tipping points** are thresholds of abrupt and often irreversible change. Examples include the melting of the Greenland ice sheet and the West Antarctic ice sheet, the collapse of the Atlantic meridional overturning circulation (AMOC), or the Amazon rainforest dieback.

[14] OECD, 2021, **Managing Climate Risks, Facing Up to Losses and Damages.**

[15] IPCC, 2022, **Climate Change 2022: Impacts, Adaptation and Vulnerability.**

[16] Yale Environment360, 2020, **Extreme Weather Events Have Increased Significantly in the Last 20 Years** Yale School of the Environment.

E3G

Climate hazards are no longer limited geographically, and their intensity and frequency are rising. According to the IPCC, climate change impacts due to human activity have resulted in the increase of extreme weather events, such as floods, droughts, or fires, but also of slow-onset processes, like sea-level rise or ocean acidification.[17] These events are being felt worldwide. In all regions, coping with heatwaves means dealing with mortality and morbidity, an increase of climate-related diseases and population displacement.

At 1.2 °C of warming, human-induced climate change has already "caused widespread adverse impacts and related losses and damages to nature and people, beyond natural climate variability".[18] However, as the concentration of CO_2 in the atmosphere continues to rise, so does the risk that critical and possibly irreversible climate tipping points will be breached, affecting the overall climate system. Moreover, the consequences of breaching tipping points go beyond the direct physical impacts and would include major socio-economic disruptions worldwide.

Our understanding of tipping points has improved, and the risks are higher than previously thought. Even recently, it was believed that tipping points would only be triggered if temperatures increased by more than 5 °C. However, the latest research warns of tipping points being breached even below 2 °C of warming.[19,20,21] Figure 1 shows different "Reasons for Concern" at different temperature thresholds. All of the areas are assessed as "high" risk and impact even at 2 °C of warming, with "Unique and threatened systems" at high risk above 1 °C.

[17] IPCC, 2022, **Climate Change 2022: Impacts, Adaptation and Vulnerability – Summary for Policy Makers.**

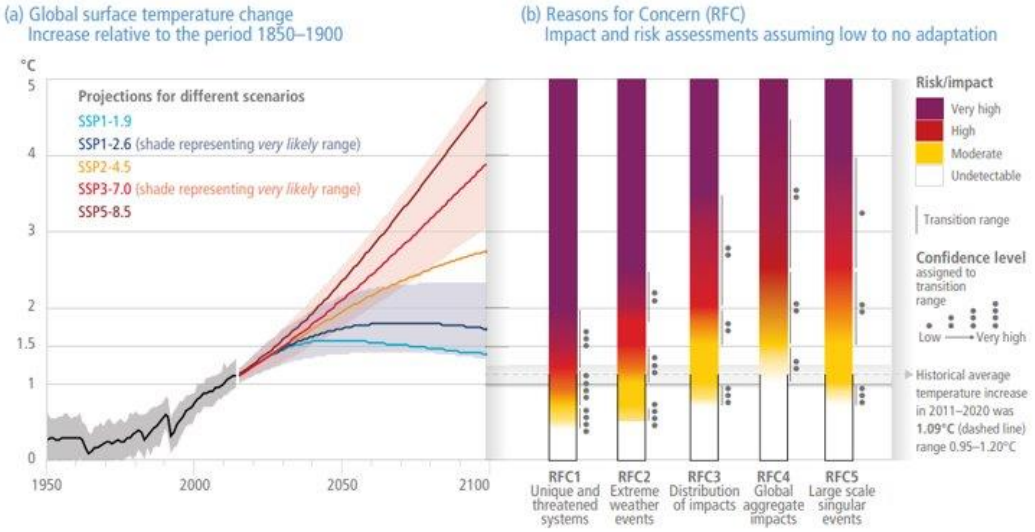
[18] ibid.

[19] IPCC, 2021, Special Report Global Warming of 1.5 °C, chapter 4 'Strengthening and implementing the global response'.

[20] Lenton, T., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W. and Schellnhuber, H., 2019, **Climate tipping points — too risky to bet against**. Nature, 575(7784), 592-595.

[21] Ritchie, P.D.L., Clarke, J.J., Cox, P.M. et al., 2021, **Overshooting tipping point thresholds in a changing climate**. Nature 592, 517–523.

Figure **1***: Reasons for Concern – impacts and risks assessments at various levels of warming.*



Source: IPCC, 2022, ***Climate Change 2022: Impacts, Adaptation and Vulnerability – Summary for Policy Makers****, page 16.*

Climate sensitivity is particularly relevant in assessing climate risk. It determines the impacts of rising levels of greenhouse gas (GHG) emissions on the planet's global temperature[22] – or more simply, how sensitive the Earth's climate system is to increasing CO_2 levels.[23] The **equilibrium climate sensitivity** is defined as the global temperature rise that would result from a prolonged doubling of CO_2.[24]

In 2021, the IPCC estimated this value to be 3 °C, with a likely range of 2.5 °C to 4 °C – a narrower range than presented in 2014, when it was estimated at 1.5–4.5 °C.[25] This means we now have a more precise estimate of the Earth's sensitivity to the increase of CO_2 levels. This change was based on improved knowledge and science of climate, paleoclimate evidence and the climate system's responses to climate change. Many factors can influence the speed of increasing temperatures, and consequently, influence the speed of breaching tipping points. These are the "feedback effects". Climate sensitivity values are not fixed, and even if they are useful for climate scenarios and modelling, they show how our assumptions can be proven wrong in a matter of years, and how

[22] MIT Climate Portal, 2021, **Climate Sensitivity**.

[23] MET Office, **What is 'climate sensitivity'?**

[24] ibid.

[25] IPCC, 2021, **Special Report Global Warming of 1.5 °C – Summary for Policy Makers**.

important alterations in the climate system can occur at lower temperature thresholds.

Possible tipping points

The **Greenland ice sheet** has been losing ice six times faster than in the 1990s[26], due to increasing global temperatures, leading to slow sea-level rise and an increase of fresh water in the ocean. If the Paris goal of limiting the rise of global temperature to 1.5 °C was successfully achieved, the losses of ice sheet in Greenland could be reduced by half compared to current emission pledges. However, some of the melting is already considered irreversible. This has implications for climate risk not only in the northern hemisphere, but also in other regions, affecting for example the **Atlantic meridional overturning circulation (AMOC)**. Breaching of one tipping point could have a domino effect on other tipping points.[27] The melting of **Arctic Sea ice** may have already crossed a tipping point, but it is unclear how long this process will take, what the impacts will be, and if they are reversible or not.[28,29]

The main driver of the melting of the **West Antarctic ice sheet** is the change in water circulation, which occurs due to the increase of GHG emissions and rising temperatures.[30] The consequences of this ice sheet melting go beyond global sea level rise – Antarctica is unique for its biodiversity and is considered an important climate archive for previous changes to the global climate systems.

The **Atlantic meridional overturning circulation (AMOC)** is a large system of ocean currents responsible for carrying warm waters towards the North Atlantic. According to scientific evidence, this system has been weakened since the mid-20th century, meaning its circulation has slowed down.[31] The decrease of warm water being circulated towards the North Atlantic will have impacts beyond the northern hemisphere. Changes in the AMOC will, for example, disrupt ocean capacity to store heat and carbon, and affect precipitation patterns in the southern hemisphere, disrupting the West African monsoon, and transforming the Amazon rainforest into a savannah.[32]

[26] OECD, 2021, **Managing Climate Risks, Facing up to Losses and Damages.**

[27] Wunderling, N., Donges, J. F., Kurths, J., and Winkelmann, R., 2021, **Interacting tipping elements increase risk of climate domino effects under global warming**, Earth Syst. Dynam., 12, 601–619.

[28] IPCC, 2021, **Special Report Global Warming of 1.5 °C – Summary for Policy Makers**.

[29] Hutt, R., 2019, **9 climate tipping points pushing Earth to the point of no return.** World Economic Forum.

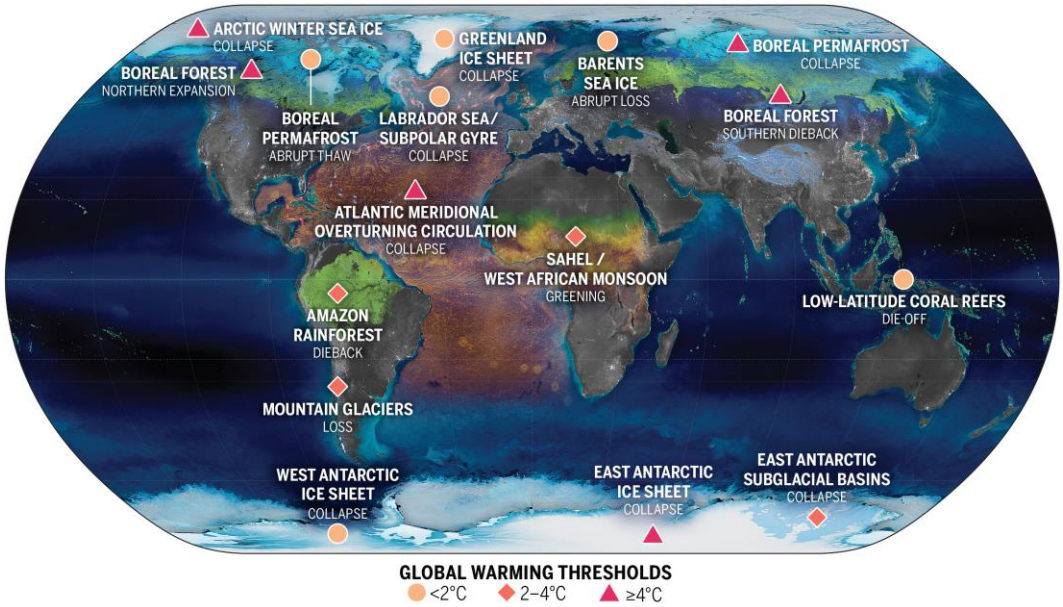
[30] Borunda, A., 2019, **West Antarctica is melting – and it's our fault**. National Geographic.

[31] Hutt, R., 2019, **9 climate tipping points pushing Earth to the point of no return.** World Economic Forum.

[32] ibid.

The dieback of the **Amazon rainforest** is another area of concern. The slowing down of the AMOC has decreased precipitation in this area, and an increase of global temperature has led to more droughts and wildfires. This region houses an incredible amount of biodiversity and is a critical carbon sink. The transformation of the Amazon rainforest into a savannah will also mean a decrease in its essential carbon-storage capacity, further raising global temperatures and causing additional changes to precipitation patterns.

Figure 2: The location of climate tipping elements and global warming levels at which their tipping points will likely be triggered



Source: ***McKay et al., Science, vol. 377, DOI: 10.1126/science.abn7950***

The economic costs of tipping points are not easy to quantify relative to sudden or slow-onset impacts like hurricanes or drought. Given the systemic nature of second- and third-order risks they are arguably incalculable in economic terms. One study found that eight climate tipping points collectively would likely increase economic damage from climate change by roughly 25%, with the authors noting this is likely a conservative estimate.[33] They found that costs increase almost everywhere, and these additional costs are spread relatively evenly. While integrating tipping points into economic models is a very useful exercise, it is equally if not more valuable to consider tipping point risk in security assessments which factor in non-economic variables as well.

[33] Dietz, S. et al., 2021, **Economic impacts of tipping points in the climate system**. Proceedings of the National Academy of Sciences of the United States of America, 118(34), e2103081118.

E3G

Climate scenarios and impacts

According to the IPCC, "with every additional increment of global warming, changes in extremes continue to become larger".[34] The 2021 IPCC report emissions and considers three timeframes: near term (2021–2040), mid-term (2041–2060) and long term (2080–2100). Looking at the long term, the 2 °C threshold will be overshot in the intermediate, high and very high GHG emissions scenarios. 1.5 °C will be surpassed in the low GHG emissions scenario. In the near term, there is "at least a greater than 50% likelihood that global warming will reach or exceed 1.5 °C."[35]

Increasing temperatures will have direct physical impacts: every additional 0.5 °C will increase the intensity and frequency of heatwaves, heavy precipitation and droughts around the world.[36] These events will not only have consequences for the environment, but also socio-economic and financial impacts that are felt beyond the region where the event took place. Depending on how much the temperature will rise, different impacts can be expected: for example, at 1.5 °C the Greenland ice sheet is already melting, and food supply chains are unstable; at 2 °C wildfire seasons become longer and more frequent, and desertification leads to water shortages; and at 4.5 °C farmland is lost around the world, leading to food supply disruptions, and ocean ecosystems are heavily impacted or lost, contributing to loss of carbon capture capacity.[37] Pressures on equity, justice and resilience will increase, urban and rural planning will be more challenging, and economic and non-economic losses and damages will grow with increasing temperatures.[38]

An important finding of the most recent scientific assessments is that climate risks are not limited by borders – their effects are transboundary and are accompanied by economic and social impacts. Crossing a tipping point means increasing a global socio-economic and financial risk.[39] Changes in temperature and precipitation patterns will have multiple effects, including:

> Changes in crop production (both in quantity and quality) and water accessibility, and disturbance of food systems, health and wellbeing.

[34] IPCC, 2021, **Climate change 2021: The Physical Science Basis – Summary for Policy Makers**.

[35] IPCC, 2022, **Climate change 2022: Impacts, Adaptation and Vulnerability – Summary for Policy Makers.**

[36] ibid.

[37] MIT Climate Portal, 2021, **Climate Sensitivity**.

[38] IPCC, 2022, **Climate change 2022: Impacts, Adaptation and Vulnerability – Summary for Policy Makers.**

[39] Dietz, S., Rising, J., Stoerk, T. and Wagner, G., 2021, **Economic impacts of tipping points in the climate system**. Proceedings of the National Academy of Sciences, 118(34), p.e2103081118.

E3G

> Economic damages in sectors such as energy, tourism, trade and forestry.

> Weakening of infrastructures and increase of political, economic, cultural and social instability, which will contribute to conflict risk, weaker governance and enhanced migration and displacement.[40]

The Paris Agreement, a legally binding international treaty which was adopted at COP21 in 2015, set out the goal of limiting global warming to below 2 °C, preferably to 1.5 °C. Yet as of today, none of the world's major emitters have a climate pledge that is aligned with the Agreement. Current country emission reduction targets – assuming they will be fully delivered– would only limit global warming to between 2.4 °C and 2.7 °C beyond 2050. If countries were to fail to deliver on these pledges or backslide, there is a one-in-ten chance of warming of up to 7 °C by the end of the century. But, as the science shows, tipping points could be breached even if existing emission reduction targets are met.

[40] IPCC, 2022, **Climate change 2022: Impacts, Adaptation and Vulnerability – Summary for Policy Makers.**

E3G

CHAPTER 2
GEOPOLTICAL DRIVERS FOR TIPPING POINT RISK

Summary

Tipping point risk will reshape the geopolitics of climate change in unexpected ways as the value of safeguarding fossil fuel access falls and the value of deep decarbonisation rises. Possible drivers include:

> **Technology**: There will be a temptation to attempt to geoengineer the climate, for example by reflecting sunlight back into space. Countries may also attempt to capture carbon from the atmosphere through land-use approaches like bioenergy or with direct air capture machines. Models show that some amount of carbon dioxide removal will be necessary to ensure a safe climate. But bioenergy requires land, which may be needed for other sectors (such as agriculture and forestry), raising the question of who will bear the costs. Geoengineering technologies are untested, may have uneven impacts and lack appropriate governance mechanisms.

> **Finance**: Most financial support for developing countries is currently for mitigation, not adaptation. No money is currently dedicated specifically to addressing losses and damages from climate impacts that are already occurring. Negotiations over finance and other support for climate adaptation and loss and damage are already contentious; this will become more urgent as the risks increase.

> **Food insecurity**: As countries become more concerned about extreme temperature scenarios and cascading risks from tipping points, one possible response would be food export bans like those seen in 2010 following a major drought in eastern Europe. These kinds of resource shocks can contribute to political and social instability.

> **Energy security**: Crash mitigation programs would speed up the energy transition significantly and change the balance of power between energy producers and consumers. This could leave some medium and large fossil exporters unprepared while giving early investors in batteries and other clean technologies new levers of influence.

> **Migration**: As the world warms more people will be forced to move, particularly in the Global South. The World Bank estimates that 140 million people will be displaced by 2050 in sub-Saharan Africa, South Asia, and South America due to climate change. Some people might choose to move due to the expectation of breaching tipping points. This will raise challenges in sovereignty, responsibility to host refugees, social pressure, and possibly conflict.

As climate risk increases, tipping points come into focus and climate action takes on a greater sense of urgency, it is likely to reshape the role of climate change in geopolitics and international security. We identify five drivers that are likely to be impacted. Specific geopolitical implications in each of these areas are explored in more detail below.

Technology

Here we consider two different technology-based approaches: **geoengineering** and **carbon dioxide removal (CDR)**.

Geoengineering

Geoengineering refers to the deliberate large-scale manipulation of an environmental process that affects the Earth's climate to counteract the effects of global warming. One of the most frequently cited geoengineering methods is solar radiation management (SRM). This could include aerosol particle injection, increased reflectivity of the Earth through mirrors put in space, or alteration of the amount and elements of clouds.[41,42] All of these could have effects on temperature rise, but critically they would not deal with other damaging climate impacts. For example, as the oceans are forced to absorb more carbon, they are becoming more acidic, which also has implications for biodiversity and global food supply.

Unintended consequences could include adverse localised climate implications such as changes in regional precipitation patterns, as any cooling would be uneven across the globe.[43] This could have serious implications for the

[41] Climate Analytics, **Why negative CO2 emission technologies should not be classified as Geoengineering.**

[42] Morton, O., 2020, **The Geopolitical Challenges of Geoengineering—and Geoengineering's Challenge to Geopolitics.** Wilson Center.

[43] Harvard, **Solar Geoengineering Research Programme**.

E3G

environment and activities dependent upon it, like agriculture or forestry. Today, countries like the US[44], China and India[45] are investing in research in geoengineering, as part of potential solutions to decrease their carbon emissions. But adding to the possible unintended consequences, the lack of an international architecture for governing these kinds of interventions is also problematic. Unilateral deployment by states or non-state actors could result in changes to weather systems beyond national borders, and risks conflict if other nations experience weather disasters they believe were caused by geoengineering.[46] The current lack of international governance and agreed oversight mechanisms raises the risk that unintended consequences could spill over into geopolitical tension.[47]

Carbon dioxide removal (CDR)

Most pathways to keeping warming to 1.5 °C or even 2 °C involve some use of negative emission technologies (NETs).[48] These include direct air carbon capture and storage (DACCS) and bioenergy with carbon capture and storage (BECCS). According to the International Energy Agency, there are currently 26 carbon capture, utilisation and storage operating facilities [49], with pilots and R&D being led by the US, the EU, the UK, Japan, China and Australia.[50]

The advantages of DACCS[51] include its possible scalability and the fact that its placement is not dependent on the source or timing of emissions. Large-scale deployment of DACCS is relatively uncontroversial and is unlikely to result in geopolitical tension. However, direct air capture has a very high energy usage and a high cost per ton of CO_2 removed. This raises questions about where DACCS should be located and who would be responsible for bearing the cost.

[44] Temple, J., 2022, **The US government is developing a solar geoengineering research plan**. MIT Technology Review.

[45] Jayaram, D., 2021, **Geopolitics, geoengineering governance, and the role of developing countries**. Observer Research Foundation.

[46] National Intelligence Council, 2021, **Climate Change and International Responses Increasing Challenges to US National Security Through 2040**. National Intelligence Estimate.

[47] Keith, D. (2020) ***The world needs to explore solar geoengineering as a tool to fight climate change.*** Boston Globe.

[48] IPCC, 2022, **Climate change 2022: Mitigation of Climate Change – Summary for Policy Makers.**

[49] IEA, 2021, **CCUS in Industry and Transformation – Analysis.**

[50] McCulloch, S., 2021, **Carbon capture in 2021: Off and running or another false start?**

[51] DACCS: consists of a chemical process that extracts CO_2 directly from the atmosphere and stores it underground. Cran-McGreehin, S., 2018, **Negative emissions: why, what, how?**

BECCS[52] could increase the use and production of biofuel and has high potential for decarbonising sectors and industries where carbon abatement is more difficult.[53] Nevertheless, to be truly effective, it would need to be scaled up significantly which would likely result in significant competition for cropland, with knock-on effects on food security. Incentivising BECCS could also do more harm than good, if for example forests are cut down to make way for energy crops.

In addition to implications for food security and biodiversity, competition over land use could increase conflicts over the rights of indigenous people in certain territories, and lead to changes in different sectors, like the food and agricultural industries, including the possibility of resource price spikes. It is also possible that BECCS would be deployed in countries that have contributed relatively little to climate change, but are economically dependent on agriculture, and particularly small-scale farming.[54] Further, the additional production of biofuels involved in BECCS means that any inefficiencies in carbon capture could have implications for achieving global temperature targets and could lead to disputes about countries failing to meet their emission reduction commitments.

With climate target deadlines approaching fast, and some countries temporarily returning to fossil fuels to attenuate the effects of Russia's war in Ukraine, using these technologies could become more popular as an instrument to mitigate emissions from gas or coal. If there is a global interest in these technologies, research and development could increase, and prices could fall, making it a more competitive market. However, deploying NETs could also be used as an excuse to avoid other national and international mitigation efforts. With tensions between major emitters and vulnerable countries already high, scaling up reliance on existing or potential future negative emissions in place of renewable energy deployment or efficiency measures could further strain geopolitical relations.

[52] BECCS: is a combination of two processes – the burning of plant matter to produce bioenergy, and the capturing and storage underground of the CO_2 released during this procedure. This makes the soil more fertile and increases the flora, which will then also absorb CO_2 and could be used for bioenergy. Cran-McGreehin, S., 2018, **Negative emissions: why, what, how?**

[53] Consoli, C., 2019, **Bioenergy and Carbon Capture and Storage**. Global CCS Institute.

[54] Kreuter J., Lederer M., 2021, **The geopolitics of negative emissions technologies**: **learning lessons from REDD+ and renewable energy for afforestation, BECCS, and direct air capture.** Global Sustainability 4, e26, 1–14.

E3G

Finance

A core part of the grand bargain in international climate negotiations is an agreement that developed countries provide finance to help developing countries reduce their emissions and adapt to climate impacts. In 2009, developed countries pledged to mobilise $100 billion to this end by 2020.[55] But developed countries have fallen short of the target. Furthermore, only about one -fifth of the total climate finance provided is for adaptation, with the rest going to mitigation.[56] Only a relatively small percentage of adaptation finance is finding its way to the poorest and most vulnerable countries.

As impacts are increasing around the world, they are felt most acutely by developing countries with the fewest resources to cope. The UN has estimated that developing countries will need $300 billion per year in adaptation finance by 2030.[57] This has also brought the issue of climate "loss and damage" to the fore of the negotiations. Loss and damage does not have an official legal definition, but it generally refers to climate impacts that cannot be avoided through mitigation, and exceed current adaptation capacity. Developing countries have in recent years focused on negotiating technical and financial support for loss and damage, in addition to mitigation and adaptation finance. Developed countries have resisted, partly due to concerns about legal liability.

The International Monetary Fund has recently determined that climate change adaptation is a macro-critical risk, meaning that it affects financial stability and balance of payment issues.[58] Many vulnerable countries already spend a significant percentage of their GDP on disaster preparedness and recovery, leaving them less fiscal space for investment in other areas including mitigation. Furthermore, developing countries get hit twice: not only do these countries have less money and administrative capacity to cope, but their vulnerability to climate change increases the costs for them to access global financial markets for funding. From 2008 to 2018, 20 of the most climate-vulnerable developing countries paid $40 billion to $62 billion[59] more in interest payments on sovereign debt due to the risk of droughts, floods, and hurricanes.

[55] UNFCCC, 2009, **The Copenhagen Accord**.

[56] Farrand, C., 2019, **Only one-fifth of climate finance going to adaptation, finds OECD**. Climate Change News.

[57] UN News, 2021, **The trillion dollar climate finance challenge (and opportunity)**.

[58] Aligishiev, Z.; Massetti, E.; Bellon, M., 2022, **Macro-Fiscal Implications of Adaptation to Climate Change.** IMF.

[59] Burh, B. et al., 2018, **Climate Change and the Cost of Capital in Developing Countries**. London and Geneva: Imperial College London; SOAS University of London; UN Environment.

E3G

Negotiations over finance are often contentious. The threat of breaching tipping points and the existential risk they pose particularly for small island developing states (SIDS) will add urgency to the challenge. Cooperation on climate risk management and resilience is unlikely to be seen in isolation from other areas of diplomacy. If developing countries believe they are not getting enough out of the bargain they will be less likely to invest in climate negotiations, and also less likely to support developed country partners in other areas like trade, energy and security.

Food insecurity

Climate change is already impacting food insecurity through warming temperatures and an increase in droughts and floods. According to the IPCC, mid- to long-term food security risks increase markedly at 2 °C warming or higher, especially in Sub-Saharan Africa, South Asia, Central and South America and SIDS.[60] Crop production patterns will change in a warmer planet – maize production would decline, while wheat production would increase in some parts and decrease in others.[61] This can lead to social pressures: communities dependent on agriculture could lose their sources of livelihoods or decide to migrate to new lands, and tensions with local communities could arise.

Food shortages or food price spikes have been linked to political unrest and conflict across the world.[62,63] Russia's war in Ukraine and its impact on African countries who rely on Ukrainian or Russian grain supplies is a sharp reminder of the interdependency of the global food system and how food can be used as a geopolitical tool. Even the possibility of breaching climate tipping points could have far more drastic impacts on food security, conflict risk and geopolitical relations.

A collapse of the AMOC, for example, could result in a reduction in EU yields of approximately 30%[64] and would mean that it will not be possible to grow maize

[60] Aligishiev, Z.; Massetti, E.; Bellon, M., 2022, **Macro-Fiscal Implications of Adaptation to Climate Change.** IMF.

[61] Gray, E., 2021, **Global Climate Change Impact on Crops Expected Within 10 Years, NASA Study Finds**. NASA Climate Change: Vital Signs of the Planet.

[62] World Economic Forum, 2021, **Food shortages and conflict put millions of people at risk.**

[63] Food and Agriculture Organisation and International Food Policy Research Institute, 2017, **Conflict, migration and food security: The role of agriculture and rural development**.

[64] Food Security Programme, 2017, **Environmental tipping points and food system dynamics: Executive Summary.**

E3G

and wheat in most current areas of production. Almost all countries would lose out, apart from Russia where potential for production in Siberia would increase.[65] The current European dependency on Russian fossil fuels could become a global dependency on Russian grain. In cases where climate change leads to new (limited) arable land, excessive non-sustainable practices could be put in place, such as the use of chemicals to increase crop production. However, the losses could outweigh the gains as water scarcity and decline of planetary and human health would be the most likely consequences.[66]

The melting of Arctic ice is accelerating and is expected to have knock-on impacts on some of the most productive agriculture areas in the world.[67] The threat to food security caused by climate change is already spurring countries such as China and India to buy up land in Africa to guarantee future food security.[68]

Coral reefs are important biodiversity hotspots, but also crucial sources of food and livelihoods around the world. For example, they account for 20 to 25% of the fish caught by developing nations.[69] Ocean temperature plays a vital role in coral reefs' health: a 1 °C increase in global temperature has high impacts on these ecosystems, and at 2 °C their bleaching is almost total,[70] putting communities at food, social and financial risk. An increasingly warmer planet will lead to land and ocean unavailability due to droughts, soil salinisation or floods, affecting agriculture, fisheries and aquaculture, and livelihoods, which will in turn increase food prices, disturb global food systems, and further push communities into poverty.

Scarcity of food and water, caused by climate impacts, the breaching of tipping points or the expectation of breaching tipping points, will have geopolitical implications. Intra- and inter-state tensions could intensify, which in turn will increase migration flows, and boost the need for foreign aid and humanitarian assistance. It is possible this could catalyse a cooperative global response with investment in more sustainable food systems and support for the most food insecure countries. But geopolitical tensions could also result in governments

[65] Armstrong McKay et al., 2021, **Updated assessment suggests > 1.5C global warming could trigger multiple climate tipping points.**

[66] Ahmed, M., 2017, **Climate Change Effects on Food Security**. Forbes & Fifth, Volume 10, Spring 2017. University of Pittsburgh.

[67] Brown, P., 2016, **China Is Buying Land in Africa and South America to Ensure Its Food Supply.** Thruthdig.

[68] Viswanathan, H.; Mishra, A., 2020, **India-Africa partnership for food security: Beyond strategic concerns.** ORF Occasional Paper 242.

[69] Coral Reef Alliance, **Food.**

[70] IPCC, 2022, **Climate change 2022: Impacts, Adaptation and Vulnerability – Summary for Policy Makers.**

E3G

going inwards, discounting global cooperation, and investing in more protectionist and nationalistic responses. For example, by imposing trade and crop exports bans – like those seen in 2010 following a multi-year drought.[71]

Energy security

The rapid acceleration of deep decarbonisation efforts in response to extreme risk, combined with the more decentralised nature of clean energy production, would likely have a profound impact on the geopolitics of energy. The influence of fossil fuel producers will wane as renewable energy systems become more important, with far-reaching consequences. To take a recent example, Russia likely believed that its ability to invade Ukraine without facing serious geopolitical consequences was strengthened by European dependence on Russian gas. On the other hand, energy imports cost the EU an average of €320 billion per year.[72] One of the reasons the EU has agreed such aggressive climate policies is to strengthen its strategic position by reducing its energy dependence.

An acceleration of deep decarbonisation would put additional pressure on fossil fuel producers, particularly those least prepared for the transition.[73] The high levels of exposure to fossil fuel rents among many low- and middle-income countries, particularly in the Middle East and Africa, could result in increased instability and conflict. Even in the absence of more extreme physical risk scenarios, the threat of stranded assets could spark a fire sale of fossil assets by OPEC countries with serious implications for the global economy.[74,75] The notion of energy security will shift in different parts of the world: countries highly dependent on fossil fuel exports might face security challenges that go beyond energy supply; countries with critical raw materials will have a new position in geopolitics and will drive the competition for those sources; and decentralised energy infrastructure will play a bigger role, empowering local entities.

New alliances and foreign policy approaches are certain to emerge. Alliances between major energy consumers, rather than fossil fuel producers, could be strengthened. Energy and climate security interests could be increasingly delivered through cooperation on technology development and diffusion, which

[71] Climate Diplomacy, **Droughts and the Grain Export Ban in Russia.**

[72] Borrell, F. and Timmermans, F., 2021, **The Geopolitics of Climate Change**. Project Syndicate.

[73] Geopolitics of Renewables, **Redrawing the geopolitical map – A New World.**

[74] Watts, J.; Kirk, A.; McIntyre, N.; Gutierrez, P.; Kommenda, N., 2021, **Half world's fossil fuel assets could become worthless by 2036 in net zero transition.** The Guardian.

[75] Mercure, J. et al., 2021, **Reframing incentives for climate policy action**. Nature Energy 6, 1133-1143.

must address the risks emerging from extreme and slow-onset climate events. The complex global supply chains for clean energy systems will present new risks, including their resilience to the geopolitics of the energy transition but also to increasing physical risks from a warmer planet.

Finally, existing energy infrastructure is not resilient to extreme – or even in many cases moderate – climate risk. Most risk assessments are based on past climate data and optimistic assumptions. Beyond the repercussions of a fast-track transition to net zero energy systems there is also a risk that existing infrastructure fails in the face of increasingly severe climate impacts. This includes extreme weather but also flooding resulting from sea level rise or prolonged drought as water is needed for cooling in the power sector, and transporting fuels. Higher temperatures and extremes are also already putting more strain on power grids, leaving them at greater risk of failure. Record-breaking drought in China[76] and the US[77] for example have led to hydropower shortages. Cross-border electricity interconnections could be shut down as countries attempt to ration energy.

Migration

According to the Platform on Disaster Displacement, between 2008 and 2017, 25 to 30 million people were displaced by climate-related disasters every year. Current estimates of climate-driven displacement are upwards of 200 million people by 2030.[78] The World Bank estimates that 140 million people will be displaced by 2050 in sub-Saharan Africa, South Asia and South America alone.[79] It is unclear how much of this displacement will be within borders and how much will be international migration. Migration can be an effective adaptation strategy in the face of climate impacts. However, unplanned sudden and large movements of people can lead to political instability, and in some cases, higher risk of armed conflict.[80]

[76] Davidson, H., 2022, **China drought causes Yangtze to dry up, sparking shortage of hydropower.** The Guardian.

[77] Kelley, D., 2022, **Drought threatens Colorado River hydropower, major source of renewable energy.** Colorado Politics.

[78] Ahmad, A. and Heirich Boehl Foundation, 2019, **Climate Justice and Migration: Mobility, Development, and Displacement in the Global South**.

[79] World Bank, 2018, **Climate change could force over 140 million to migrate within countries by 2050**.

[80] Smith, D., and Vivekanada, J., 2007, **A Climate of Conflict. The links between climate change, peace and war.**

E3G

Significant forced migration is already leading to calls for changes in international responsibility for climate refugees.[81] Failure to adapt to the growing threat of climate change would increase the climate migration pattern further. Some countries in the Global North, such as the UK, Canada and the US, have significant diaspora communities from vulnerable countries such as Bangladesh, Pakistan, the Pacific Island States and countries in the African continent such as Nigeria. This could result in increasing pressure for developed countries to accept larger numbers of refugees, based on claims related to responsibility.

Sea level rise will have existential consequences for SIDS, which are highly vulnerable because of their topography.[82] Some island nations could disappear entirely, such as Tuvalu and the Maldives. Uninhabited Pacific islands have already disappeared due to sea level rise and erosion, and parts of inhabited ones have lost territory, leading to the relocation of people.[83] Some of these countries have most likely negotiated resettlement rights with neighbouring countries – Tokelauans already have access to New Zealand and the inhabitants of Tuvalu have negotiated migration rights for half of their population. However, it is likely that sovereignty rights and the right to reside in current locations will be brought up in UN negotiations in the coming decade.[84] Defining rights under the UN system for exile populations might have more profound implications for other contentious sovereignty issues such as fishing rights and tensions over marine minerals. Similar rights are likely to be claimed by distinct populations inside other countries or regions, such as the Sahel, where pastoral groups are already moving south, and where in this case displacement of pastoral groups has already been shown to exacerbate conflict.[85]

[81] Ahmed, B., 2018, **Who takes responsibility for the climate refugees?** International Journal Of Climate Change Strategies And Management, 10(1), 5-26.

[82] Robinson, S., 2020, **Climate change adaptation in SIDS: A systematic review of the literature pre and post the IPCC Fifth Assessment Report.** Wires Climate Change, 11(4).

[83] The Guardian, 2016, **Five Pacific islands lost to rising seas as climate change hits**. The Guardian.

[84] Martyr-Koller, R., Thomas, A., Schleussner, C., Nauels, A., and Lissner, T., 2021, **Loss and damage implications of sea-level rise on Small Island Developing States.** Current Opinion In Environmental Sustainability, 50, 245-259.

[85] Mabey, N., 2008, **Delivering Climate Security: International Security Responses to a Climate Changed World**. London, United Kingdom: RUSI.

E3G

CHAPTER 3
WHAT IS BEING DONE TO PREPARE FOR EXTREME RISK?

Summary

> Governments are not prepared for the social and geopolitical implications of tipping point risk. Climate risk assessment is slowly being integrated into policies and planning but mostly for mid-range temperature scenarios that are based on optimistic assumptions. Long-tail risks and wider geopolitical implications are rarely considered.

> Approaches like strategic foresight and anticipatory governance can be useful tools in preparing for tipping point risks, but they are not widely used. Some governments in the Global North have integrated foresight in their political structures but the time horizon is limited, and they are not considering tipping points. There are a few examples of strategic foresight tools in the Global South, but they tend to lack a specific focus on climate change.

Governments and institutions are slowly integrating climate risk and threat assessments into their economic and security policies. Examples include:

> The **United Kingdom**, where an independent government advisory body called the Climate Change Committee[86] periodically assesses national climate risks. The UK has also launched a Climate Change National Strategy Implementation Group (NSIG) made up of senior officials from across departments.[87]

> Since at least 2008, the **European Union's** Security Strategy has identified climate change as a threat multiplier that could exacerbate conflict and lead to disputes over migration, trade routes, maritime zones, and resources.

[86] Climate Change Committee, 2021, **Independent Assessment of UK Climate Risk.**

[87] UK National Audit Office, 2020, **Achieving net zero.**

E3G

> The **United States** has released intelligence assessments on climate, including a National Intelligence Estimate in 2021 on what climate means for national security.[88] It considers implications related to geoengineering and migration, among other drivers.

> In 2021 **Germany** released a Climate Risk and Impact Assessment[89] that includes an assessment of cascading effects across different systems. The time horizon is until the end of the century and it uses temperature scenarios of 3.1 °C to 4.7 °C.

> In 2020, the Ministry of Environment in **Japan** released an Assessment Report on Climate Change Impacts in the country.[90] The assessment does attempt to review systemic risks through a section on "Inter-sectoral Impact Linkages" as well as the impact of complex disasters. It also mentions the risk of tipping points as a critical reason for scaling up mitigation efforts.

> The incoming government of **Australia** has launched a review of the security threats posed by the climate crisis.[91]

> Climate change has been recognised as a security risk by regional organisations including the **African Union**, which held its 774th meeting of the AU Peace and Security Council on "The link between climate change and conflicts in Africa and addressing the security implications".[92] The **Association of Southeast Asian Nations (ASEAN)** and the **Economic Community of West African States (ECOWAS)** have recognised the links between climate and security, including in the context of climate change amplifying other challenges like food security and disaster risk .

> **NATO** has recently released a Climate Change and Security Impact Assessment[93] and climate change has been a topic of debate in the **UN** Security Council. The UN has established a Climate Security Mechanism to serve as an institutional home for climate change as a security issue.

However, there are relatively few examples of governments making serious attempts to integrate climate threat assessments into their economic, security

[88] US Office of the Director of National Intelligence, 2021, **Climate Change and International Responses increasing challenges to US National Security through 2040**.

[89] German Environment Agency, 2021, **Climate Impact and Risk Assessment 2021 for Germany – Summary.**

[90] Japan Ministry of Environment, 2020, **Assessment report on climate change impacts in Japan.**

[91] Hurst, D., 2022, **Anthony Albanese to order intelligence chief to examine security threats posed by climate crisis.** The Guardian.

[92] **AU Peace and Security Council 774th meeting (2018).**

[93] NATO, 2022, **Climate Change and Security Impact Assessment.**

E3G

and foreign policy planning. Most countries have yet to develop clear goals which reflect their core national interests, for example, effectively eliminating the chance of 4 °C scenario.

Where examples do exist, they typically use median IPCC scenarios, or in some cases assume that policies manage to keep temperatures below the Paris Agreement target of 1.5 °C. Current assessment is also dominated in most countries by ministries in charge of implementing policy, despite clear conflicts of interest between assessment and policy functions.

It is clear from recent climate-driven disasters as well as the Covid-19 pandemic response how poorly prepared governments and institutions are to deal with "long-tail" risk or "surprising" events. Long-term planning has not been a priority for most government or international organisations. But integrating different types of uncertainties and a more comprehensive set of scenarios into strategic thinking and planning would lead to a better identification of appropriate policy solutions and instruments. This would lower costs in the long run and lead to a more efficient use of resources across sectors; more efficient disaster risk management; and more resilient societies.

This is where anticipatory governance[94] and strategic foresight[95] can play an important role in dealing not only with climate risk, but also with overall security challenges. Foresight analysis can deal with complex systems and multiple sectors, such as in the case of climate change. There are various foresight tools[96,97] that can be deployed, by themselves or in combination, as shown in **Table 1** below.

[94] Anticipatory governance: "the process of acting on a variety of inputs to manage emerging knowledge-based technologies and socio-economic developments while such management is still possible". Guston, D., 2013, **Understanding 'anticipatory governance'.** Social Studies of Science, 44(2), pp.218-242.

[95] Strategic foresight: "a method and practice used to create functional and operational views of possible futures and the possibilities that exist within them with a view towards influencing today's decisions". Tõnurist, P. and Hanson, A., 2020, **Anticipatory Innovation Governance - Shaping the future through proactive policy making**. OECD Working Papers on Public Governance No.44.

[96] OECD-OPSI, ***Futures & Foresight – Observatory of Public Sector Innovation.***

[97] European Commission, ***Strategic foresight.***

E3G

Table 1: Foresight tools

Foresight tool	Description
Horizon scanning	Systematic scan of signals, trends and events of change in the present and their potential impacts in the future.
Megatrend analysis	Exploring and discussing large-scale patterns, their shifts and interactions with multiple policy domains, so a plan of action can be drawn.
Scenario planning	Multiple scenarios are developed (possible, plausible, probable), based on scientific analysis, interviews, and modelling. The goal is to understand how these futures could unravel and their implications, both in the present and future.
Systems modelling	Dynamic tool, highly dependent on innovation and technology, that generates various alternative futures, based on a set of assumptions. The criteria to define those assumptions can be subjective and will influence the outcomes, but systems modelling remains a powerful tool in predicting and researching climate tipping points, for example.
Visioning	Identifying a preferred or desirable direction, and creating a roadmap backwards, so the actions to achieve that future can be identified and the entity, be it a government or an organisation, can work towards that path.

Incorporating long-term climate risk and scenarios into foresight analysis and scenario planning is not mainstreamed across the world. A few examples that exist from the Global North and South are set out below.

Examples from the Global North

Some countries in the Global North have developed foresight tools that take a long-term perspective and an integrated approach. Countries reviewed here mainly began using foresight for military or defence purposes but have expanded it to other sectors and, in some cases, use it as part of horizontal policy coordination. Foresight activities generally result in reports with a medium- to long-term timescale, where different trends, threats and possible solutions are identified.

Depending on the country's political structure, foresight activities can either be centralised or decentralised. In centralised examples, such as in the US, France or Finland, the executive is responsible for conducting foresight activities and aggregates information from different ministries. When a decentralised approach is put in place, like in the Netherlands, each ministry defines specific

E3G

priorities and leads their own foresight work (**Table 2** in Annex). Depending on the political context, both approaches are valid. Decentralisation allows more flexibility within a specific ministry but can be harder to mainstream and align with other sectors. A centralised approach ensures national coordination but is more time consuming.

Examples from the Global South

Malaysia, Singapore and the UAE are examples of countries in the Global South[98] that have developed foresight strategies and policies. Although well developed, they lack a specific focus on climate change and response (**Table 3** in Annex). Moreover, these countries are not necessarily representative of most of the Global South, as they have more developed economic and financial capabilities, as well as more stable governance systems in place. Foresight tools for poor and climate-vulnerable countries would need to cover priorities such as building resilient agricultural systems, ensuring local livelihoods, protecting fresh water supplies, addressing risks posed to the energy sector, impacts on health and reducing risks from extreme weather.[99]

While extreme climate risks can sometimes be covered by insurance, in the Global South insurance covers less than one-third of weather catastrophe losses. This is also most extreme in the most vulnerable countries. For example, in Asia (excluding Japan) less than 5% of the overall losses from weather catastrophes since 1980 were insured. This is because people, companies or even governments frequently do not have sufficient risk awareness and lack financial capacity to adapt.[100]

The increasing risks of climate hazards – and the fact that these are intertwined with political, economic, social, health and environmental stability – require structures that can identify and map out multiple scenarios and act as a critical input for mitigating the associated risks. Although time consuming and costly, foresight enables states and their societies to become more resilient and able to adapt to climate change, and manage uncertainty more generally.

[98] This study defines Global South countries as the **UN G77+China group** and will therefore consider all developing countries from this group as countries from the Global South.

[99] Parry, J. and Terton, A., 2016, **How Are Vulnerable Countries Adapting to Climate Change?** International Institute for Sustainable Development.

[100] Munich Re, ***Extreme weather risks.***

E3G

Beyond threat assessments and the use of foresight tools there are climate efforts already being pursued that, intentionally or unintentionally, could be helpful in managing the risks of tipping points. Reducing emissions from methane or other short-lived climate forcers is one example. Over 100 countries have signed the Global Methane Pledge, corresponding to 45% of global methane emissions caused by human activity.[101] Signatories have committed to reducing global methane emissions by at least 30% by 2030. An aggressive focus on reducing methane emissions would buy the world time to keep the temperature rise within 1.5°C. This is because of both methane's potency – the IPCC estimates that it contributes to 0.5 °C of current warming[102] – and its short lifespan of only 12 years.

[101] Global Methane Pledge, **Fast action on methane to keep a 1.5°C future within reach**.

[102] IPCC, 2021, **Climate change 2021: The Physical Science Basis – Summary for Policy Makers**.

E3G

CHAPTER 4
LOOKING AHEAD AND RECOMMENDATIONS

Summary

> The world is facing a new era of extreme climate risk. Evidence is growing that critical and irreversible climate tipping points could be breached at lower than expected temperatures. Even the expectation of breaching tipping points, as well as tipping points themselves, will likely reshape geopolitics.

> Governments and relevant institutions can take steps to prepare for and prevent the worst-case scenarios. Action should focus on better data collection and analysis; integration of threat assessments and scenario planning into decision making; more financial support to vulnerable countries; and more formal and informal dialogue on extreme risk.

The latest science is clear: climate change is happening globally, the risks rise significantly above 1.5 °C, and the window of opportunity to maintain a safe and stable climate is closing rapidly. Climate tipping points are interconnected. Some are already being breached due to rising temperatures, and this will have systemic and transboundary consequences. Extreme risk and tipping points used to be associated with long-term climate scenarios – but rising temperatures have shortened the timeline, and we are facing some of these risks today. However, the speed of change in the climate system is not being matched by decision makers. Extreme risk is not getting the political attention it needs.

With every additional 0.1 °C of warming, climate risk increases. The effects are not just physical, such as changes in borders or the disappearance of territories. This report has set out the possible geopolitical implications of increasing climate risk: larger migration flows; shifts in energy access and dependency; changes in food security; and changes in power and alliances due to the deployment of geoengineering technologies and access to raw materials.

Even if political momentum is growing around climate risk, the policy response at national and international levels is not as advanced as it should be. We have

E3G

illustrated, with the limited examples that exist, how some countries are integrating long-tail risk into their national structures. The scale of the solutions needs to match the scale of the risk we are facing globally.

Considering the findings presented above, we recommend the following:

Data and risk assessment

> The IPCC should produce **a Special Report on tipping points** and their possible cross-sectoral impacts by the end of 2024.

> The creation of a global **Climate Risk Observatory** under the UN could facilitate exchange, help address the transboundary nature of climate risk, and contribute to a goal of having early warning systems in place by 2027.

Decision making and finance

> Governments should fully **integrate climate change risk management into economic and security planning and decision making**. This should include the full range of potential temperature scenarios including threat assessments of tipping points as well as the widespread use of strategic foresight.

> International financial institutions need to **integrate climate extreme risk as a financial risk**. This would help mainstream risk management in the long term in both the private and public sector and contribute to global resilience.

> Developed countries should scale up their **international adaptation finance commitments** and should provide **finance for loss and damage** either through new or existing mechanisms. Innovative sources of private finance should be agreed.

> Developed countries should also **increase humanitarian assistance** provided for people forcibly displaced by climate events.

Dialogue and cooperation

> An international **taskforce on geoengineering** should be created. This could potentially be housed in the UN but should be composed of representatives from governments, civil society, and the private sector.

E3G

> Countries should **develop more formal and informal dialogues on extreme risk** between the major emitters and most vulnerable countries. This should be done in classical climate fora (for example have extreme risk as a recurrent topic in UNFCCC discussions) but should not be limited to them.

> Multilateral engagement is needed on climate-related migration to ensure that **legal protections are assured for climate migrants**. As a first step, the International Organisation for Migration (IOM) and UN High Commission on Refugees (UNHCR) should co-facilitate a Task Force on reducing the risks of displacement in the context of climate-driven disasters, and recognise climate change as a driver of migration. This could build on existing government-led efforts like the Migrants in Countries in Crisis (MICIC) Initiative.

> The G7 should establish a **platform for working with middle-income countries and major energy exporters on net zero transition plans**. The platform should include a working group on social protection.

E3G

ANNEX

Table 2: Examples of foresight activities from the Global North

Country	Foresight activities
USA	> Mainly centralised system, established at federal level but with some activities dispersed through different agencies and offices. Such entities include US Coast Guard, US Forest service, CIA or NASA, as well as a number of universities.[103] > Strategic foresight is used primarily in military sector, for strategising and executing operations around the world. > The Global Trends report is published by the National Intelligence Council every four years, providing analysis for incoming administrations.[104,105] Climate change is identified as a major topic, but the assessment is medium term (20 years or until 2040), meaning that a 3 °C increase in global temperature is not contemplated.
Canada	> Decentralised system with different ministries setting up foresight units within their internal entities or carrying out strategic studies on technology, military, health, environment or science. > There is a federal foresight organisation called Policy Horizons. It is responsible for informing and shaping the government's decision-making process. Work is focused on economic, social and governance topics limited to 2030–2050.[106] > Also present in other services such as Department of National Defense, Global Affairs Canada and Health Affairs Canada, and a Federal Foresight Network was created to better integrate all sectors, and to make foresight a more participatory process.[107]

[103] School of International Futures, 2021, **Features of effective systemic foresight in governments around the world.**

[104] National Intelligence Council, 2021, **Climate Change and International Responses Increasing Challenges to US National Security Through 2040**. National Intelligence Estimate.

[105] Office of the Director of National Intelligence, **Global Trends**

[106] Government of Canada, **Policy Horizons Canada**

[107] School of International Futures, 2021, **Features of effective systemic foresight in governments around the world.**

France	> Mainly centralised approach to strategic foresight, but the country is developing units and networks that are either horizontal or integrated in specific departments – such as the Armed Forces, and the Agriculture and Food and Ecological Transition Ministries.[108] > The Centre for Strategic Analysis sits in the Prime Minister's office and advises on policy formulation and implementation. The General Secretariat for National Defence and Security also carries out foresight activities.[109]
Finland	> Centralised approach to strategic foresight. Each new government has a Government Foresight Report prepared by the Prime Minister's office, which each ministry and the Parliament's Committee for the Future are consulted on and contribute to.[110] > Two main players in the foresight landscape: the Government Foresight Group and the National Foresight Network.[111,112] The first is an expert group that supports the decision-making and is both a producer and user of foresight data. The second is composed by a wide variety of national foresight data producers, and it is considered the main forum for foresight discussion and coordination in the country.
Netherlands	> Decentralised approach, distributed across sectors and ministries. > The Netherlands Scientific Council for Government Policy (WRR) – an independent advisory body – advises the government on long-term and multi-sectoral challenges with high relevance. > Diverse ministries are involved in foresight activities, such as the Ministry of Foreign Affairs; the Central Planning Bureau for Economic Policy Analysis in the Ministry for Economic Affairs; and the National Institute for Public Health and Environment, part of the Ministry of Health, Welfare and Sports, which regularly publishes foresight reports on health, and has shared with other countries its experience and knowledge on foresight activities.[113]
United Kingdom	> Foresight responsibilities are under the Government Office for Science Futures Team and headed by the Government Scientific Chief Advisor.[114] > The Ministry of Defence also carries out foresight activities through the UK Defence Science and Technology Laboratory, the organisation responsible for technology and science research in the defence and security fields, in which climate change is approached.[115]

[108] Roëls, C., 2020, **Foresight in the State Public Service in France: An Overview**. Journal of Futures Studies, 24(3), pp. 63–77.

[109] Ebrary, **Strategic foresight in government**.

[110] ibid.

[111] Finland, **The National Foresight Network**

[112] Government of Finland, **Prime Minister's Office - Government Foresight Group**

[113] National Institute for Public Health and the Environment, **Foresight Studies**

[114] Government of the UK, **Futures, Foresight and Horizon Scanning**

[115] Government of the UK, **Defence Science and Technology Laboratory**

European Union	> The European Commission has been prioritising strategic foresight since 2019 under Von der Leyen's Presidency. Vice-President Šefčovič has political responsibility and implementation is led by the Joint Research Centre (JRC). > Three strategic foresight reports have been released so far, following widespread internal and external consultation.[116] > An EU-wide Foresight Network was launched in 2020, comprising foresight officials from the different EU countries, and their designated "Ministers for the Future".

Table 3: Examples of foresight activities from the Global South

Country	Foresight activities
Malaysia	> Mainly decentralised system, where foresight work is carried out through diverse governmental institutions. > Often focused on vision setting. Early visions were aspirational, but not linked to action. More recent visions have had a stronger focus on prioritisation and action. These include the Academy of Sciences Malaysia's Envisioning Malaysia 2050: A Foresight Narrative, and Malaysia 2050 - Emerging Science, Engineering & Technology (ESET) report.[117] > Malaysia has invested in several foresight institutions: Malaysian Industry–Government Group for High Technology (MIGHT) leads on foresight work, focused on new and emerging technology. MIGHT's governance, board, networks and work offer an example of public and private partnerships for technology use and business development with considerable consultation.
Singapore	> Decentralised system with different ministries setting up foresight units within their internal entities. The government has clear structures and processes for foresight with impact. Foresight has played an important role from independence, helping to frame a national vision that is live to the geopolitical location and the resources available. > The Centre for Strategic Futures (CSF) is used by government bodies to engage in scenario planning and to examine likely and less likely signals and trends in preparation for the future. They have also implemented a Strategic Futures Network (SFN) which brings together senior policymakers to introduce new vocabulary and build awareness in ministries. Its focus is on ensuring its work has policy impact, to maintain relevance and support. To that end, it aims to develop projects with varying timeframes from relatively near-term to long-term.[118]

[116] European Commission, **Strategic foresight.**

[117] School of International Futures, 2021, **Features of effective systemic foresight in governments around the world.**

[118] ibid.

United Arab Emirates	> Centralised approach with the development of a Future Foresight strategy, which focuses on developing models for the health, education, development, and environment sectors. > Goal is to have government structures that integrate foresight tools and help develop studies and scenarios in key priority areas, such as the future of climate change, energy, water or food safety.[119] Alongside the strategy, an electronic Future Foresight Platform was also launched, to raise awareness and accessibility on foresight tools and resources.[120]

[119] UAE Government, **Future Foresight Strategy**

[120] ibid.