

# World's top climate scientists expect global heating to blast past 1.5C target

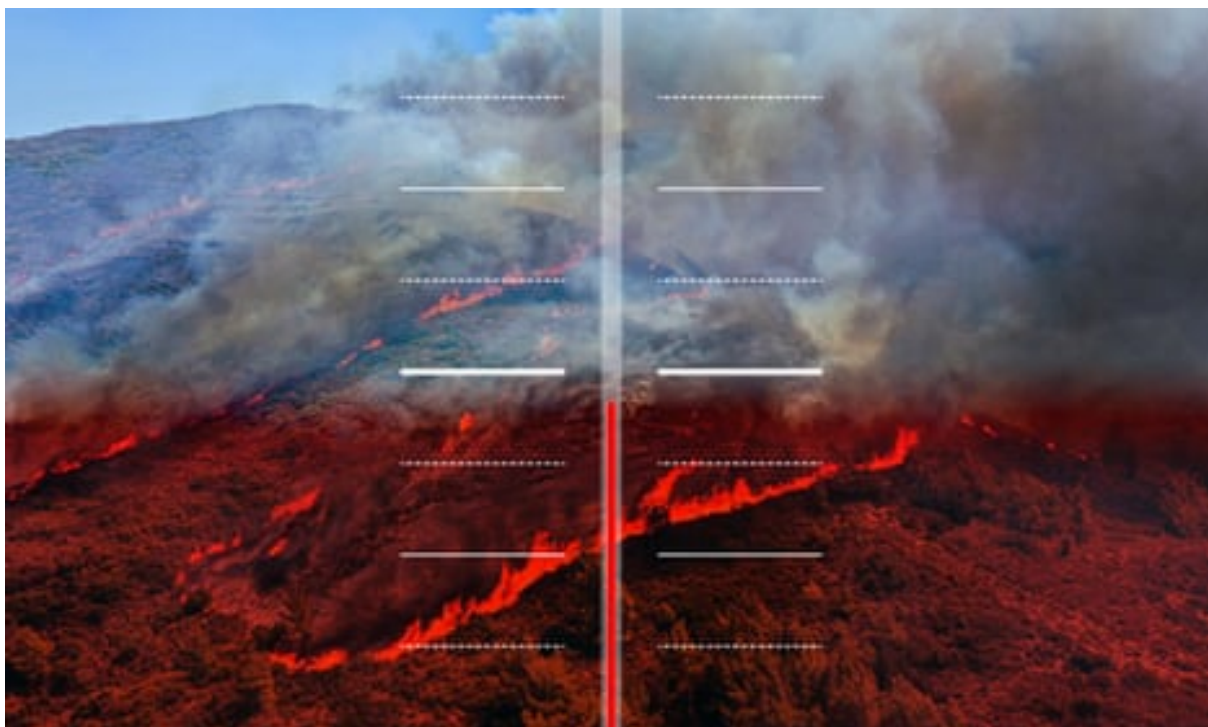
**Exclusive: Planet is headed for at least 2.5C of heating with disastrous results for humanity, poll of hundreds of scientists finds**

**'Hopeless and broken': why the world's top climate scientists are in despair**

**Damian Carrington** *Environment editor*

Wed 8 May 2024 10.00 BST

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The climate crisis is already causing profound damage to lives and livelihoods across the world. Illustration: Guardian Design/Halil Kahraman

Hundreds of the world's leading climate scientists expect global temperatures to rise to at least 2.5C (4.5F) this century, blasting past internationally agreed targets and causing catastrophic consequences for humanity and the planet, an exclusive Guardian survey has revealed.

Almost 80% of the respondents, all from the authoritative Intergovernmental Panel on Climate Change (IPCC), foresee at least 2.5C of global heating above

preindustrial levels,, while almost half anticipate at least 3C (5.4F). Only 6% thought the internationally agreed 1.5C (2.7F) limit will be met.

Many of the scientists envisage a “semi-dystopian” future, with famines, conflicts and mass migration, driven by heatwaves, wildfires, floods and storms of an intensity and frequency far beyond those that have already struck.

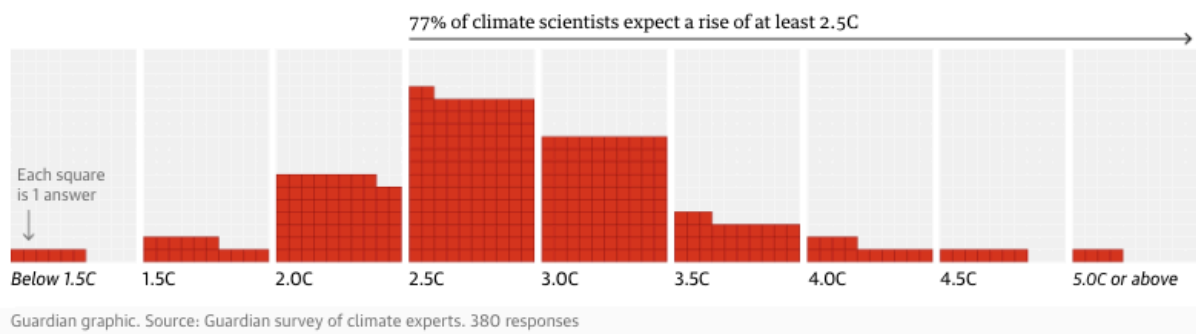
Numerous experts said they had been left feeling hopeless, infuriated and scared by the failure of governments to act despite the clear scientific evidence provided.

“I think we are headed for major societal disruption within the next five years,” said Gretta Pecl, at the University of Tasmania. “[Authorities] will be overwhelmed by extreme event after extreme event, food production will be disrupted. I could not feel greater despair over the future.”

### How high will global heating go?

How high above pre-industrial levels do you think average global temperature will rise between now and 2100?

Count of answers given by IPCC climate experts



But many said the climate fight must continue, however high global temperature rose, because every fraction of a degree avoided would reduce human suffering.

Peter Cox, at the University of Exeter, UK, said: “Climate change will not suddenly become dangerous at 1.5C – it already is. And it will not be ‘game over’ if we pass 2C, which we might well do.”

The Guardian approached every contactable lead author or review editor of IPCC reports since 2018. Almost half replied, 380 of 843. The IPCC’s reports are the gold standard assessments of climate change, approved by all governments and produced by experts in physical and social sciences. The results show that many of the most knowledgeable people on the planet expect climate havoc to unfold in the coming decades.

The climate crisis is already causing profound damage to lives and livelihoods across the world, with only 1.2C (2.16F) of global heating on average over the past four years. Jesse Keenan, at Tulane University in the US, said: “This is just the beginning: buckle up.”

Nathalie Hilmi, at the Monaco Scientific Centre, who expects a rise of 3C, agreed: “We cannot stay below 1.5C.”

The experts said massive preparations to protect people from the worst of the coming climate disasters were now critical. Leticia Cotrim da Cunha, at the State University of Rio de Janeiro, said: “I am extremely worried about the costs in human lives.”

The 1.5C target was chosen to prevent the worst of the climate crisis and has been seen as an important guiding star for international negotiations. Current climate policies mean the world is on track for about 2.7C, and the Guardian survey shows few IPCC experts expect the world to deliver the huge action required to reduce that.

Younger scientists were more pessimistic, with 52% of respondents under 50 expecting a rise of at least 3C, compared with 38% of those over 50. Female scientists were also more downbeat than male scientists, with 49% thinking global temperature would rise at least 3C, compared with 38%. There was little difference between scientists from different continents.

Dipak Dasgupta, at the Energy and Resources Institute in New Delhi, said: “If the world, unbelievably wealthy as it is, stands by and does little to address the plight of the poor, we will all lose eventually.”

The experts were clear on why the world is failing to tackle the climate crisis. A lack of political will was cited by almost three-quarters of the respondents, while 60% also blamed vested corporate interests, such as the fossil fuel industry.

Many also mentioned inequality and a failure of the rich world to help the poor, who suffer most from climate impacts. “I expect a semi-dystopian future with substantial pain and suffering for the people of the global south,” said a South African scientist, who chose not to be named. “The world’s response to date is reprehensible – we live in an age of fools.”

About a quarter of the IPCC experts who responded thought global temperature rise would be kept to 2C or below but even they tempered their hopes.

“I am convinced that we have all the solutions needed for a 1.5C path and that we will implement them in the coming 20 years,” said Henry Neufeldt, at the

UN's Copenhagen Climate Centre. "But I fear that our actions might come too late and we cross one or several tipping points."

Lisa Schipper, at University of Bonn in Germany, said: "My only source of hope is the fact that, as an educator, I can see the next generation being so smart and understanding the politics."

We asked 380 top climate scientists what they felt about the future...

"Hopeless and broken" Ruth Cerezo-Mota Mexico

"We live in an age of fools" Anonymous South Africa

"I worry about the future my children are inheriting" Lorraine Whitmarsh UK

They are terrified, but determined to keep fighting.  
Here's what they said

## 'Hopeless and broken': why the world's top climate scientists are in despair

Exclusive: Survey of hundreds of experts reveals harrowing picture of future, but they warn climate fight must not be abandoned

- World's top climate scientists expect global heating to blast past 1.5C target

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"Sometimes it is almost impossible not to feel hopeless and broken," says the climate scientist Ruth Cerezo-Mota. "After all the flooding, fires, and droughts of the last three years worldwide, all related to climate change, and after the fury of Hurricane Otis in Mexico, my country, I really thought governments were ready to listen to the science, to act in the people's best interest."

Instead, Cerezo-Mota expects the world to heat by a catastrophic 3C this century, soaring past the internationally agreed 1.5C target and delivering enormous suffering to billions of people. This is her optimistic view, she says.

“The breaking point for me was a meeting in Singapore,” says Cerezo-Mota, an expert in climate modelling at the National Autonomous University of Mexico. There, she listened to other experts spell out the connection between rising global temperatures and heatwaves, fires, storms and floods hurting people – not at the end of the century, but today. “That was when everything clicked.



Dr Ruth Cerezo-Mota: ‘There is no safe place for anyone.’ Photograph: Tamara Uribe/  
The Guardian

“I got a depression,” she says. “It was a very dark point in my life. I was unable to do anything and was just sort of surviving.”

Cerezo-Mota recovered to continue her work: “We keep doing it because we have to do it, so [the powerful] cannot say that they didn’t know. We know what we’re talking about. They can say they don’t care, but they can’t say they didn’t know.”

In Mérida on the Yucatán peninsula, where Cerezo-Mota lives, the heat is ramping up. “Last summer, we had around 47C maximum. The worst part is that, even at night, it’s 38C, which is higher than your body temperature. It doesn’t give a minute of the day for your body to try to recover.”

She says record-breaking heatwaves led to many deaths in Mexico. “It’s very frustrating because many of these things could have been avoided. And it’s just silly to think: ‘Well, I don’t care if Mexico gets destroyed.’ We have seen these extreme events happening everywhere. There is not a safe place for anyone.

“I think 3C is being hopeful and conservative. 1.5C is already bad, but I don’t think there is any way we are going to stick to that. There is not any clear sign from any government that we are actually going to stay under 1.5C.”

### *‘Infuriating, distressing, overwhelming’*

Cerezo-Mota is far from alone in her fear. An exclusive Guardian survey of hundreds of the world’s leading climate experts has found that:

- 77% of respondents believe global temperatures will reach at least 2.5C above pre-industrial levels, a devastating degree of heating;
- almost half – 42% – think it will be more than 3C;
- only 6% think the 1.5C limit will be achieved.

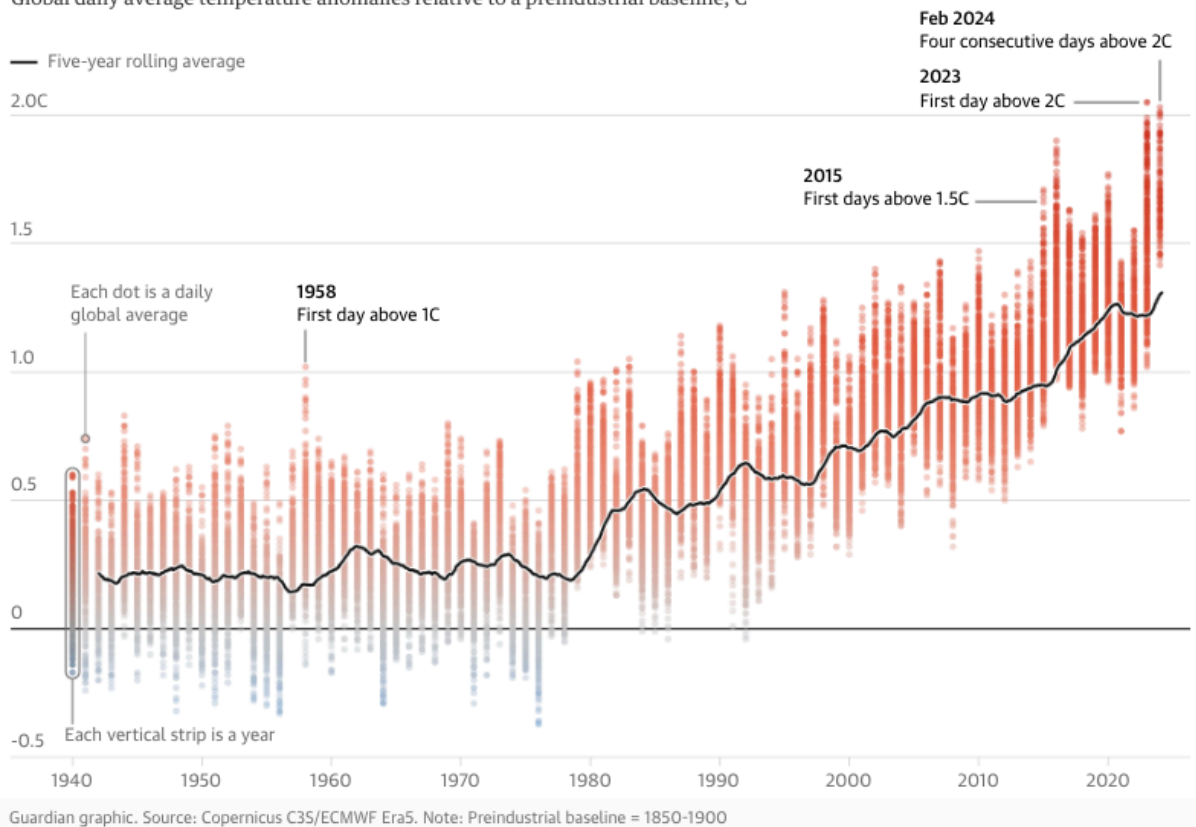
The task climate researchers have dedicated themselves to is to paint a picture of the possible worlds ahead. From experts in the atmosphere and oceans, energy and agriculture, economics and politics, the mood of almost all those the Guardian heard from was grim. And the future many painted was harrowing: famines, mass migration, conflict. “I find it infuriating, distressing, overwhelming,” said one expert, who chose not to be named. “I’m relieved that I do not have children, knowing what the future holds,” said another.

The scientists’ responses to the survey provide informed opinions on critical questions for the future of humanity. How hot will the world get, and what will that look like? Why is the world failing to act with anything remotely like the urgency needed? Is it, in fact, game over, or must we fight on? They also provide a rare glimpse into what it is like to live with this knowledge every day.

The climate crisis is already causing profound damage across the planet with just 1.2C of average global heating over the last four years. But the scale of future impacts will depend on what happens – or not – in politics, finance, technology and global society, and how the Earth’s climate and ecosystems respond.

## Daily temperature anomalies

Global daily average temperature anomalies relative to a preindustrial baseline, C



The Intergovernmental Panel on Climate Change (IPCC) has convened thousands of experts in all these fields to produce the most authoritative reports available, which are approved by all governments. It was founded in 1988 by the United Nations, which was concerned even at that time that global heating could “be disastrous for mankind if timely steps are not taken at all levels”.

The IPCC’s task was to produce a comprehensive review and recommendations, which it has now done six times over 35 years. In terms of scale and significance, it may be the most important scientific endeavour in human history.

The IPCC experts are, in short, the most informed people on the planet on climate. What they think matters. So the Guardian contacted every available lead author or review editor of all IPCC reports since 2018. Almost half replied – 380 out of 843, a very high response rate.

Their expectations for global temperature rise were stark. Lisa Schipper, at the University of Bonn, anticipates a 3C rise: “It looks really bleak, but I think it’s realistic. It’s just the fact that we’re not taking the action that we need to.” Technically, a lower temperature peak was possible, the scientists said, but few had any confidence it would be delivered.

Their overwhelming feelings were fear and frustration. “I expect a semi-dystopian future with substantial pain and suffering for the people of the global south,” said a South African scientist who chose not to be named. “The world’s response to date is reprehensible – we live in an age of fools.”

### *‘Running away from it is impossible’*

So how do the scientists cope with their work being ignored for decades, and living in a world their findings indicate is on a “highway to hell”?

Camille Parmesan, at the CNRS ecology centre in France, was on the point of giving up 15 years ago. “I had devoted my research life to [climate science] and it had not made a damn bit of difference,” she said. “I started feeling [like], well, I love singing, maybe I’ll become a nightclub singer.”

She was inspired to continue by the dedication she saw in the young activists at the turbulent UN climate summit in Copenhagen 2009. “All these young people were so charged up, so impassioned. So I said I’ll keep doing this, not for the politicians, but for you.





Henri Waisman. Photograph: Jean Larive

“The big difference [with the most recent IPCC report] was that all of the scientists I worked with were incredibly frustrated. Everyone was at the end of their rope, asking: what the fuck do we have to do to get through to people how bad this really is?”

“Scientists are human: we are also people living on this Earth, who are also experiencing the impacts of climate change, who also have children, and who also have worries about the future,” said Schipper. “We did our science, we put this really good report together and – wow – it really didn’t make a difference on the policy. It’s very difficult to see that, every time.”

Climate change is our “unescapable reality”, said Joeri Rogelj, at Imperial College London. “Running away from it is impossible and will only increase the challenges of dealing with the consequences and implementing solutions.”

Henri Waisman, at the IDDRI policy research institute in France, said: “I regularly face moments of despair and guilt of not managing to make things change more rapidly, and these feelings have become even stronger since I became a father. But, in these moments, two things help me: remembering how

much progress has happened since I started to work on the topic in 2005 and that every tenth of a degree matters a lot – this means it is still useful to continue the fight.”

### *‘1.5C is a political game’*

In the climate crisis, even fractions of a degree do matter: every extra tenth means 140 million more people suffering in dangerous heat. The 1.5C target was forced through international negotiations by an alliance of uniquely vulnerable small island states. They saw the previous 2C target as condemning their nations to obliteration under rising oceans and storms.

The 1.5C goal was adopted as a stretch target at the UN climate summit in Paris in 2015 with the deal seen as a triumph, a statement of true multilateral ambition delivered with beaming smiles and euphoric applause. It quickly became the default target for minimising climate damage, with UN summits being conducted to the repeated refrain of: “Keep 1.5 alive!” For the target to be breached requires global temperatures to be above 1.5C across numerous years, not just for a single year.

It remains a vital political target for many climate diplomats, anchoring international climate efforts and driving ambition. But to almost all the IPCC experts the Guardian heard from, it is dead. A scientist from a Pacific Island nation said: “Humanity is heading towards destruction. We’ve got to appreciate, help and love each other.”

Schipper said: “There is an argument that if we say that it is too late for 1.5C, that we are setting ourselves up for defeat and saying there’s nothing we can do, but I don’t agree.”

Jonathan Cullen, at the University of Cambridge, was particularly blunt: “1.5C is a political game – we were never going to reach this target.”



Lars Nilsson of Lund University. Photograph: none

The climate emergency is already here. Even just 1C of heating has supercharged the planet's extreme weather, delivering searing heatwaves from the US to Europe to China that would have been otherwise impossible. Millions of people have very likely died early as a result already. At just 2C, the brutal heatwave that struck the Pacific north-west of America in 2021 will be 100-200 times more likely.

But a world that is hotter by 2.5C, 3C, or worse, as most of the experts anticipate, takes us into truly uncharted territory. It is hard to fully map this new world. Our intricately connected global society means the impact of climate shocks in one place can cascade around the world, through food price spikes, broken supply chains, and migration.

One relatively simple study examined the impact of a 2.7C rise, the average of the answers in the Guardian survey. It found 2 billion people pushed outside humanity's "climate niche", ie the benign conditions in which the whole of human civilisation arose over the last 10,000 years.

The latest IPCC assessment devotes hundreds of pages to climate impacts, with irreversible losses to the Amazon rainforest, quadrupled flood damages and

billions more people exposed to dengue fever. With 3C of global heating, cities including Shanghai, Rio de Janeiro, Miami and The Hague end up below sea level.

“It is the biggest threat humanity has faced, with the potential to wreck our social fabric and way of life. It has the potential to kill millions, if not billions, through starvation, war over resources, displacement,” said James Renwick, at Victoria University of Wellington, New Zealand. “None of us will be unaffected by the devastation.”

“I am scared mightily – I don’t see how we are able to get out of this mess,” said Tim Benton, an expert on food security and food systems at the Chatham House thinktank. He said the cost of protecting people and recovering from climate disasters will be huge, with yet more discord and delay over who pays the bills. Numerous experts were worried over food production: “We’ve barely started to see the impacts,” said one.

Another grave concern was climate tipping points, where a tiny temperature increase tips crucial parts of the climate system into collapse, such as the Greenland ice sheet, the Amazon rainforest and key Atlantic currents. “Most people do not realise how big these risks are,” said Wolfgang Cramer, at the Mediterranean Institute of Biodiversity and Ecology.

### *‘All of humanity needs to come together and cooperate’*

In the face of such colossal danger, why is the world’s response so slow and inadequate? The IPCC experts overwhelmingly pointed to one barrier: lack of political will. Almost three-quarters of the respondents cited this factor, with 60% also blaming vested corporate interests.

“[Climate change] is an existential threat to humanity and [lack of] political will and vested corporate interests are preventing us addressing it. I do worry about the future my children are inheriting,” said Lorraine Whitmarsh, at the University of Bath in the UK.

Lack of money was only a concern for 27% of the scientists, suggesting most believe the finance exists to fund the green transition. Few respondents thought that a lack of green technology or scientific understanding of the issue were a problem – 6% and 4% respectively.

“All of humanity needs to come together and cooperate – this is a monumental opportunity to put differences aside and work together,” said Louis Verchot, at the International Center for Tropical Agriculture in Colombia. “Unfortunately

climate change has become a political wedge issue ... I wonder how deep the crisis needs to become before we all start rowing in the same direction.”

Dipak Dasgupta, an economist and former government adviser in India, said short-term thinking by governments and businesses was a major barrier. Climate action needed decade-long planning, in contrast to election cycles of only a few years, said others.



Dr Shobha Maharaj in San Fernando, Trinidad, where stabilisation works have been carried out in an attempt to preserve the coastline. Photograph: Kelly Ann Bobb/The Guardian

A world of climate chaos would require a much greater focus on protecting people from inevitable impacts, said many scientists, but again politics stands in the way. “Multiple trillions of dollars were liquidated for use during the pandemic, yet it seems there is not enough political will to commit several

billion dollars to adaptation funding,” said Shobha Maharaj, from Trinidad and Tobago.

The capture of politicians and the media by vastly wealthy fossil fuel companies and petrostates, whose oil, gas and coal are the root cause of the climate crisis, was frequently cited. “The economic interests of nations often take precedence,” said Lincoln Alves at Brazil’s National Institute for Space Research.

Stephen Humphreys at the London School of Economics said: “The tacit calculus of decision-makers, particularly in the Anglosphere – US, Canada, UK, Australia – but also Russia and the major fossil fuel producers in the Middle East, is driving us into a world in which the vulnerable will suffer, while the well-heeled will hope to stay safe above the waterline” – even with the cataclysmic 3.5C rise he expects. Asked what individual action would be effective, he said: “Civil disobedience.”

Disinformation was a major concern for scientists from Brazil to Ukraine. This was polarising society, compounding a poor public understanding of climate risk and blinding people to the fact almost all the climate solutions needed were at hand, they said.

“The enormity of the problem is not well understood,” said Ralph Sims, at Massey University in New Zealand. “So there will be environmental refugees by the millions, extreme weather events escalating, food and water shortages, before the majority accept the urgency in reducing emissions – by which time it will be too late.”

## *‘Capitalism has trained us well’*

“Fight for a fairer world.” That simple message from one French scientist reflected the thoughts of many, who said the huge gap between the world’s rich and poor was a giant barrier to climate action, echoing the chasm between those responsible for the most emissions and those suffering most from the impacts.

Global solidarity could overcome any environmental crisis, according to Esteban Jobbágy, at the University of San Luis in Argentina. “But current growing inequalities are the number one barrier to that.”

Aditi Mukherji, at the CGIAR research group, said: “The rich countries have hogged all the carbon budget, leaving very little for the rest of the world.” The

global north has a huge obligation to fix a problem of its own making by slashing its emissions and providing climate funding to the rest of the world, she said. The Indian government recently put a price tag on that: at least \$1tn a year.

Overconsumption in rich nations was also cited as a barrier. “I feel resigned to disaster as we cannot separate our love of bigger, better, faster, more, from what will help the greatest number of people survive and thrive,” said one US scientist. “Capitalism has trained us well.”

[View image in fullscreen](#)

Michael Meredith of the British Antarctic Survey. Photograph: BAS

However, Maisa Rojas, an IPCC scientist and Chile’s environment minister, said: “We need to communicate that acting on climate change can be a benefit, with proper support from the state, instead of a personal burden.”

She is one of a minority of the experts surveyed – less than 25% – who still think global temperature rise will be restricted to 2C or less. The IPCC vice-chair Aïda Diongue-Niang, a Senegalese meteorologist, is another, saying: “I believe there will be more ambitious action to avoid 2.5C to 3C.”

So why are these scientists optimistic? One reason is the rapid rollout of green technologies from renewable energy to electric cars, driven by fast-falling prices and the multiple associated benefits they bring, such as cleaner air. “It is getting cheaper and cheaper to save the climate,” said Lars Nilsson, at Lund University in Sweden.

Even the rapidly growing need to protect communities against inevitable heatwaves, floods and droughts could have an upside, said Mark Pelling, at University College London. “It opens exciting possibilities: by having to live with climate change, we can adapt in ways that bring us to a more inclusive and equitable way of living.”

Such a world would see adaptation go hand-in-hand with cutting poverty and vulnerability, providing better housing, clean and reliable water and electricity, better diets, more sustainable farming, and less air pollution.

However, most hope was heavily guarded. “The good news is the worst-case scenario is avoidable,” said Michael Meredith, at the British Antarctic Survey. “We still have it in our hands to build a future that is much more benign climatically than the one we are currently on track for.” But he also expects “our societies will be forced to change and the suffering and damage to lives and livelihoods will be severe”.



“I believe in social tipping points,” where small changes in society trigger large-scale climate action, said Elena López-Gunn, at the research company Icatalist in Spain. “Unfortunately, I also believe in physical climate tipping points.”

Back in Mexico, Cerezo-Mota remains at a loss: “I really don’t know what needs to happen for the people that have all the power and all the money to make the change. But then I see the younger generations fighting and I get a bit of hope again.”

*Note: Julian Ganz provided the technical support to conduct the survey, which was sent on 31 January 2024. Men made up 68% of the respondents, women 28% and 4% preferred not to state their gender. This mirrors the gender split of the IPCC authors overall. A large majority of the scientists – 89% – were aged between 40 and 69 and they were from 35 different countries across the world, with every continent represented by dozens of experts. The age and gender questions were not mandatory but were answered by 344 and 346 respondents respectively.*

*Excerpts of footage and images taken from the Guardian’s climate coverage*