

THE
LITTLE
BOOK
OF
DATA



AVIVA
INVESTORS

The Little Book of Data

October 2023



“It is a capital mistake to theorise before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.”

Sherlock Holmes
Arthur Conan Doyle, “A Scandal in Bohemia”, 1891

Foreword

The world’s greatest detective was clearly onto something. Long before statements like “*data is the new oil*” entered the public lexicon, smart people in a multitude of disciplines, from academia to business, understood the advantage of access to data.

Data on its own, however, is meaningless. It must be cleaned, sorted and processed effectively to become useful. Turning it into information and actionable insights requires judgement, a flair for design, and a solid grasp of computing and statistics.

This is where data visualisation comes in. The ability to present data in clear and creative ways is a valuable commodity in its own right. Doing it well saves time and confusion. From the simplest line chart showing how a company’s share price has changed over time, to a radial chart with multiple inputs and variables, data visualisation has the power to quickly draw you in and show something important or new.

The investment industry is constantly evolving and we are always looking for insights that can give us an edge. This is why we spend time each year curating and creating what we believe are some of the most relevant and thought-provoking charts and information graphics for our clients. We select the ones that catch our eyes and make us stop and think.

It helps ensure we adapt our theories to suit the facts – and not the other way round.

Enjoy the sixth edition of *The Little Book of Data*.

Mark Versey
Chief Executive Officer
Aviva Investors

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THE BIGGER PICTURE

From macroeconomics to the market impact of AI

What's \$100 trillion between friends?

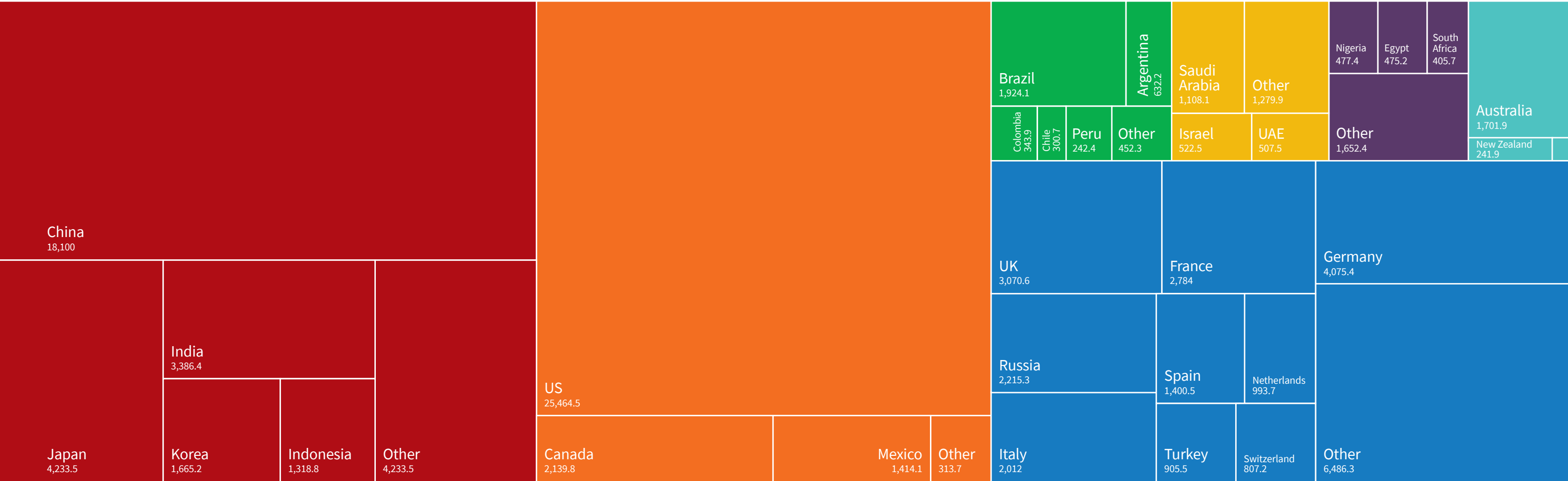
The US remains the world's dominant economy

The size of the world economy topped \$100 trillion for the first time in 2022, according to the International Monetary Fund. While the US remains the largest economy, nations such as China and India now take a significant share of global GDP.

From chipmaking to climate change, from trade policy to the fate of Taiwan, the sometimes-frosty relationship between the world's major economies is shaping the landscape of the 21st century.

Global GDP, 2022

US\$ billions



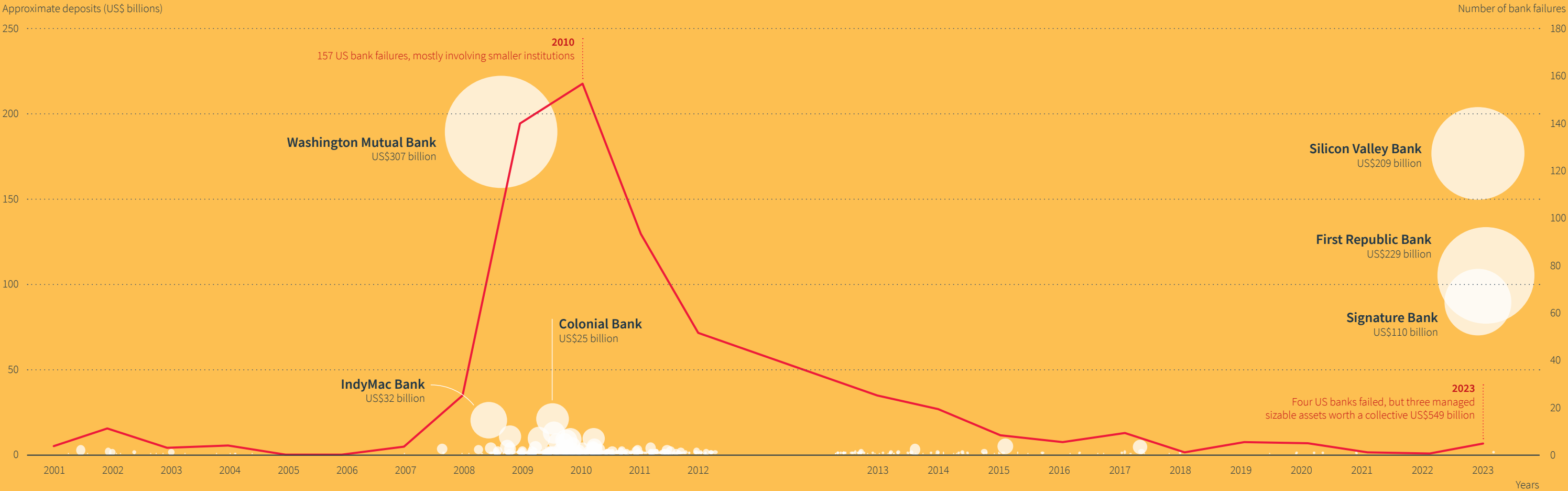
Crisis? What crisis?

How the banking episode was swiftly contained

In March 2023, several US banks suffered runs on deposits, partly due to liquidity issues prompted by rising interest rates. The same month, the Swiss government brokered an emergency arrangement that saw UBS step in to purchase domestic rival Credit Suisse.

These events spooked markets. But history offers valuable perspective. While the “mini-crisis” led to the collapse of three big US banks, swift regulatory action helped prevent wider contagion of the kind that ripped through the sector during the Global Financial Crisis.

Failures of US banks covered by the Federal Deposit Insurance Corporation, 2001-2023



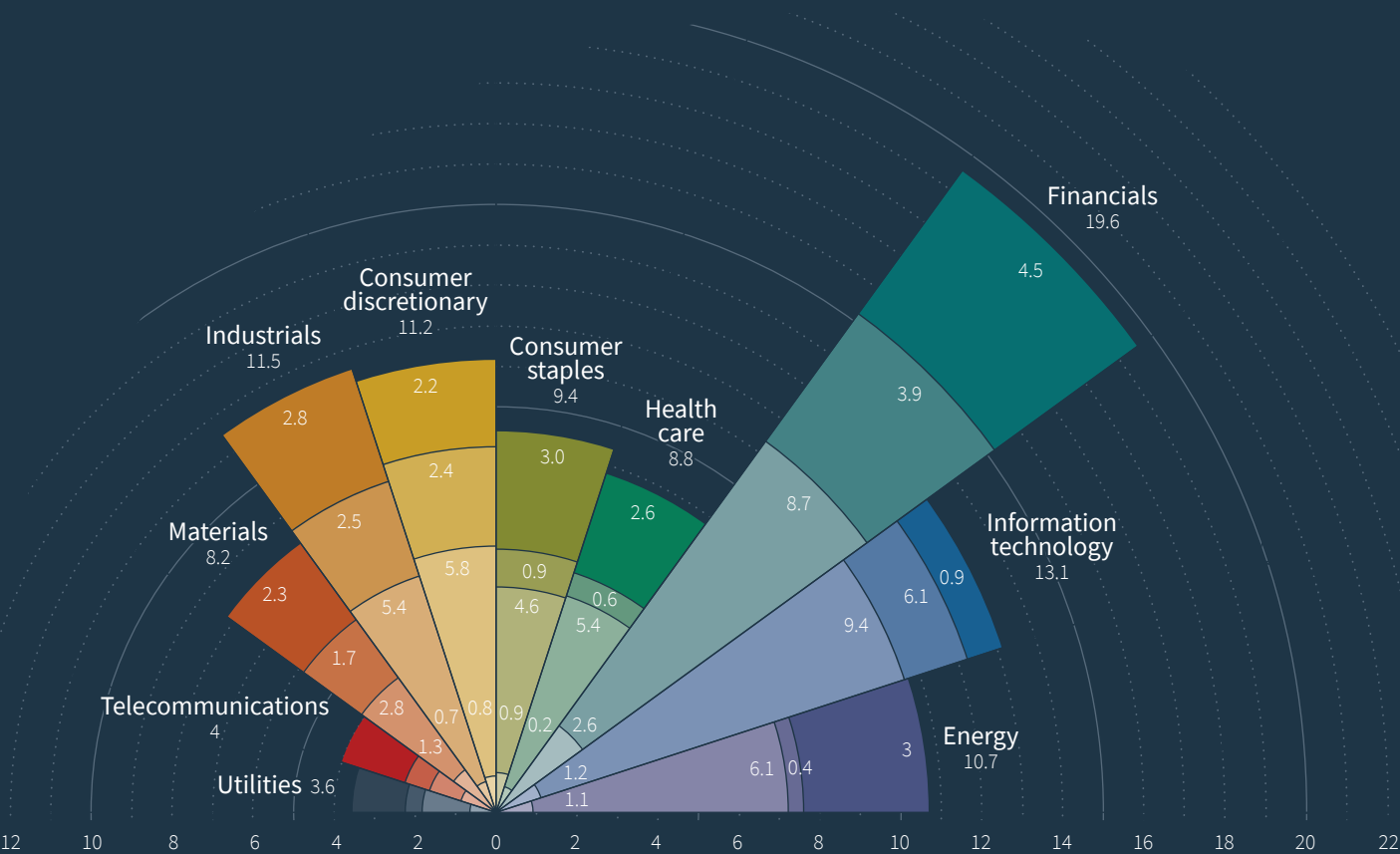
A bigger byte

Tech now dominates market indices

The composition of global markets has shifted dramatically over the past decade. In 2012, the financial sector accounted for almost 20 per cent of the MSCI All Country World Investable Market Index. Since then, its share has fallen, partly due to tougher regulation in the wake of the Global Financial Crisis, which hit banks' profitability.

Sector breakdown of the MSCI ACWI Investable Market Index, 2012

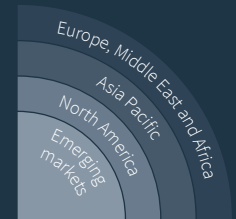
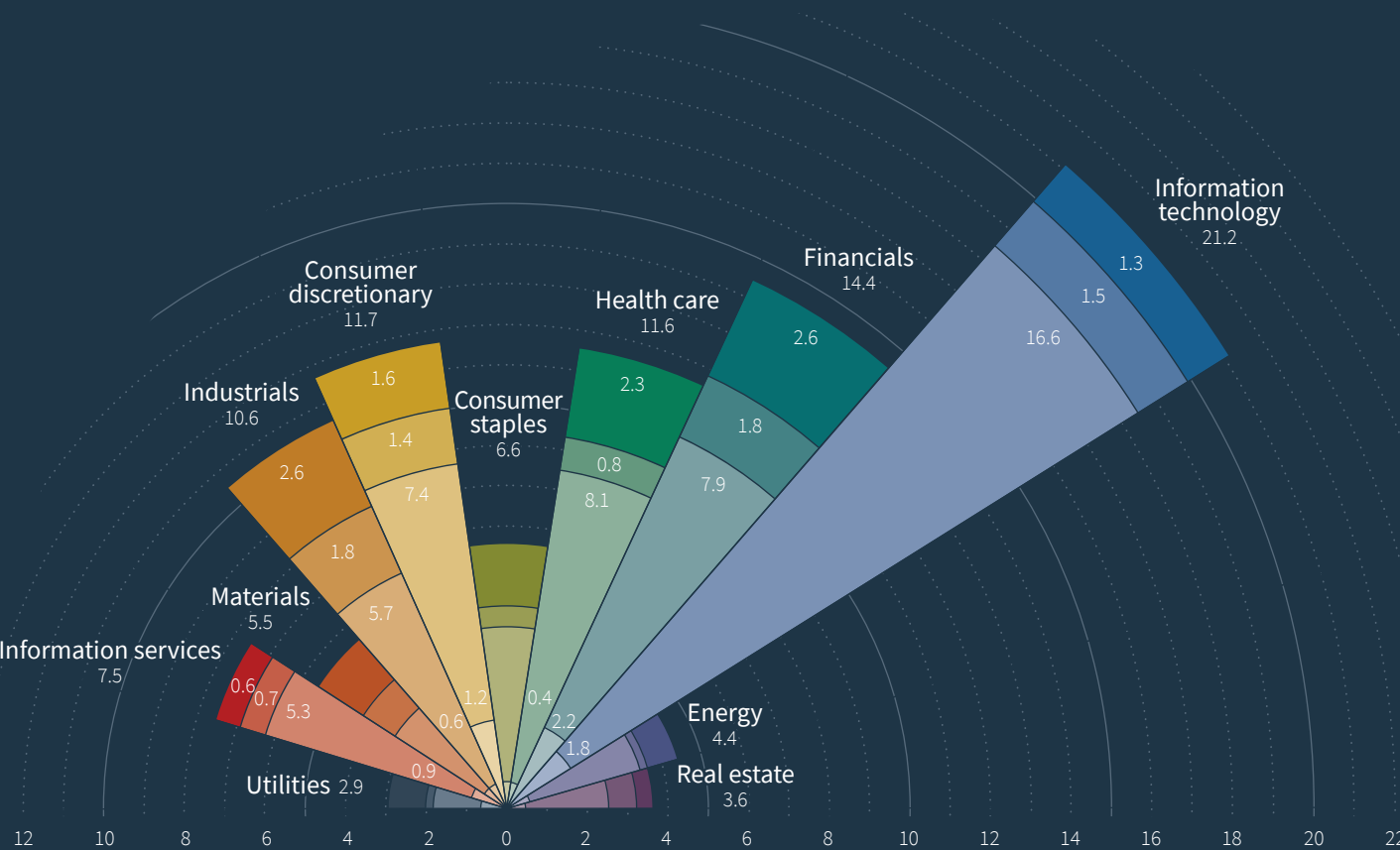
Per cent

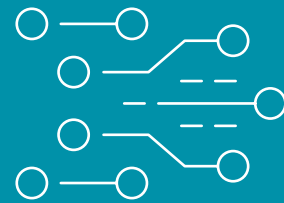


Meanwhile, the tech sector has surged into first place, powered by the seemingly unstoppable growth of Silicon Valley heavyweights such as Alphabet, Apple and Meta.

Sector breakdown, 2022

Per cent





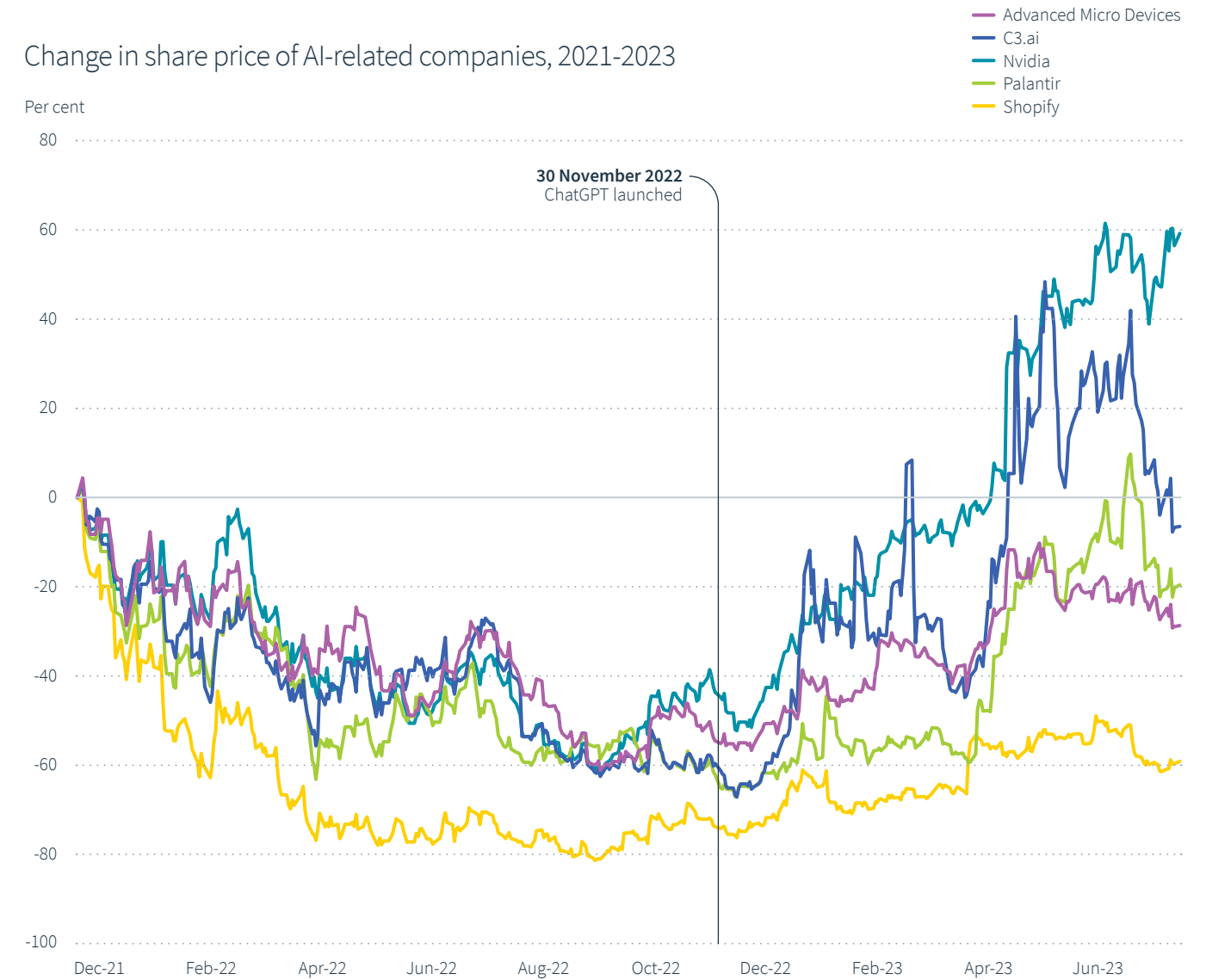
The launch of OpenAI's ChatGPT platform in November 2022 created a global sensation. Freely available to the public, ChatGPT shifted artificial intelligence into a new mass-market phase – and created a frenzy of interest in AI-related stocks.

The main beneficiaries so far have been chipmakers such as Nvidia, which specialises in making advanced chips to power energy-guzzling AI programmes.

Betting on chips

The market impact of ChatGPT

Change in share price of AI-related companies, 2021-2023



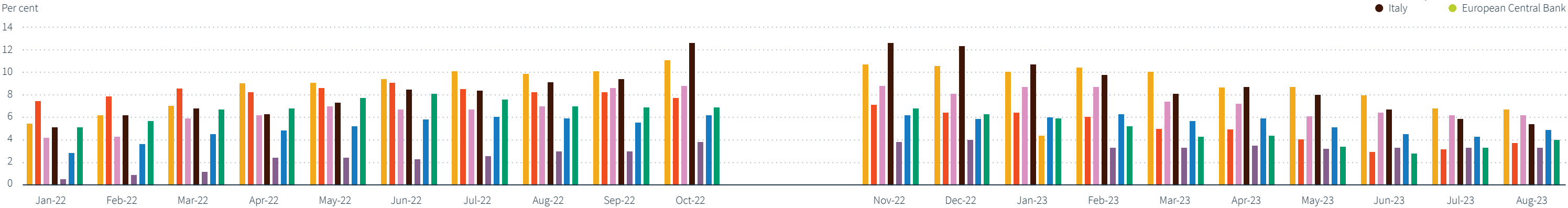
What goes up...

Have rising rates tamed inflation?

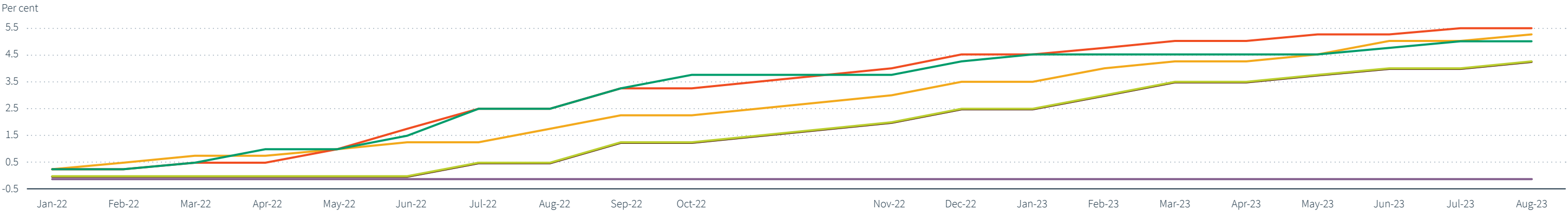
Following Russia’s invasion of Ukraine in February 2022, energy prices shot up, contributing to inflationary pressures that had been building across supply chains in the wake of the COVID-19 pandemic. Central banks around the world sharply hiked rates to tackle rising prices.

While inflation has started to fall in many countries, the full economic impact of this rapid monetary tightening cycle has still to play out.

Monthly consumer price indices in G7 countries, 2022-2023



Base rates in selected G7 countries, 2022-2023



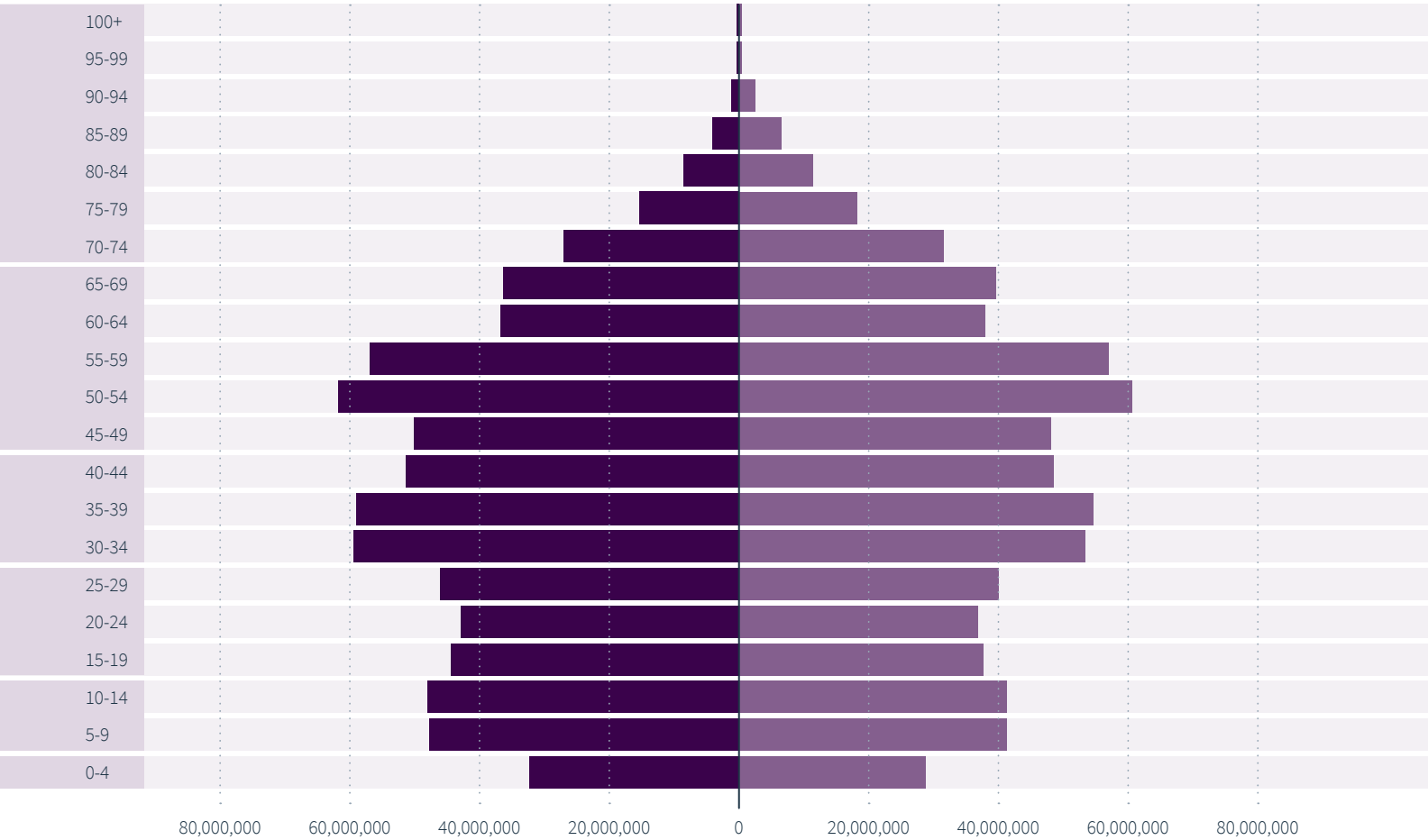
Demographic dividend

India's baby boom is a key economic advantage

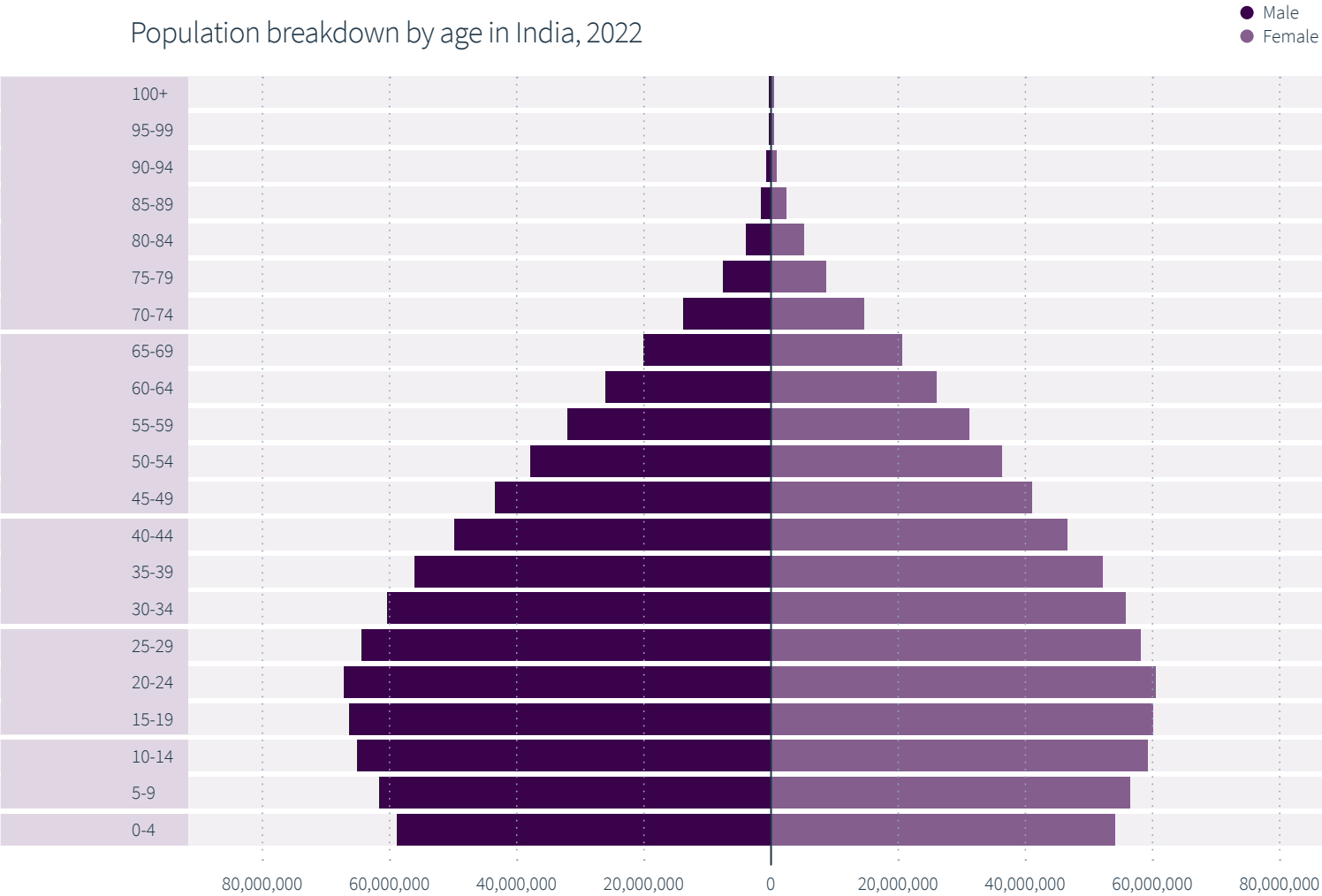
India and China are alike in many ways. Both are major economies with an increasingly affluent middle class. Both are led by “strongmen” who seek greater clout on the world stage (although India remains a democracy).

While India's economy remains smaller than China's, it has a key advantage over its rival: demography. India benefits from a young and fast-growing workforce. By contrast, China's rapidly ageing population will lead to increased costs for health and social care, putting a drag on government and household budgets.

Population breakdown by age in China, 2022



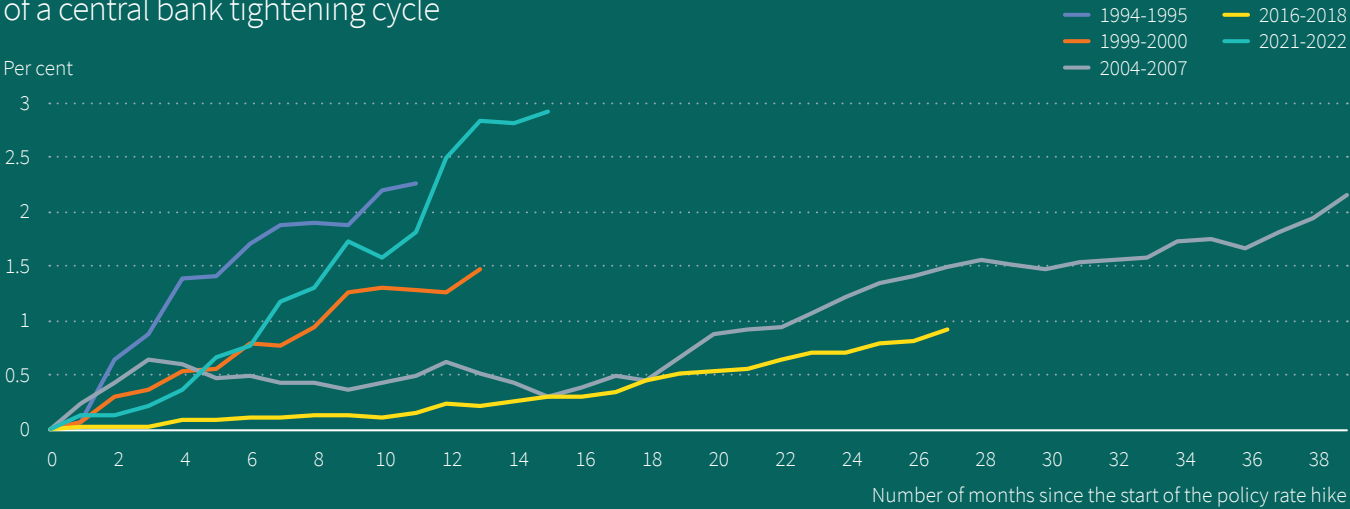
Population breakdown by age in India, 2022



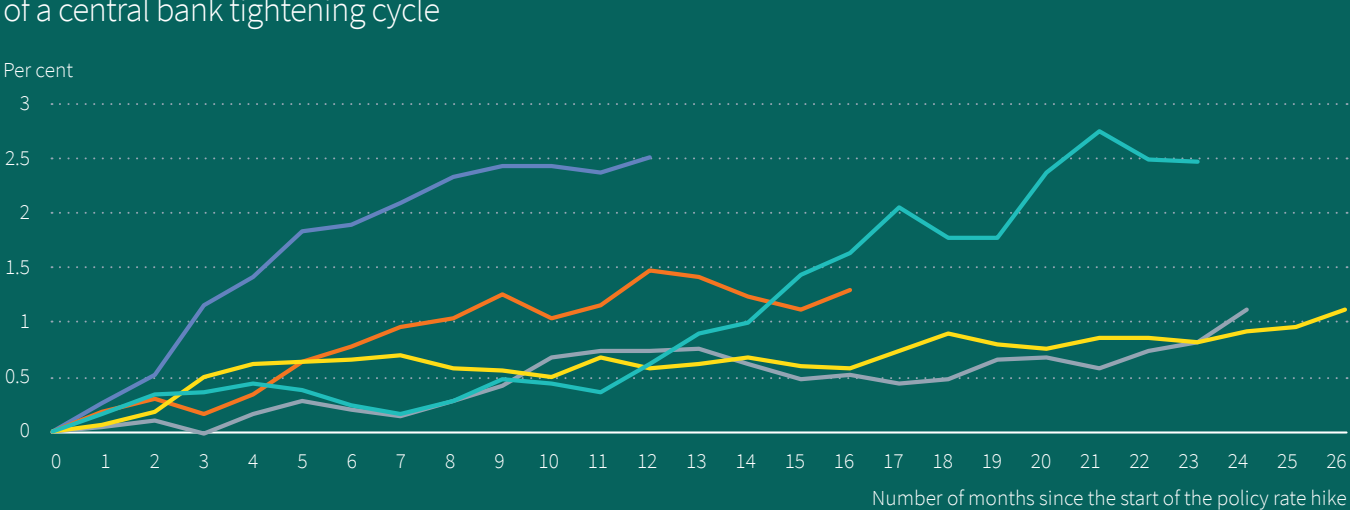
From here to maturity

Rising rates cause concern about debt burdens

Changes in G7 benchmark two-year bond yields following the start of a central bank tightening cycle



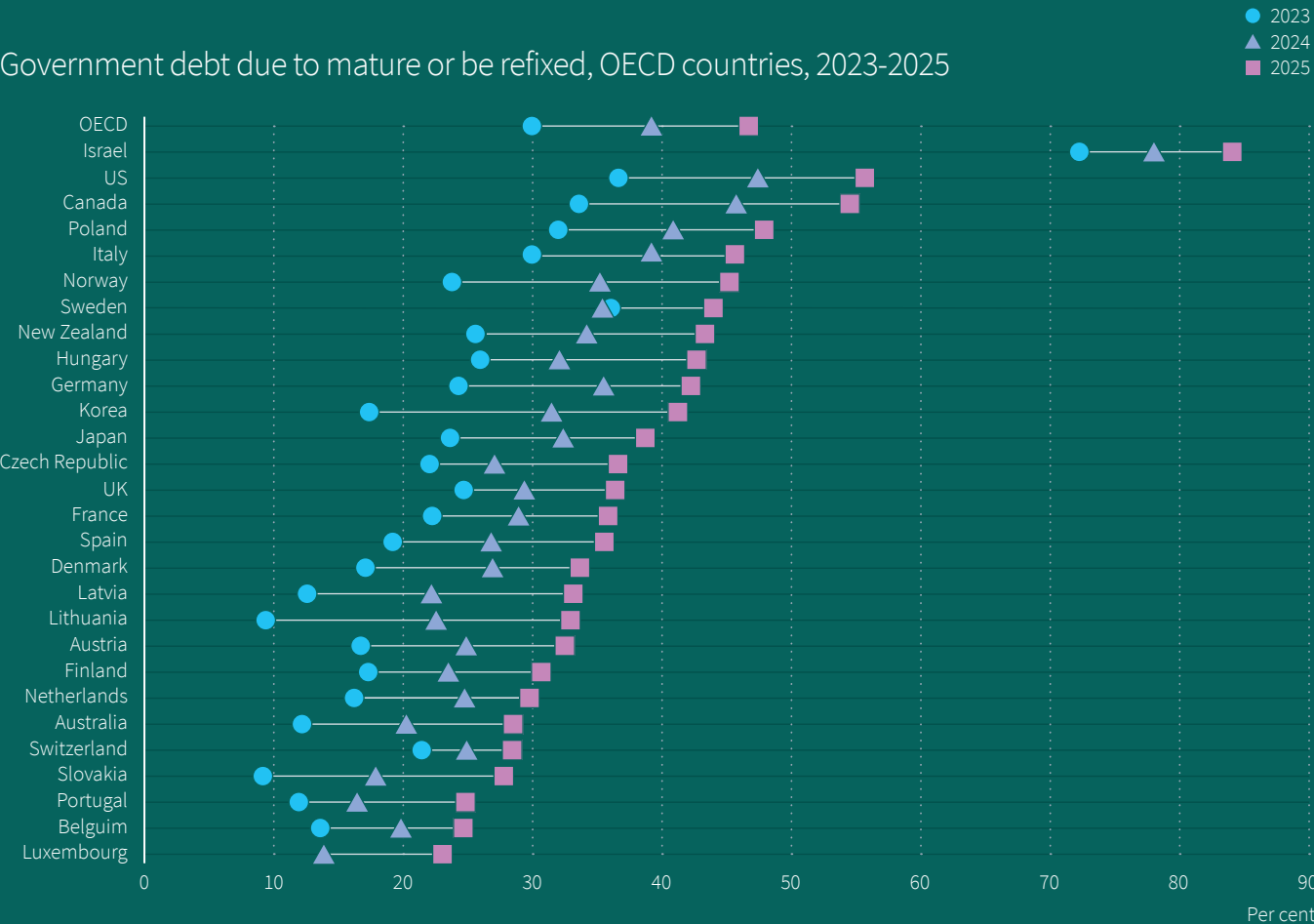
Changes in G7 benchmark ten-year bond yields following the start of a central bank tightening cycle



Figures from the Institute of International Finance show global debt has reached \$305 trillion – \$45 trillion higher than its pre-pandemic level.

With rising rates feeding through to higher borrowing costs, investors and economists are closely monitoring the maturity profiles of government bonds and the upcoming adjustments to variable-rate instruments for signs of weakness.

Government debt due to mature or be refixed, OECD countries, 2023-2025



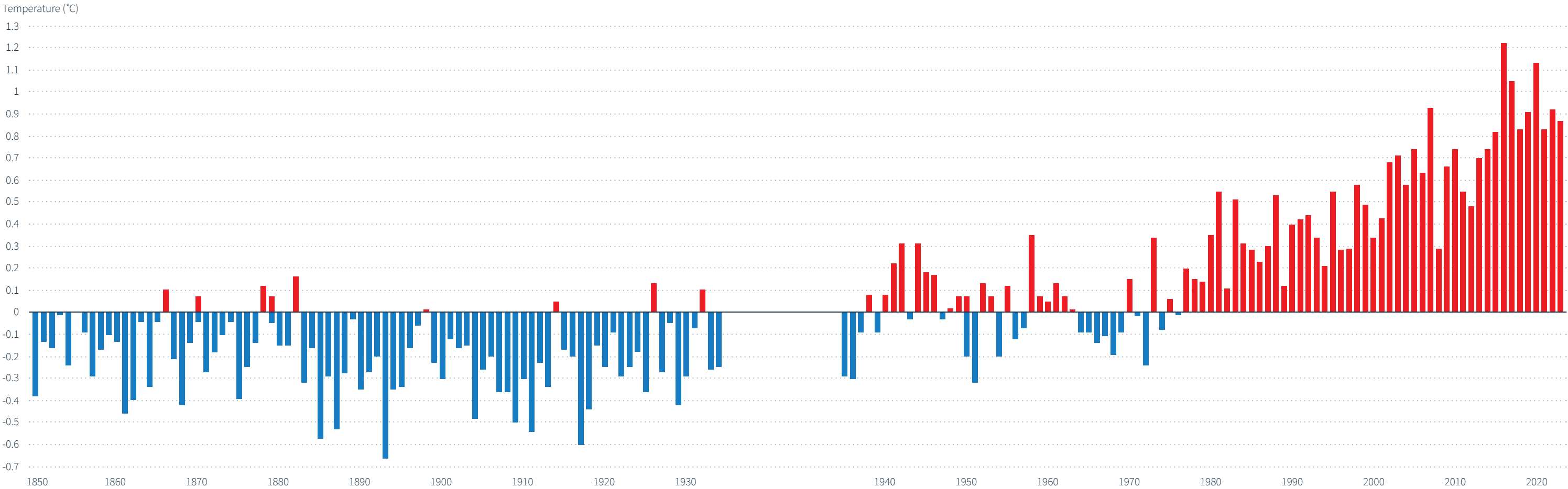
It's getting hot in here

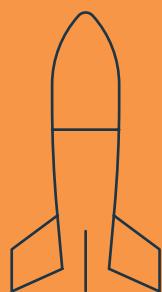
Temperature anomalies are increasingly hotter than average

July 2023 was officially the hottest month on record. The global average temperature was a full 1.5°C warmer than the average for the same month over the period 1850-1900. This was not a fluke, but a reflection of a long-term trend.

Leading climate scientists believe the best way to get a handle on temperature change is to look at anomalies (variations from a baseline) assessed at multiple points on land and sea; these show positive temperature anomalies (i.e. hotter than average) have increased rapidly since the 1980s.

Global land and ocean January temperature anomalies, 1850-2023





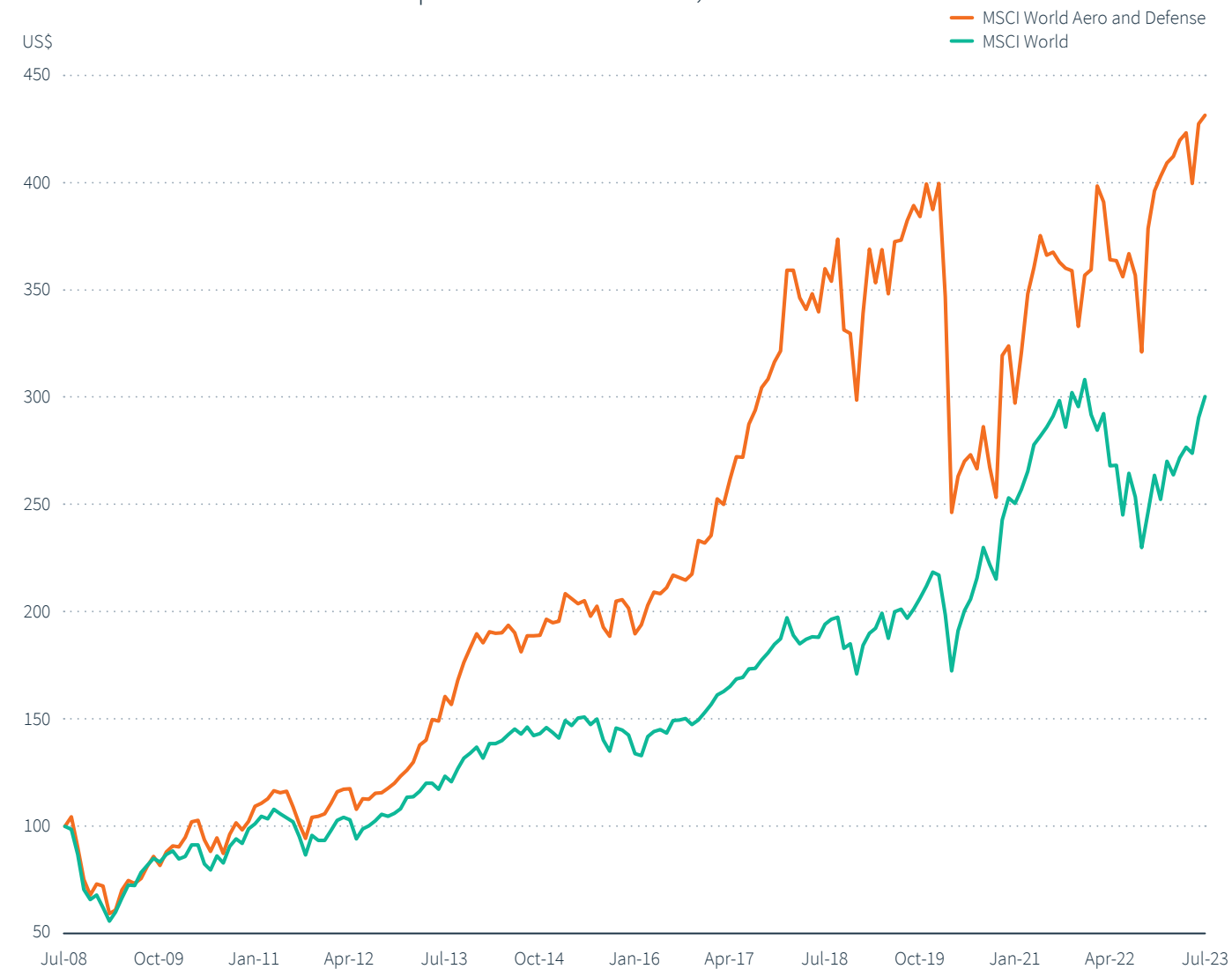
The war in Ukraine has prompted a sharp increase in defence spending. Total global military expenditure rose 3.7 per cent in real terms in 2022 to reach a new high of \$2.24 trillion, according to the Stockholm International Peace Research Institute.

Defence companies have benefited from new contracts, boosting revenues. Total dollar returns on the MSCI World Aerospace and Defense Index rose 17.6 per cent over the 12 months to end-July 2023, outperforming the broader MSCI World Index (13.5 per cent).

Bang for the buck

Rising profits among defence companies

Price returns on MSCI World Aerospace and Defense Index, 2008-2023



PEOPLE

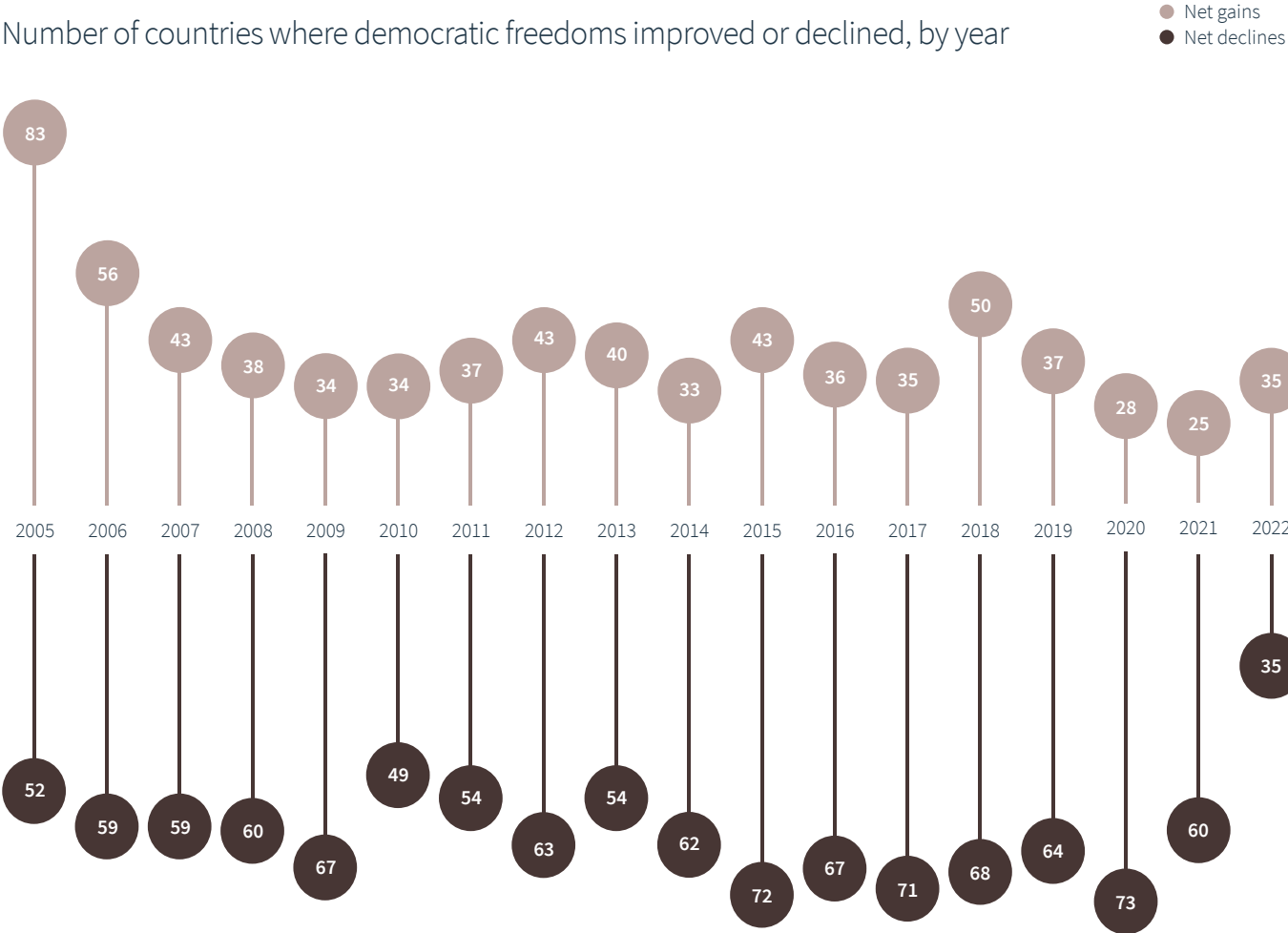
From democratic backsliding to crushing inequalities

The decline of democracy

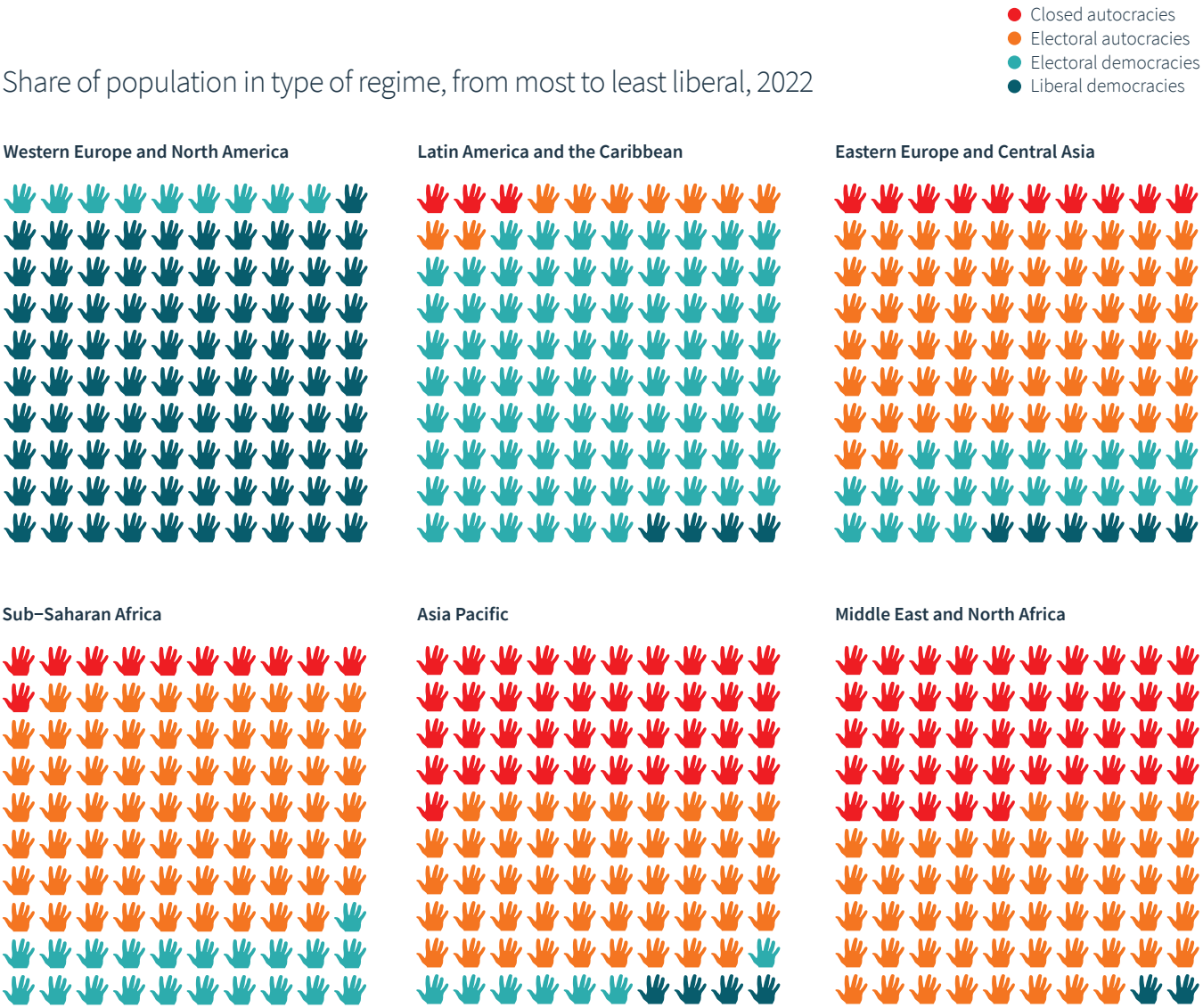
Autocracy in the ascendancy

Has the spread of Western ideology reached its end? Freedom House has tracked 17 consecutive years of decline in democratic freedoms globally. Meanwhile, according to the V-Dem Institute, almost three quarters of the world's population now live in autocracies following a huge increase in the past two decades.

Number of countries where democratic freedoms improved or declined, by year



Share of population in type of regime, from most to least liberal, 2022

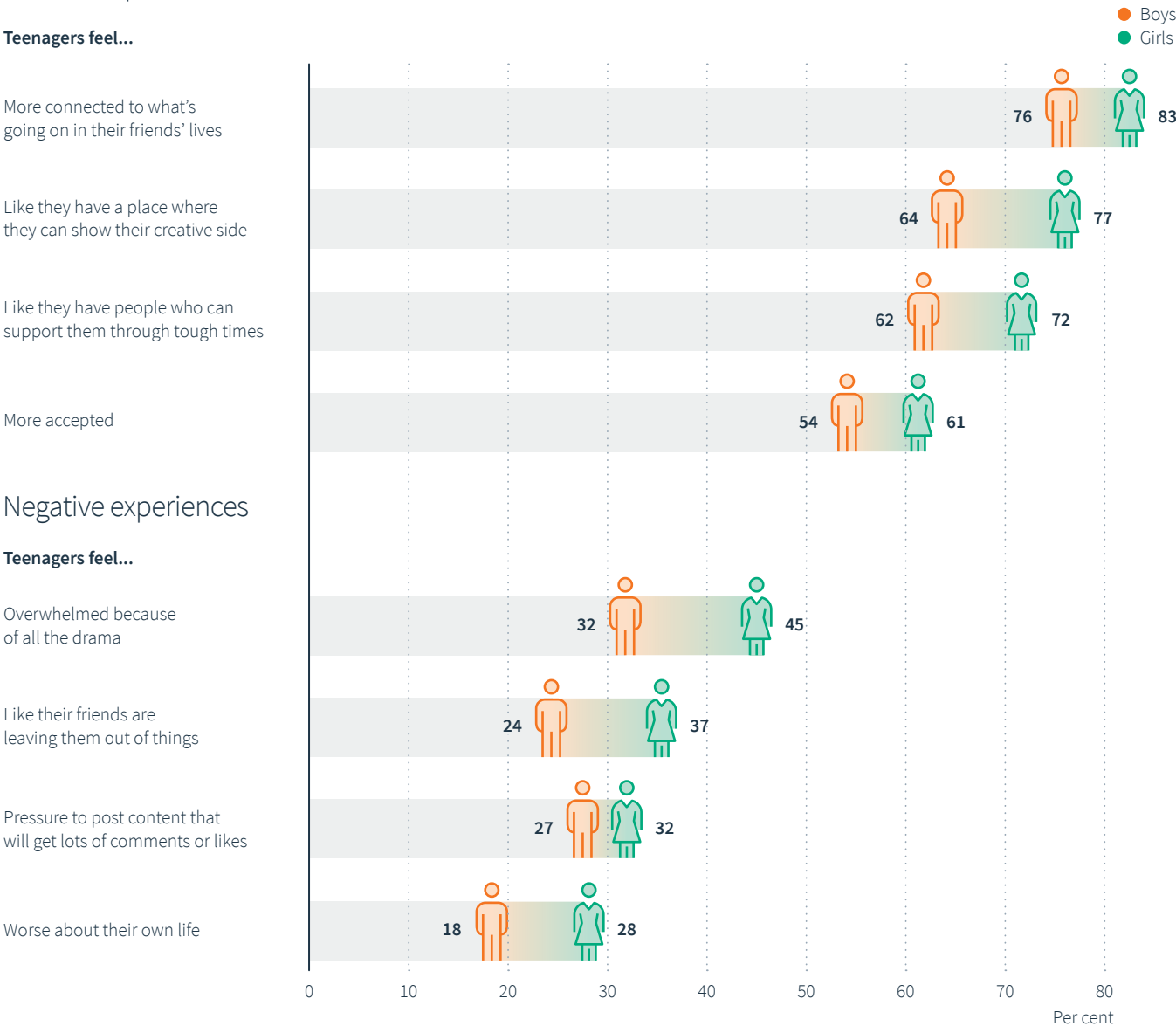


Growing pains, social strains

The link between teenage mental health and social media

Positive experiences

Teenagers feel...



“Curating their personal lives has become some of the most important work young people do.”

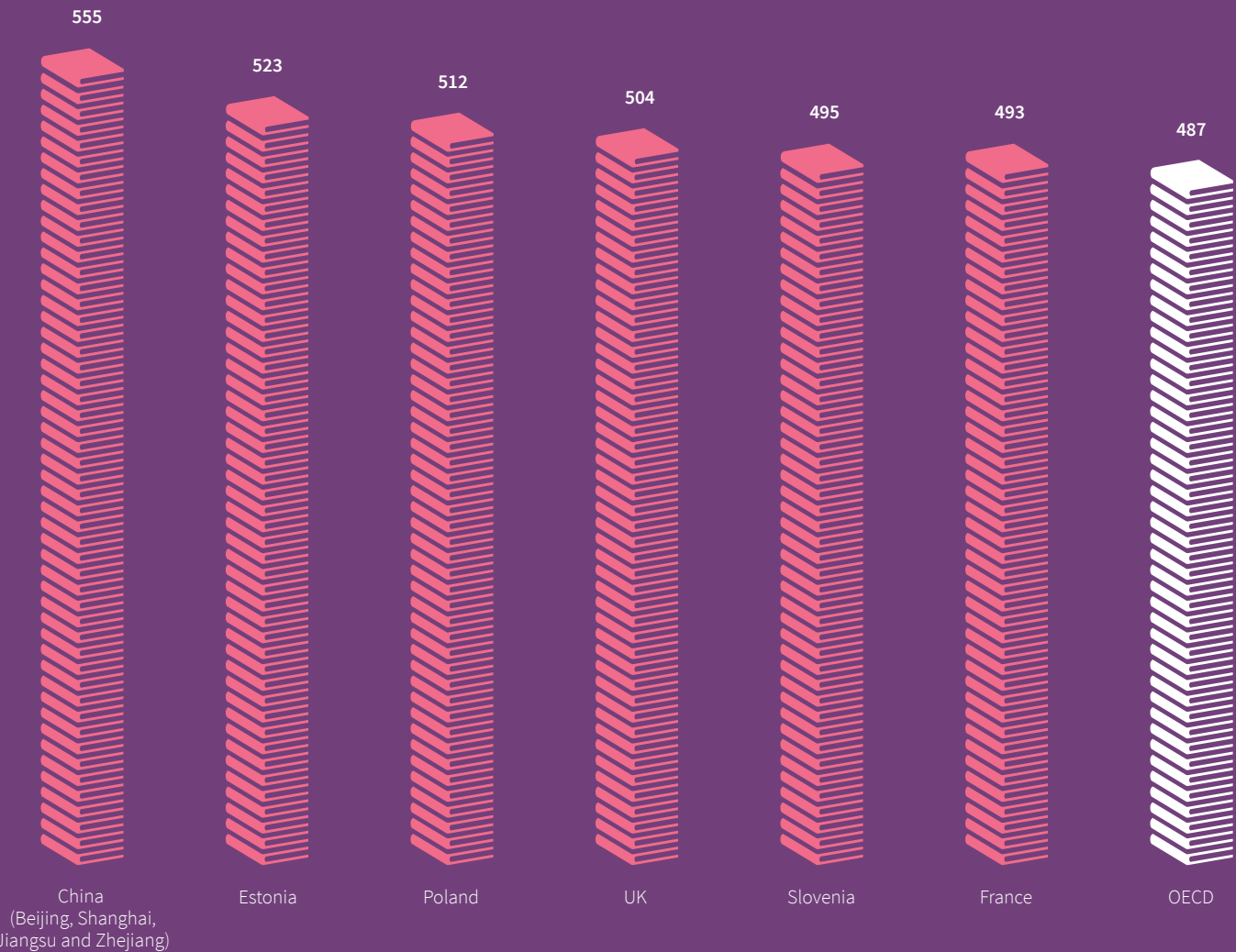
Before posting any image, uploading any video, reviewing any movie, sharing any photograph or tweet, they must be mindful of whom their choice will please or alienate.”

Yanis Varoufakis
Founder, MeRA25 and Professor of Economic Theory,
University of Athens

ABC, easy as OECD

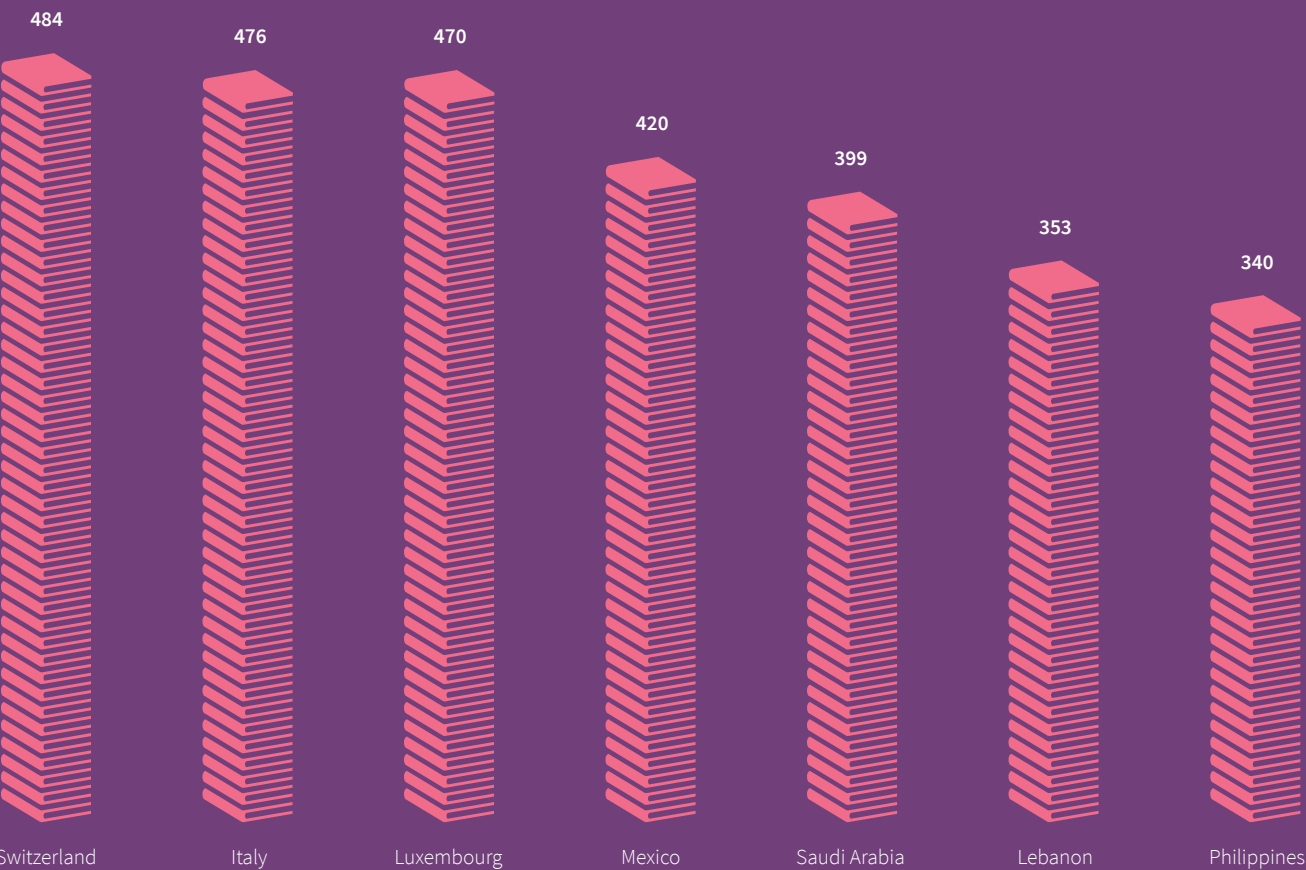
The digital divide in education

Programme for International Student Assessment (PISA), Reading score, 2018



According to UNICEF, over 600 million children worldwide do not attain minimum proficiency in reading and maths. The gap in reading performance between the highest- and lowest-scoring countries was 111 points within the OECD but 216 globally. Countries with higher spending per student tend to score higher in PISA.

Digital divides amplify the disadvantages of poorer children. The 2018 Programme found 89 per cent of students in OECD countries had access to a home computer for schoolwork, compared to less than half in countries including the Dominican Republic and the Philippines.



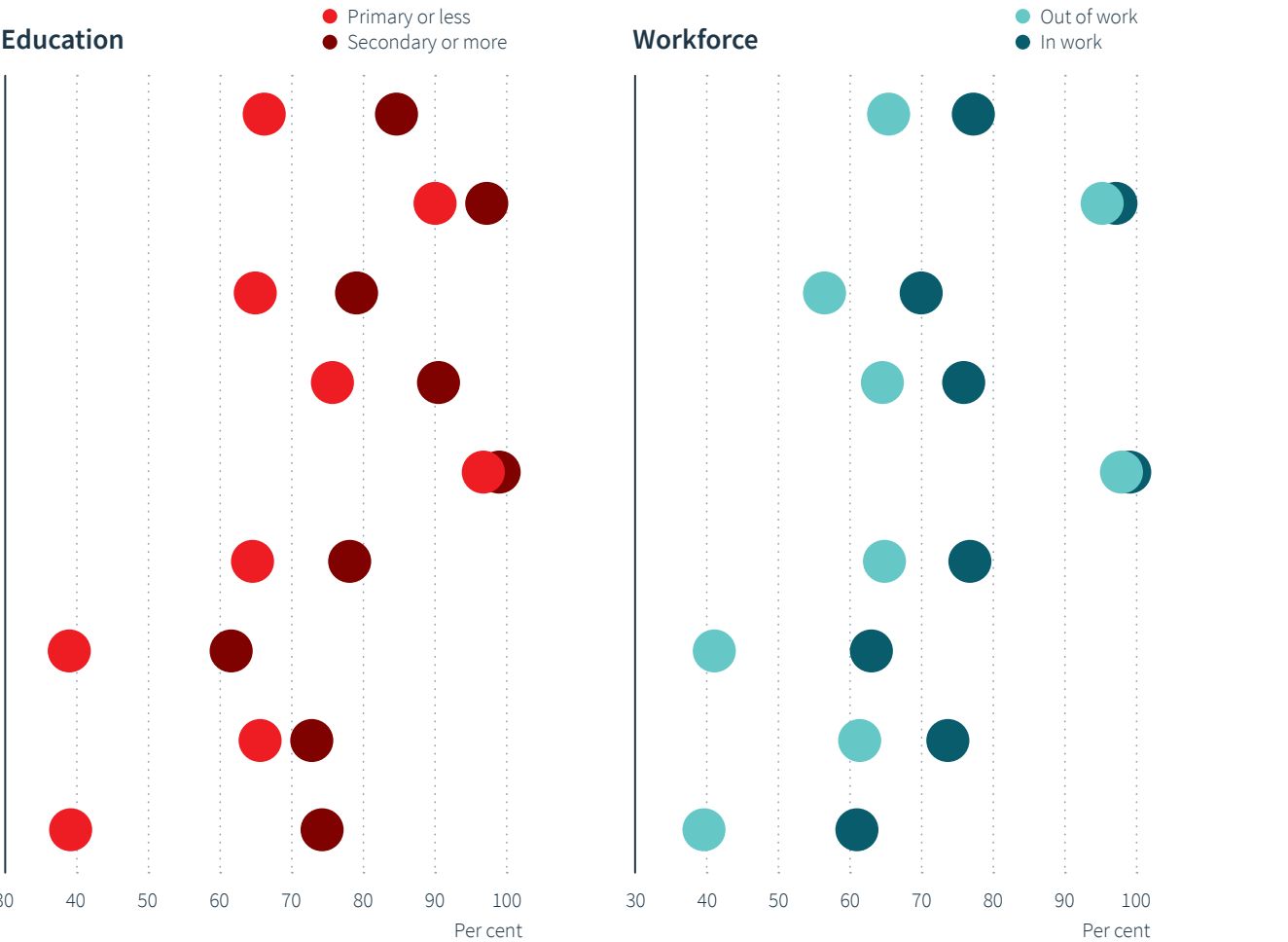
Don't bank on it

Unequal access to finance

According to the Global Findex Database, bank account ownership among adults globally increased from 51 per cent to 76 per cent in the ten years to 2021. However, progress has been slower for women, the poor and the less educated.

COVID-19 helped boost the adoption of digital financial services. In developing economies in 2021, 18 percent of adults paid utility bills directly from an account; about one third did so for the first time after the pandemic hit.

Average gender, income, education and workforce gaps in access to finance, 2021

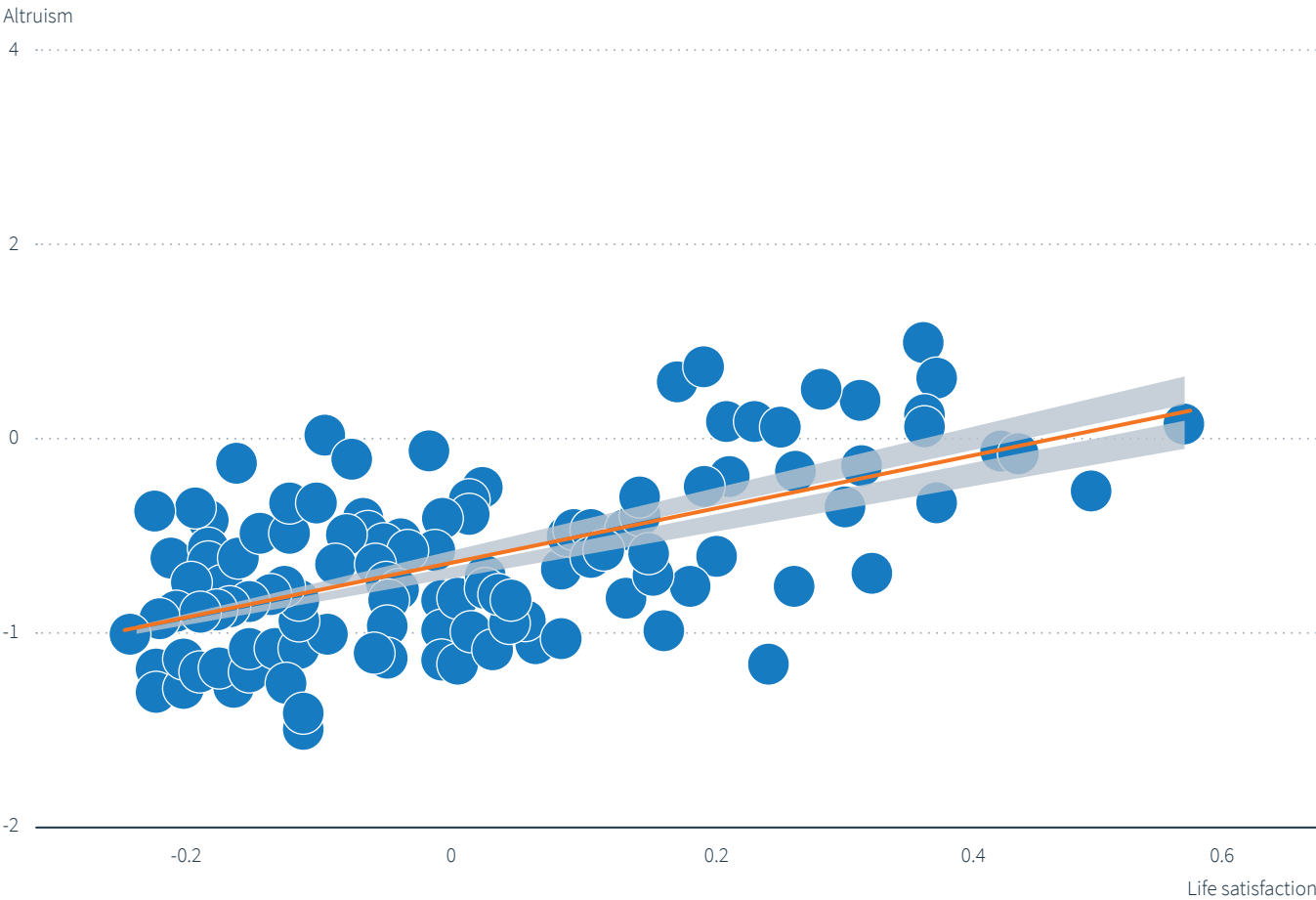


Do good, feel good

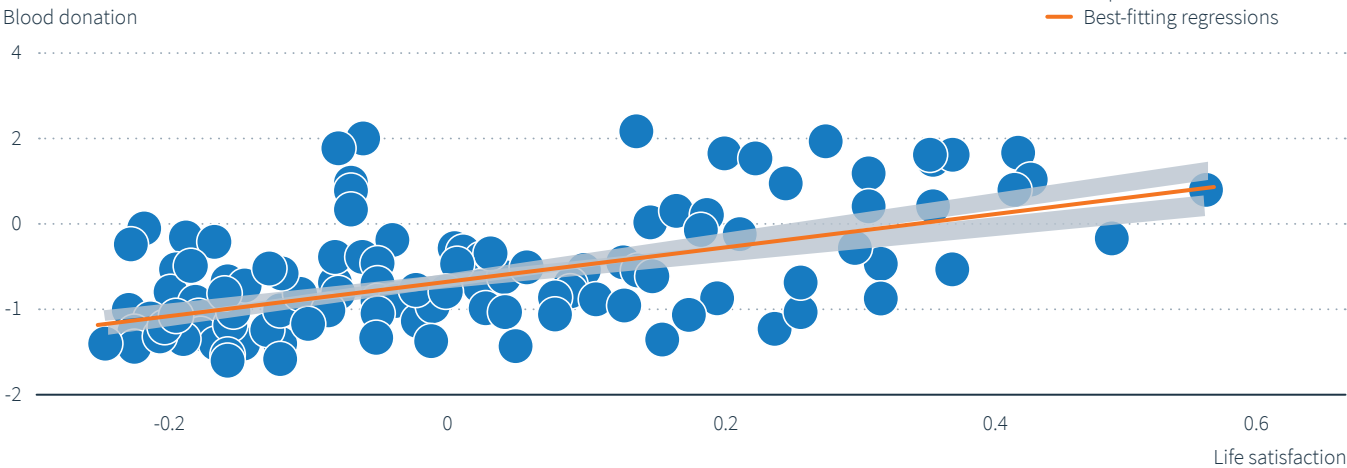
Altruistic people are happier

This 2021 study by Rhoads, et al. demonstrated a positive relationship between wellbeing and altruism but could not determine whether altruism promotes wellbeing, wellbeing promotes altruism, or the effects are bidirectional. It also found lower pro-social behaviour reliably related to lower life satisfaction. If in doubt, try some altruism.

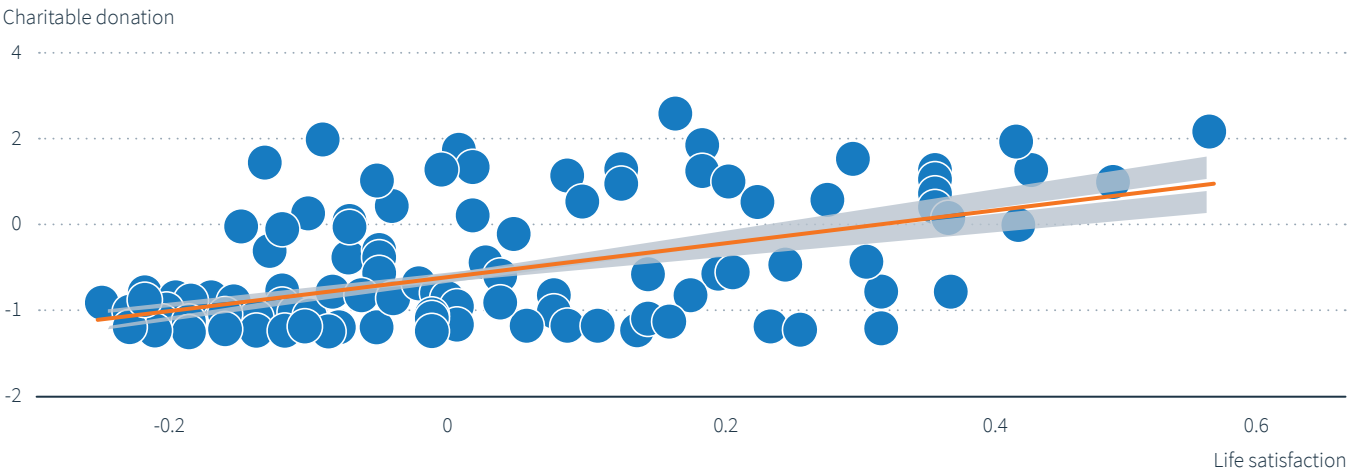
Relationship between life satisfaction and altruism around the world



Relationship between life satisfaction and blood donation



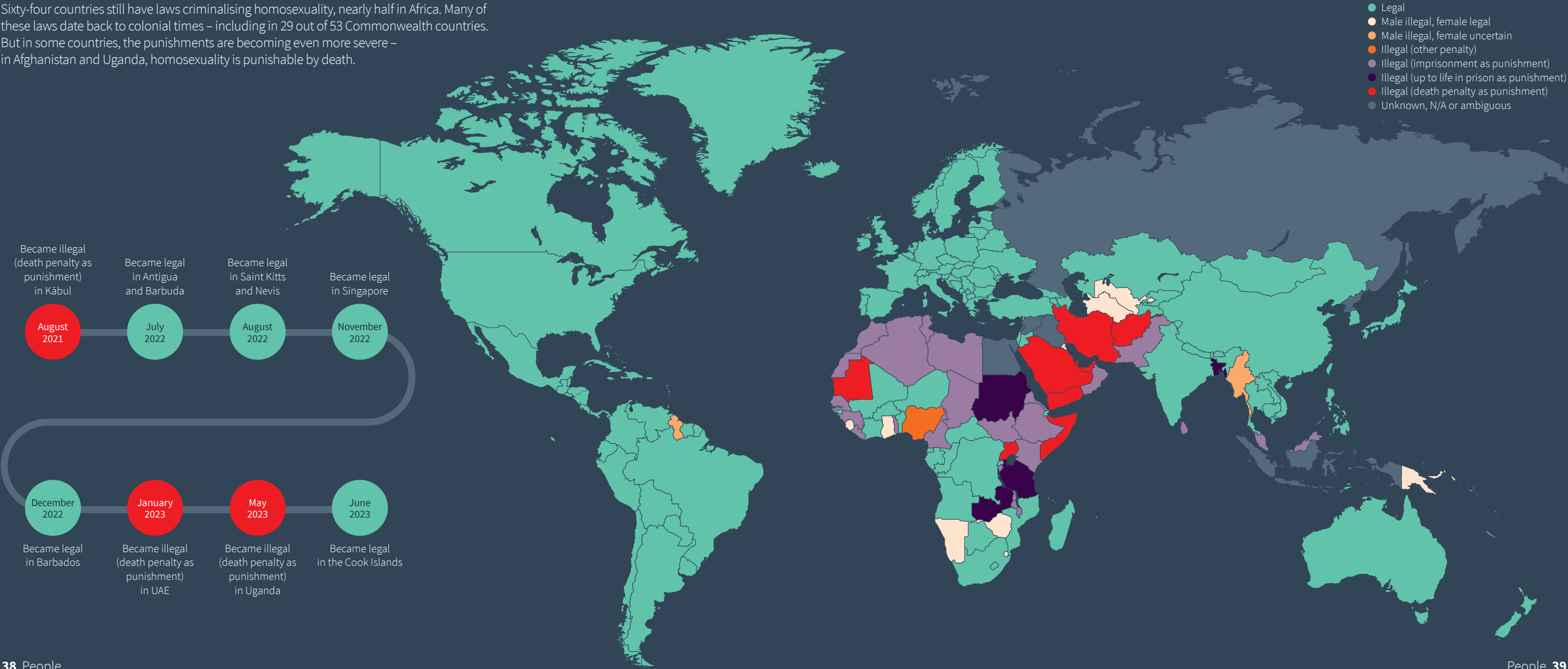
Relationship between life satisfaction and charitable donation



Not everyone is free to love

Where homosexuality is still outlawed

Sixty-four countries still have laws criminalising homosexuality, nearly half in Africa. Many of these laws date back to colonial times – including in 29 out of 53 Commonwealth countries. But in some countries, the punishments are becoming even more severe – in Afghanistan and Uganda, homosexuality is punishable by death.



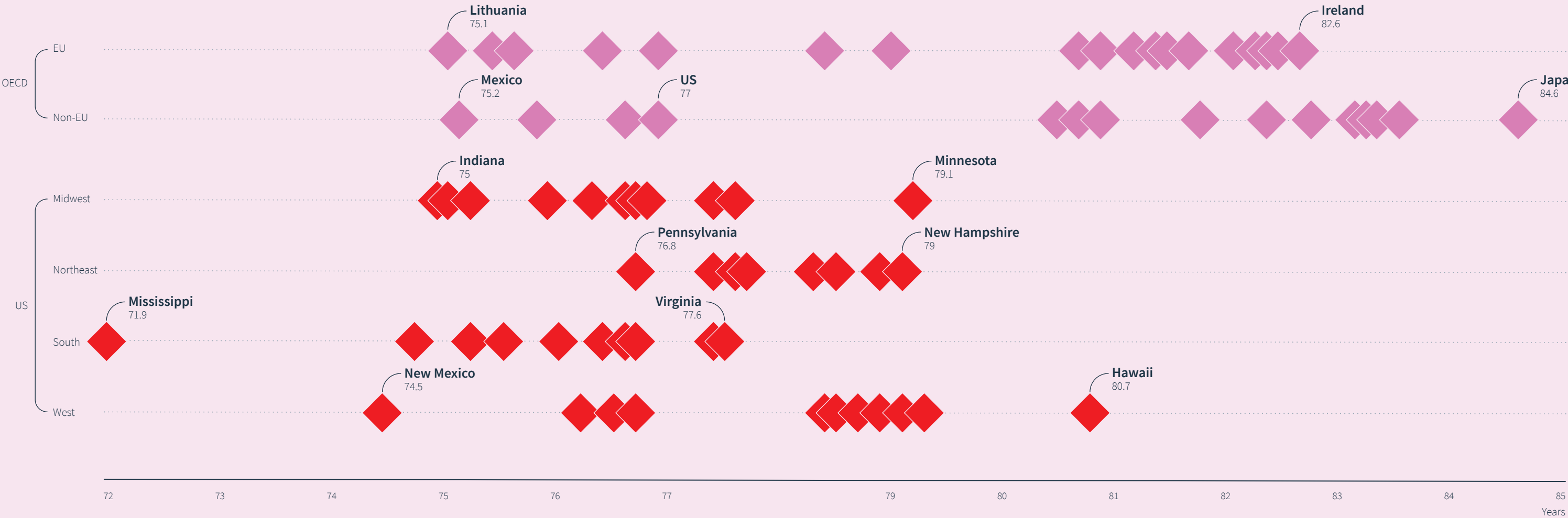
A life too short

The US lags its peers on life expectancy

The US spends more on healthcare than any other country. Yet it has a lower average life expectancy and higher “avoidable mortality” than many other comparable economies.

Avoidable mortality is defined as deaths of people under 75 from conditions that are preventable, or treatable when detected early, such as diabetes.

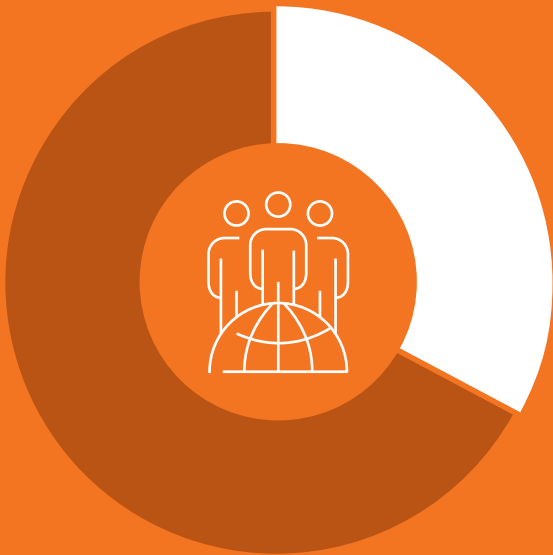
Average US life expectancy by state versus average for other rich countries, 2020



Fair's fair

The right to a living wage

Global inequality remains rife, with the poorest half of humanity living on very little. Yet greater equality would give the whole economy a huge boost.



1/3 of workers worldwide earn less than a living wage

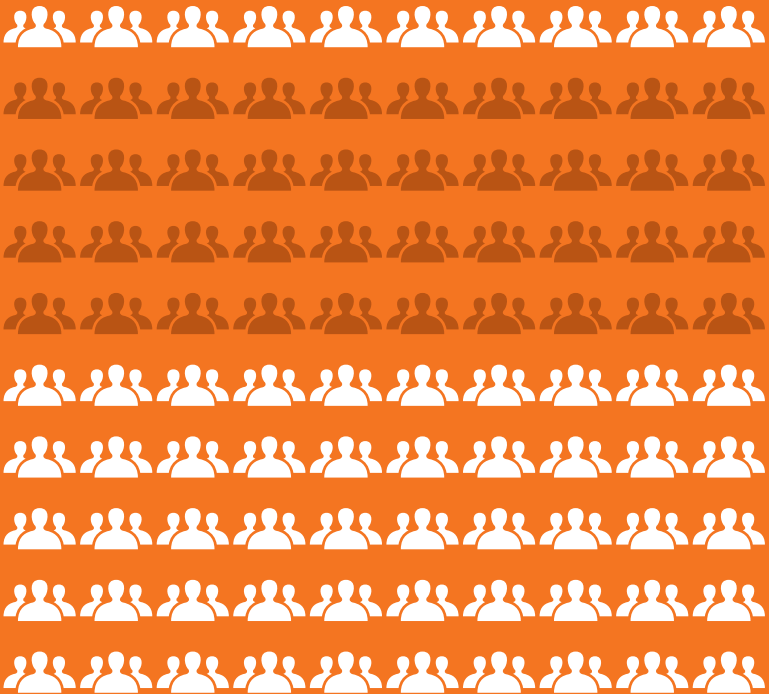


Under 50 per cent of small-scale farmers earn a living income

US\$4.5 trillion

The boost that closing the living wage gap could give to global GDP

The top 10 per cent of people



Have 75 per cent of global wealth

Get 52 per cent of global pay

The bottom 50 per cent of people

Have 2 per cent of global wealth

Get 8.5 per cent of global pay

CLIMATE

Temperatures and sea levels are rising and we could reach a point of no return, but solutions exist

What to do with a problem like methane

Curbing emissions and generating renewable energy

Molecule for molecule, methane is a much more powerful warming gas than carbon dioxide. Tackling methane emissions – especially in agriculture – is vital to climate action.

Potential solutions include better waste management and “energy crops”, which can include alternative nitrogen fixers that improve productivity. Some can be used to create biomethane, a renewable energy source and a viable alternative to fossil fuels.

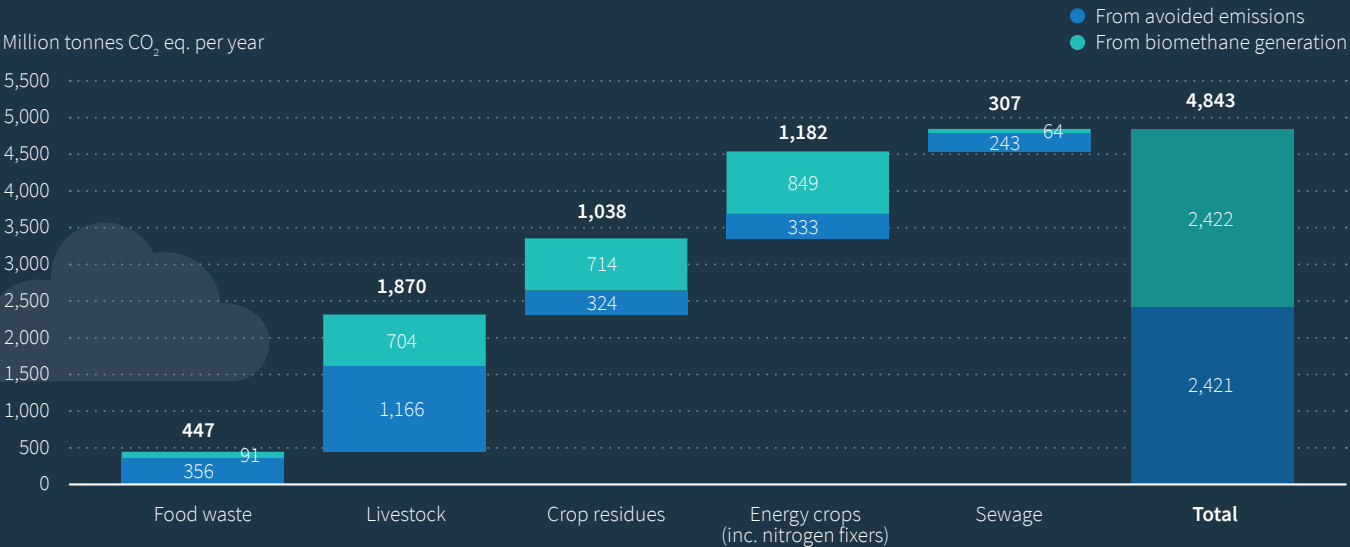
Global annual methane emissions

Kilotonnes



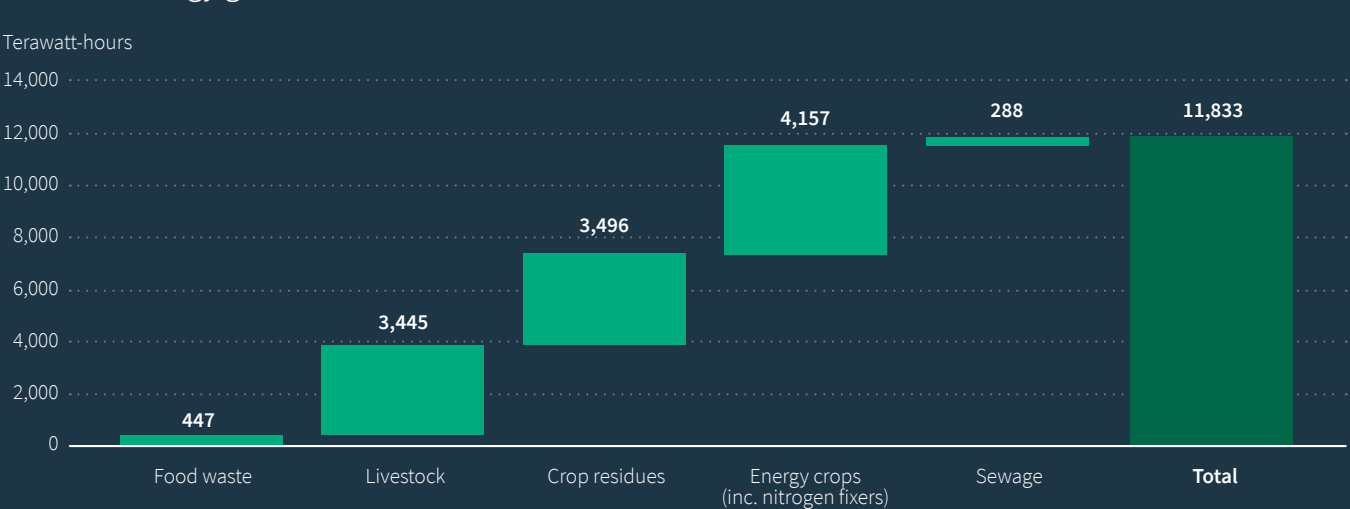
Potential GHG abatement from various feedstocks

Million tonnes CO₂ eq. per year



Potential energy generation from various feedstocks

Terawatt-hours





“Climate change has wiped out about seven years of improvements in agricultural productivity over the past 60 years. Anthropogenic climate change is already slowing us down.”

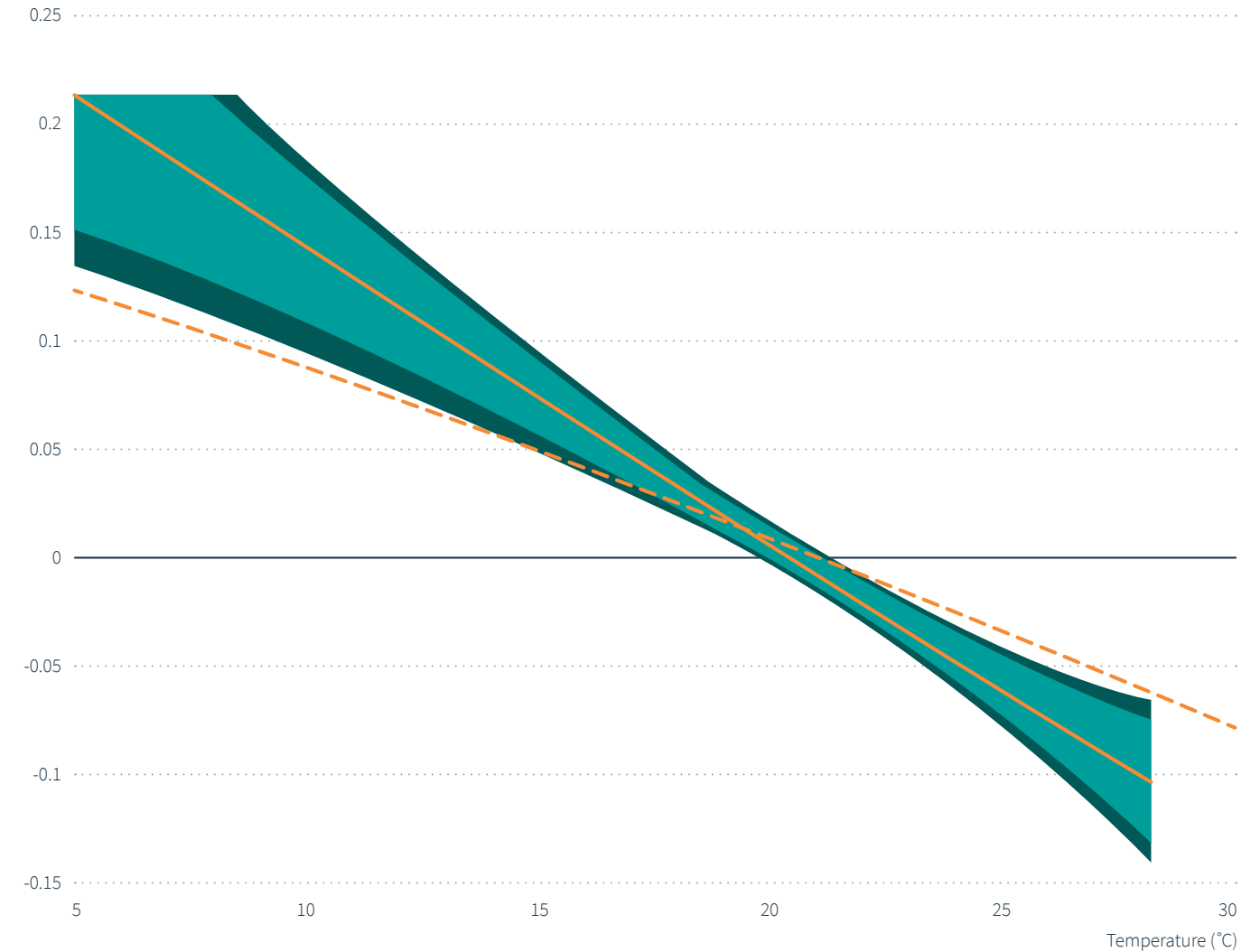
Ariel Ortiz-Bobea
Associate Professor of Applied Economics,
Cornell University

Down on the farm

Warming wiping out productivity gains

Temperature and agricultural productivity impacts, 1989-2015

Total factor productivity growth



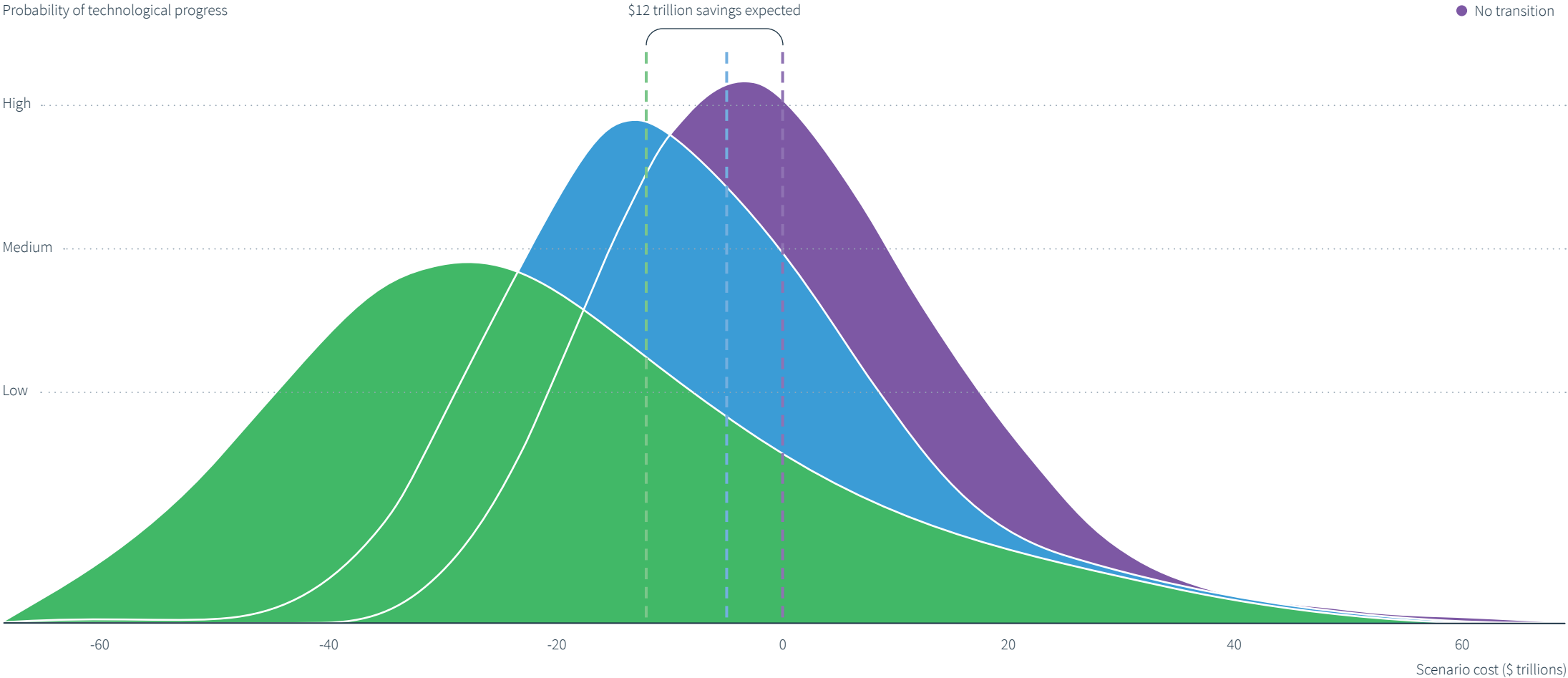
Racing green

The cost benefits of a fast transition

We often underestimate the pace of change when major technological shifts happen. Will this be the case in the transition to solar, wind and hydropower? Energy returns on investment are already higher from green energy than fossil fuels – meaning it takes less energy to produce each unit of power – and learning curves are getting steeper.

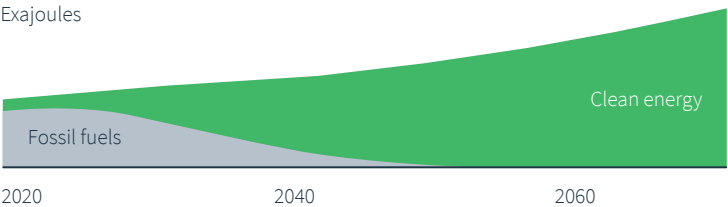
Three energy system scenarios

Probability of technological progress

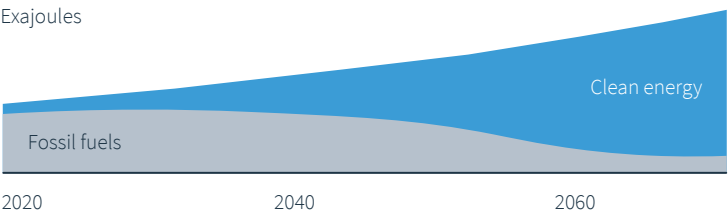


Speed of transition

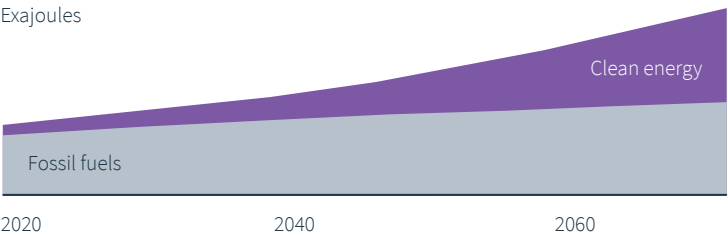
Fast transition



Slow transition



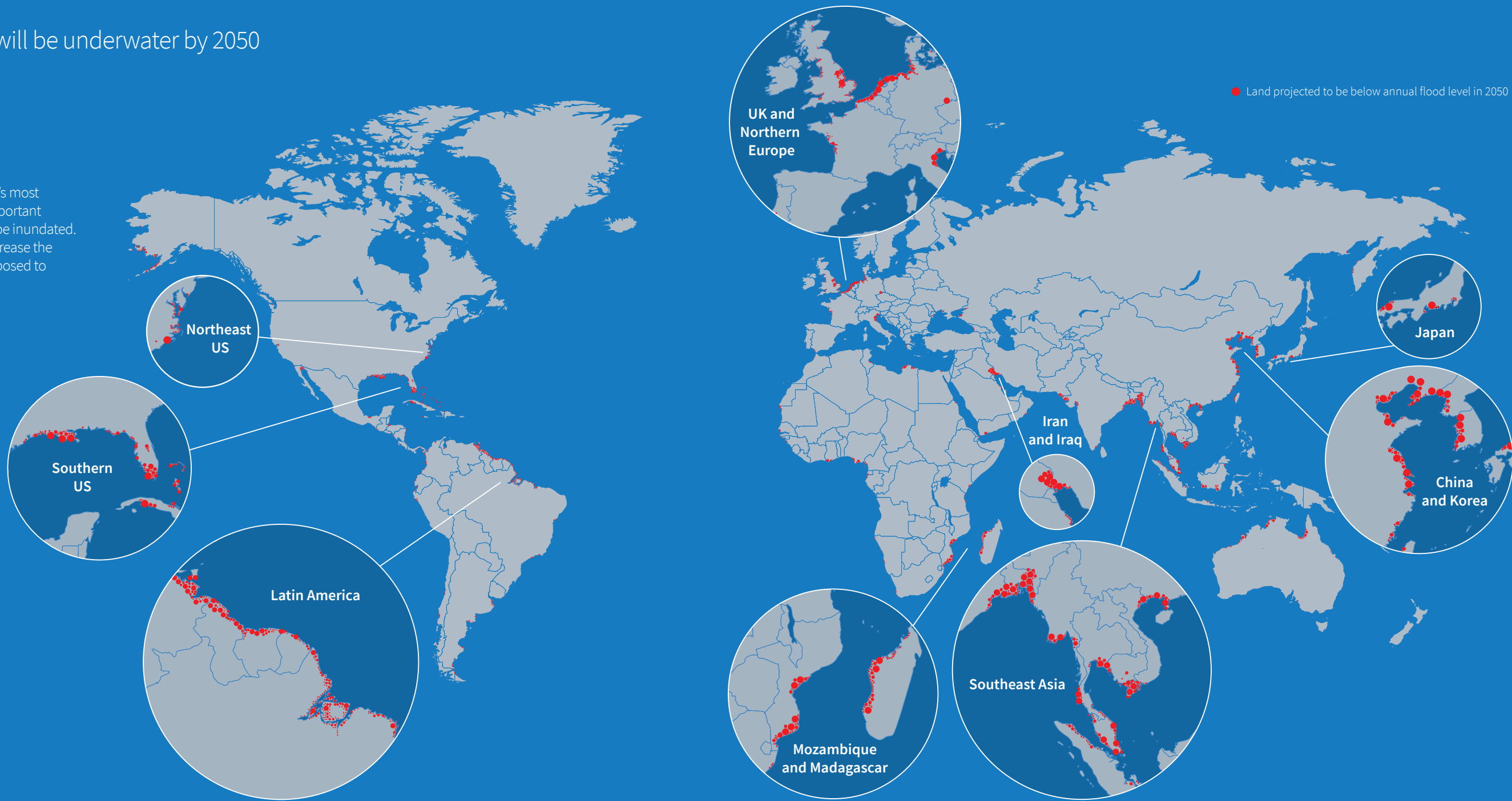
No transition



Waterworld

Many coastal areas will be underwater by 2050

In a warmer world, some of today's most densely inhabited regions and important areas of economic activity might be inundated. A 1.5°C temperature rise could increase the share of the global population exposed to flooding by 24 per cent.





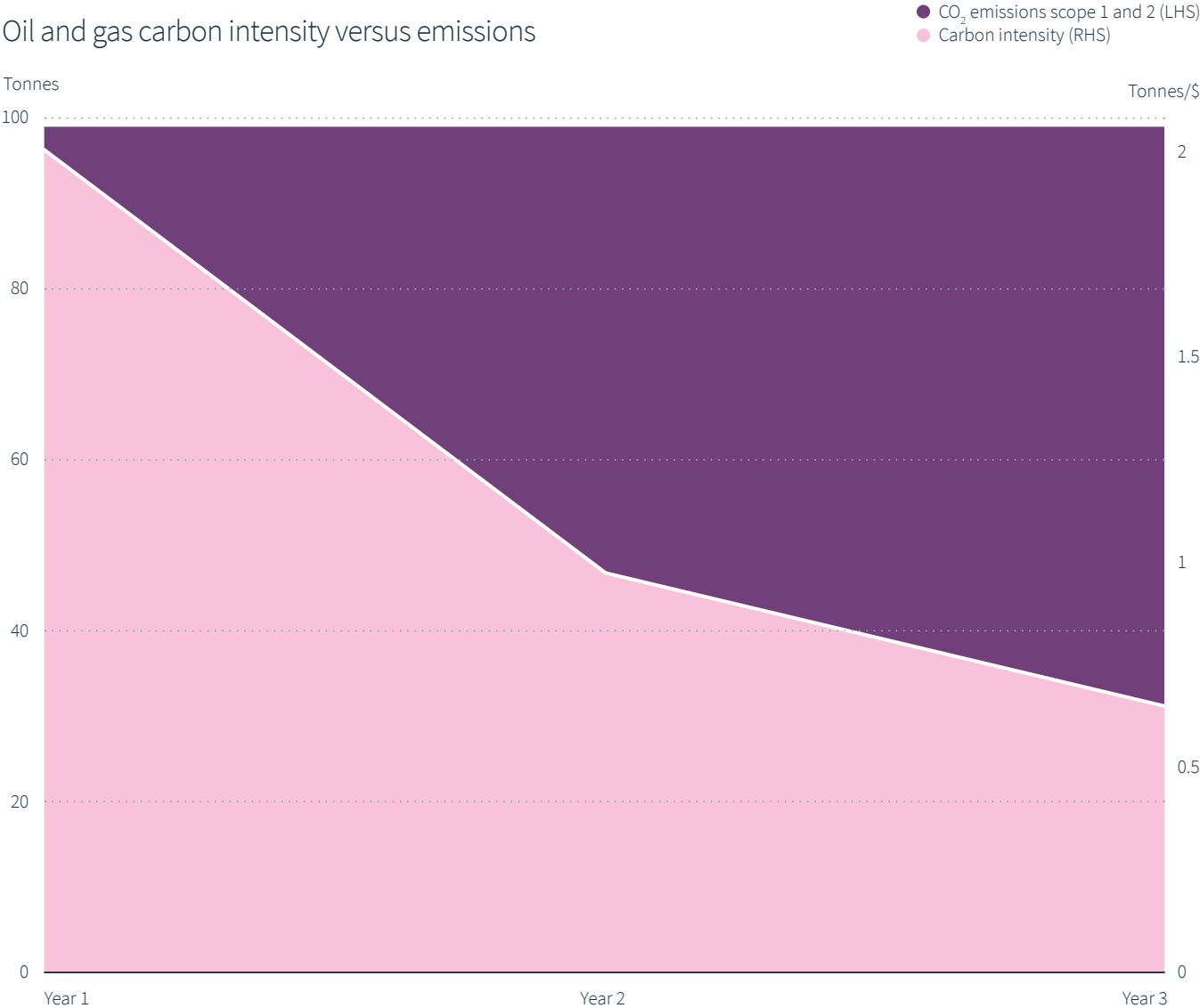
For the financial sector and investee companies, carbon intensity is the amount of carbon dioxide generated per unit of revenue. Its simplicity is part of its appeal.

But the metric can be misleading. If an energy company's revenues rise sharply, its carbon intensity may fall, even if its absolute emissions – and therefore the climate impact of its operations – are unchanged, as this example shows.

Conjuring trick

Carbon intensity can “improve” without a change in emissions

Oil and gas carbon intensity versus emissions

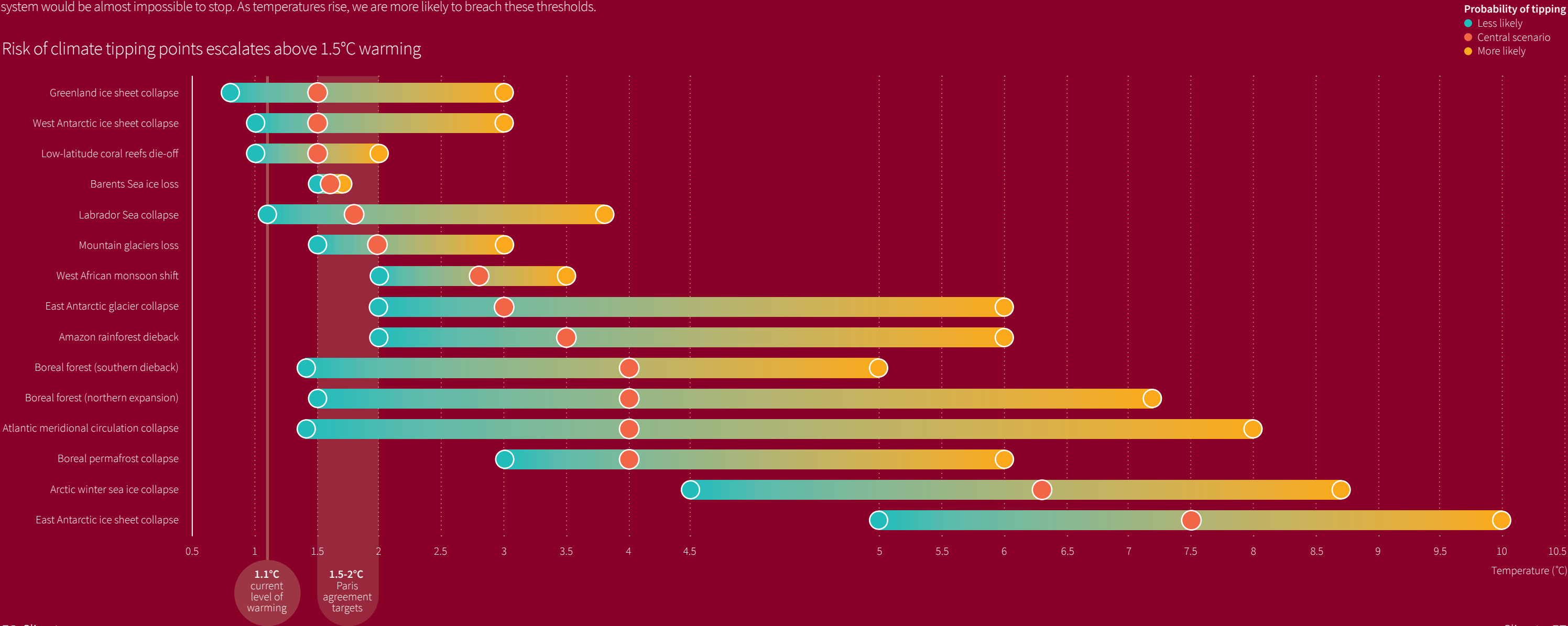


Points of no return

Are climate tipping points upon us?

Abrupt phase changes could trigger unexpected reactions in the natural world, making it impossible to anticipate the consequences. Researchers believe the world already faces a number of these essential tipping points, where self-sustaining shifts in the climate system would be almost impossible to stop. As temperatures rise, we are more likely to breach these thresholds.

Risk of climate tipping points escalates above 1.5°C warming



Powering up

Nuclear power could contribute significantly to the net-zero transition

Ramping up of nuclear power reactors



Since the first nuclear power facilities in the 1950s, generation by nuclear fission has spread around the world.

After a ten-year hiatus to improve safety designs following the Fukushima disaster, rapidly increasing energy demand and the need to decarbonise have triggered a new surge of interest, particularly in Asia. Yet few organisations have the expertise to deliver nuclear facilities and Chinese and Russian companies may have an operational advantage.

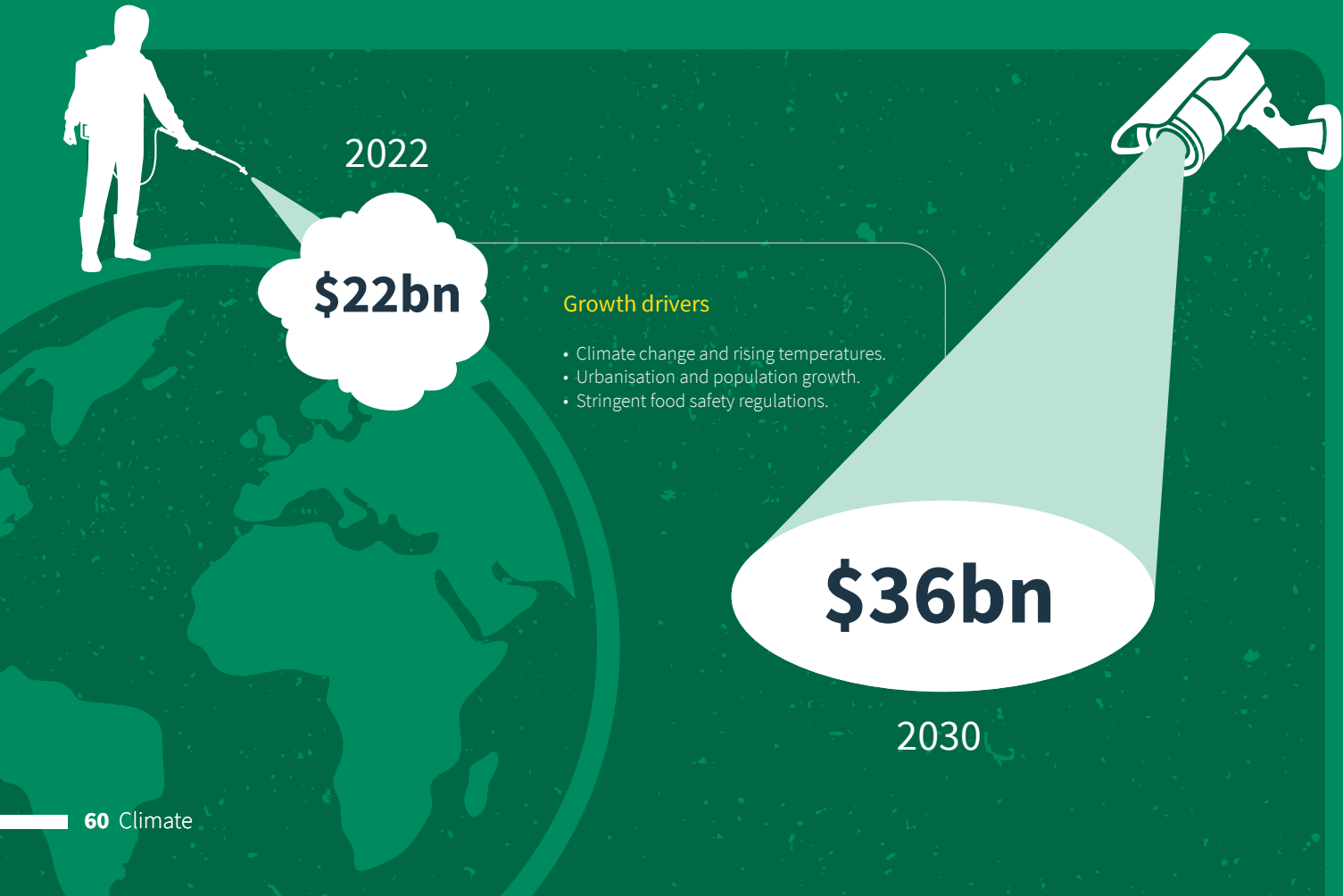
Taking care of buzzness

The pest control industry cleans up

Climate change presents a severe threat to human society as well as the natural world. But the impact will not be felt equally across sectors. Some industries may even benefit from rising temperatures.

Take pest control. A hotter climate prolongs the breeding season for many pest species, boosting their numbers and creating demand for pest-control services. Meanwhile, the industry is rolling out new tech-based solutions that reduce the need for damaging pesticides, making pest control more sustainable, effective and precise.

Global pest-control market size forecast



Pest types



Mosquitos

The Asian tiger mosquito is today found in 13 EU countries and 337 regions – compared to eight and 114 in 2013.



Rats

City inspectors in New York recorded roughly 60,000 instances of rat activity in 2022 – twice as many as 2021.



Pigeons

There are 400 million pigeons worldwide. Pigeons carry up to 60 diseases – more than rats.

Solutions



Chemical

Includes pesticides and rodenticides. They pose risks to human health and to the environment.



Physical and biological

Includes more eco-friendly options such as traps, bait stations and biological control methods.



Digital

Includes sensor technologies and wireless communications. Provides an efficient and sustainable approach.

Customer types



Residential

(Usually transactional)



Small businesses



Global companies

(Usually recurring contracts)

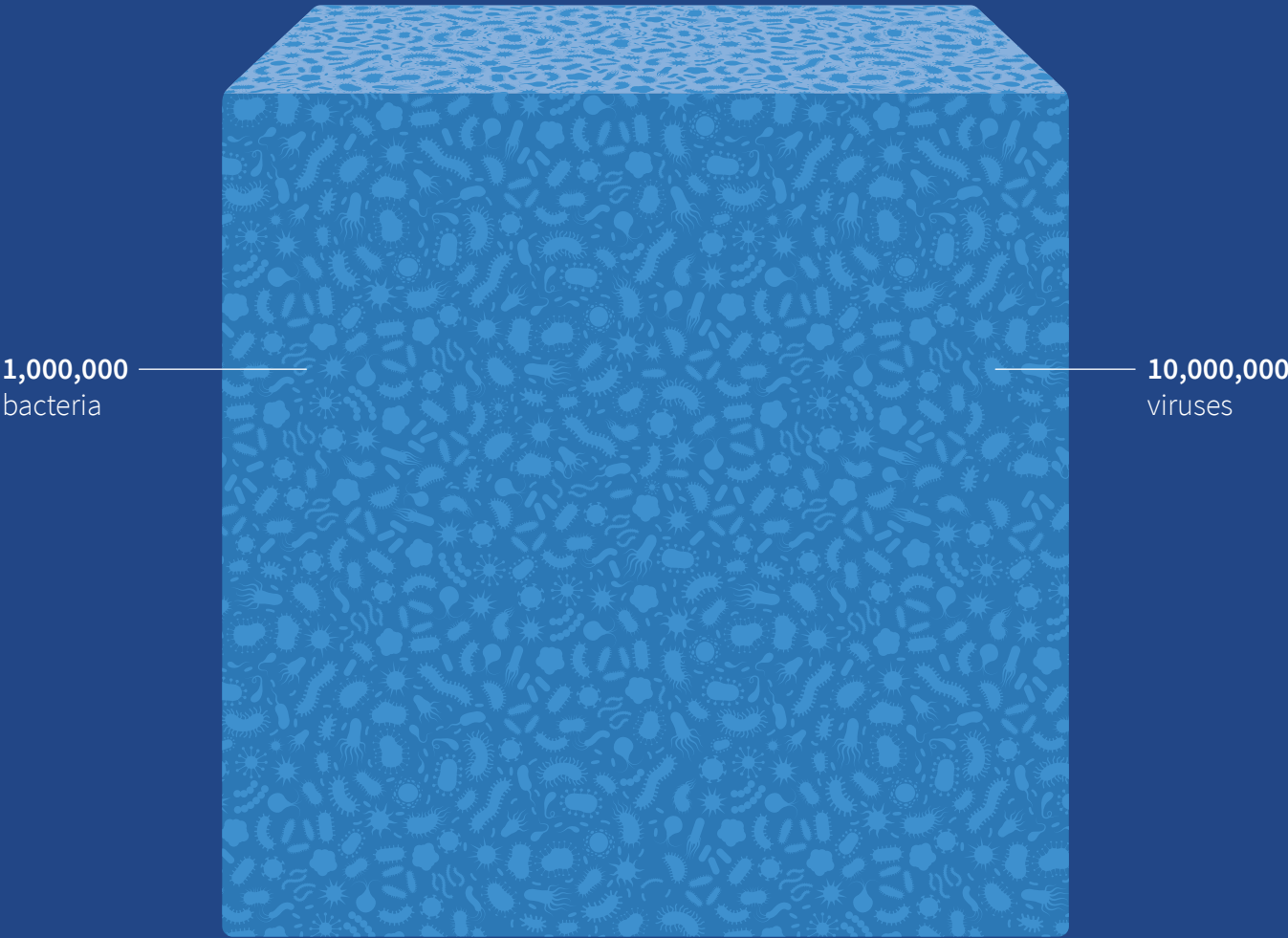
EARTH

From microbes to the global resource overshoot

A trillion little things

Earth's microbe species

What's in one sugar cube of sea water?



Microbes filter pollutants, help plants absorb nutrients, provide food for other species and are used in medicines for humans, like antibiotics. The planet is home to an estimated trillion microbe species, of which we have only discovered 0.001 per cent.

If we restore and nurture the environment, this natural abundance could yield solutions to some of our most pressing problems.



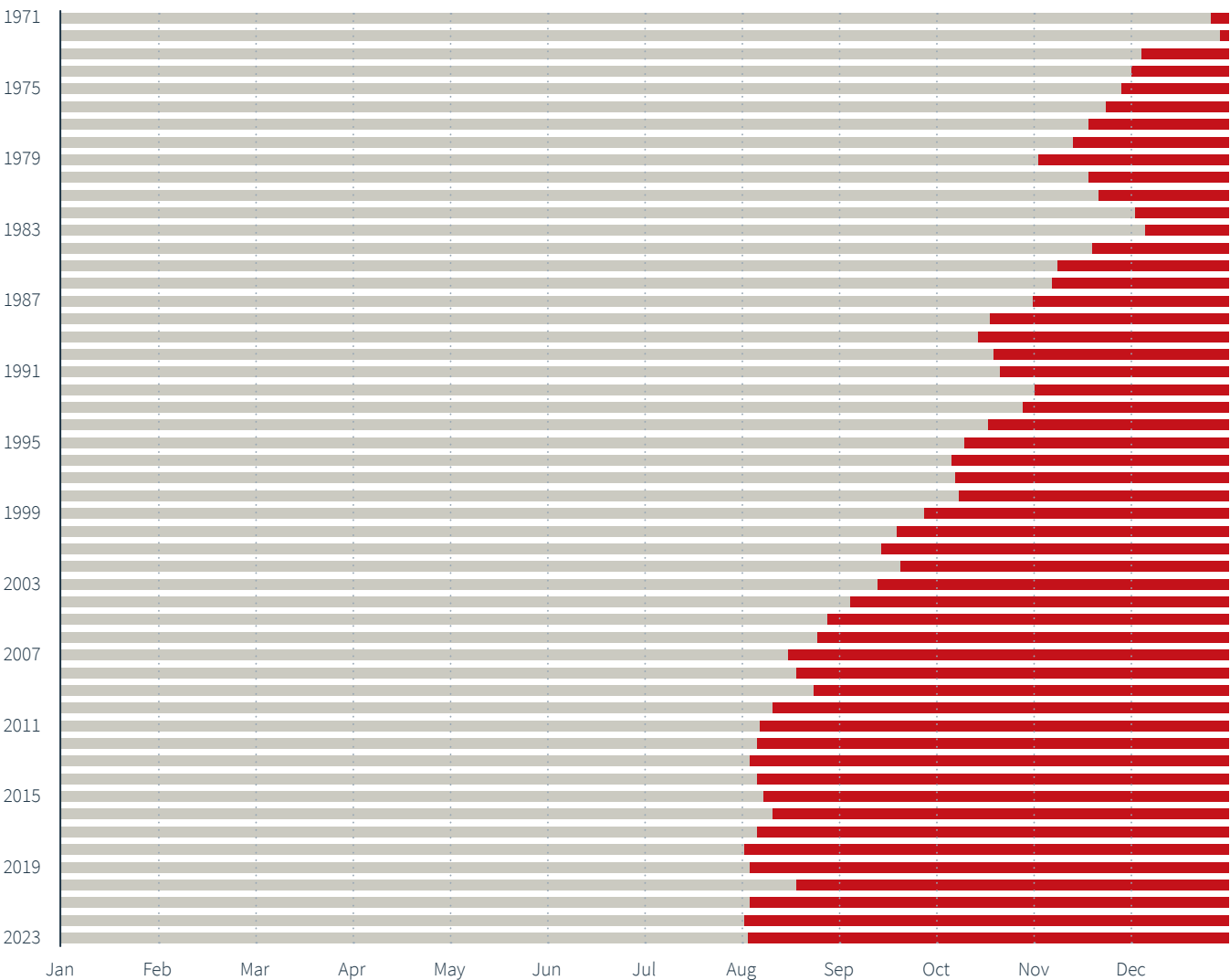
Earth Overshoot Day marks the date when human demand for ecological resources exceeds what the planet can regenerate that year. In 1970, Earth Overshoot Day fell on December 30; in 2023, it was August 2.

Although 2023's Earth Overshoot Day is slightly later than in 2022, this is due to calculation changes – and possibly a slowing economy – rather than improvements in resource management. The situation remains stark: each year, humans consume 1.7 times the amount the Earth can sustainably provide.

Breaking boundaries

Taking more than Earth can give

Earth Overshoot Day, 1971-2023



Silent spring

The decline in global biodiversity

Inspired by the “warming stripes” developed by climatologist Ed Hawkins, these “biodiversity stripes” provide a visual representation of the decline in biodiversity over time.

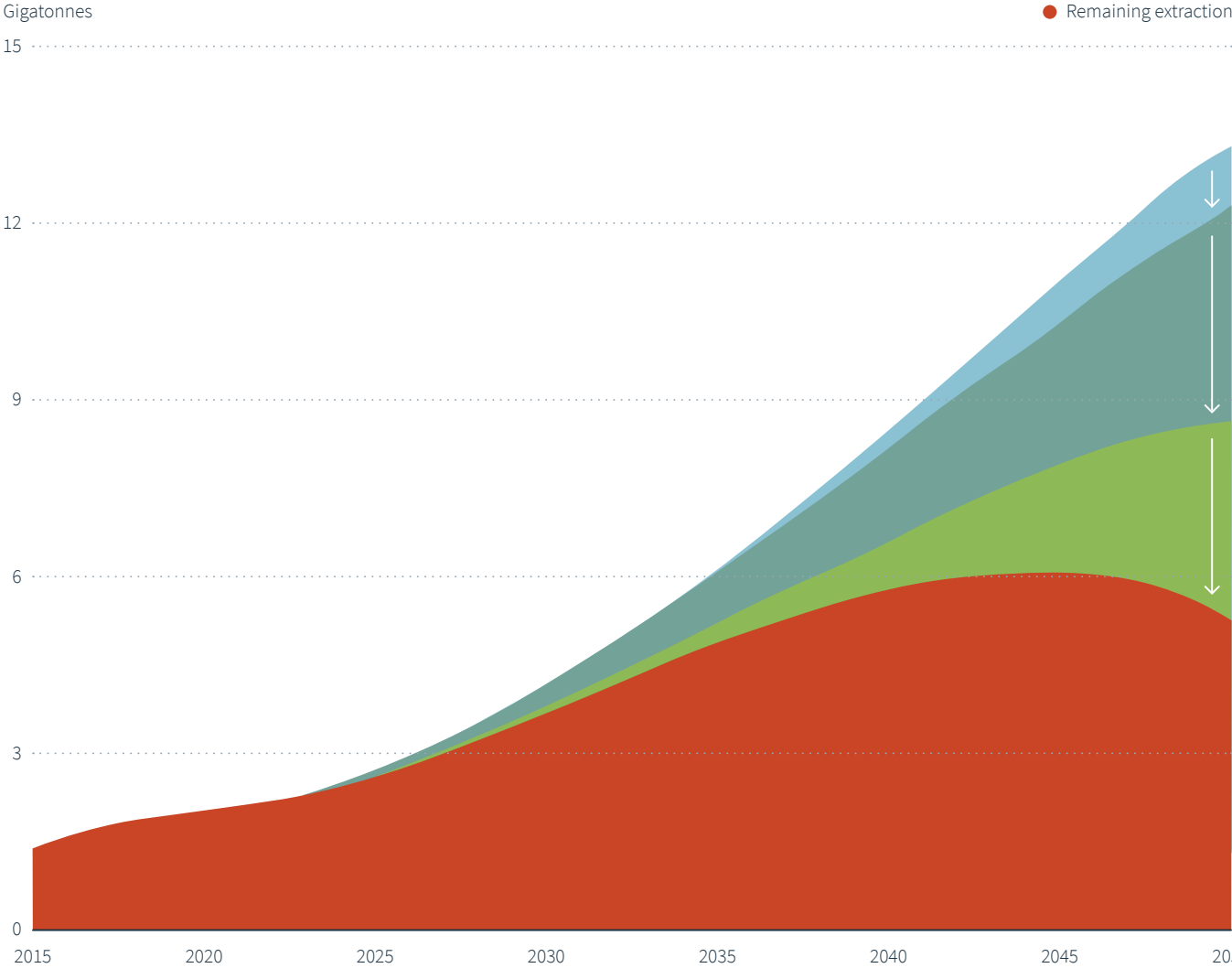
The graphic shows how the world has gone from high levels of biodiversity in the 1970s (bright green) to a much-depleted natural environment in the 21st century (grey). Each stripe represents one year.



What goes around...

Circular solutions to complex problems

How the transport industry's demand for metals could be mitigated, 2015-2050



Working towards a “circular economy” could help lessen the impact of human activity on the planet.

As this chart shows, three key strategies could reduce resource extraction associated with metal production for transport by 60 per cent by 2050. Lifetime extension, through measures like reuse and repair, car- and ride-sharing and end-of-life recycling could lead to big improvements in the amount of materials needed to build and maintain vehicles.

Nothing lasts forever

Can we remove PFAS from the environment?



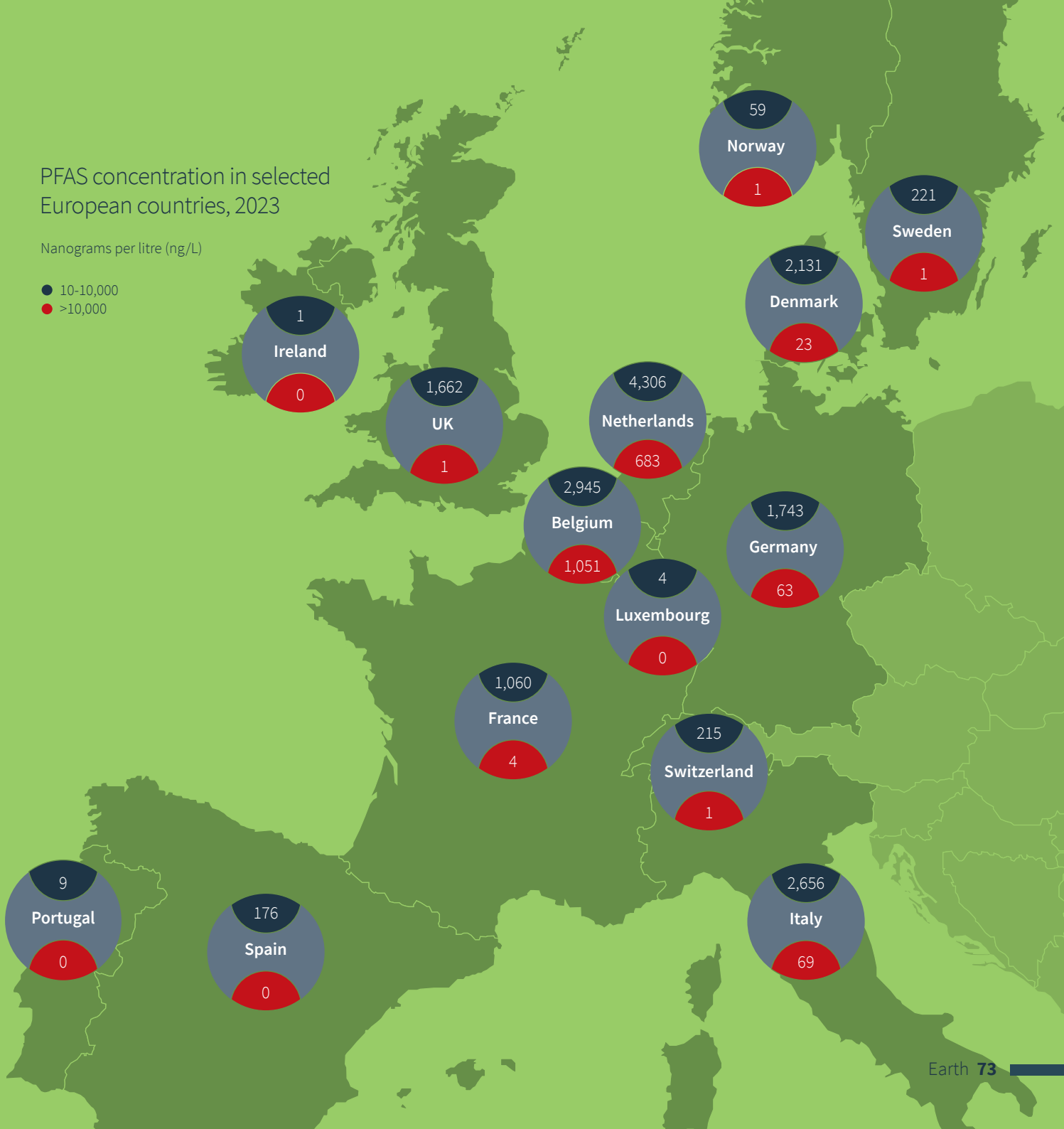
Synthetic chemicals called PFAS (polyfluoroalkyl substances), used for decades in everything from non-stick pans to makeup, don't break down but accumulate in nature and the animals that ingest them, including humans.

They are linked to various health problems, from cholesterol to cancer; experts consider concentrations of more than 100 ng/L potentially hazardous to health. Yet PFAS have been detected at over 10,000 ng/L in 1,932 hotspots in Western Europe.

PFAS concentration in selected European countries, 2023

Nanograms per litre (ng/L)

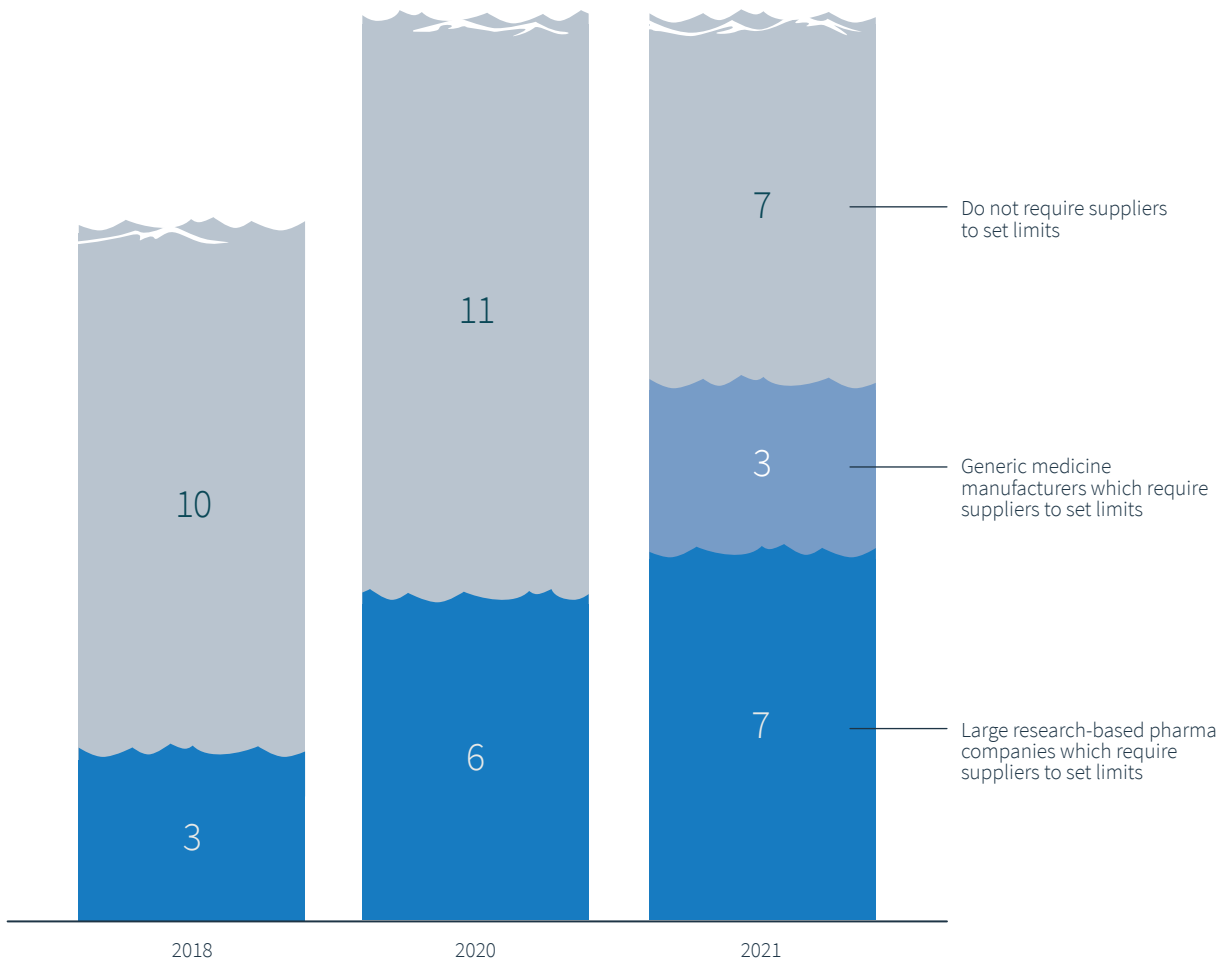
● 10-10,000
● >10,000



Battling the superbugs

Progress on limiting antibiotic wastewater discharge

Growth in the number of providers that require suppliers to set limits, 2018-2021



Resistance to antimicrobials, like antibiotics, kills over one million people a year globally. Part of the problem is that manufacturers such as drug producers release contaminated wastewater back into the environment.

But there has been progress on this issue, as investors and policymakers engage and manufacturers start to improve their practices. More providers are requiring suppliers to set limits on antibiotic wastewater discharge into the environment.

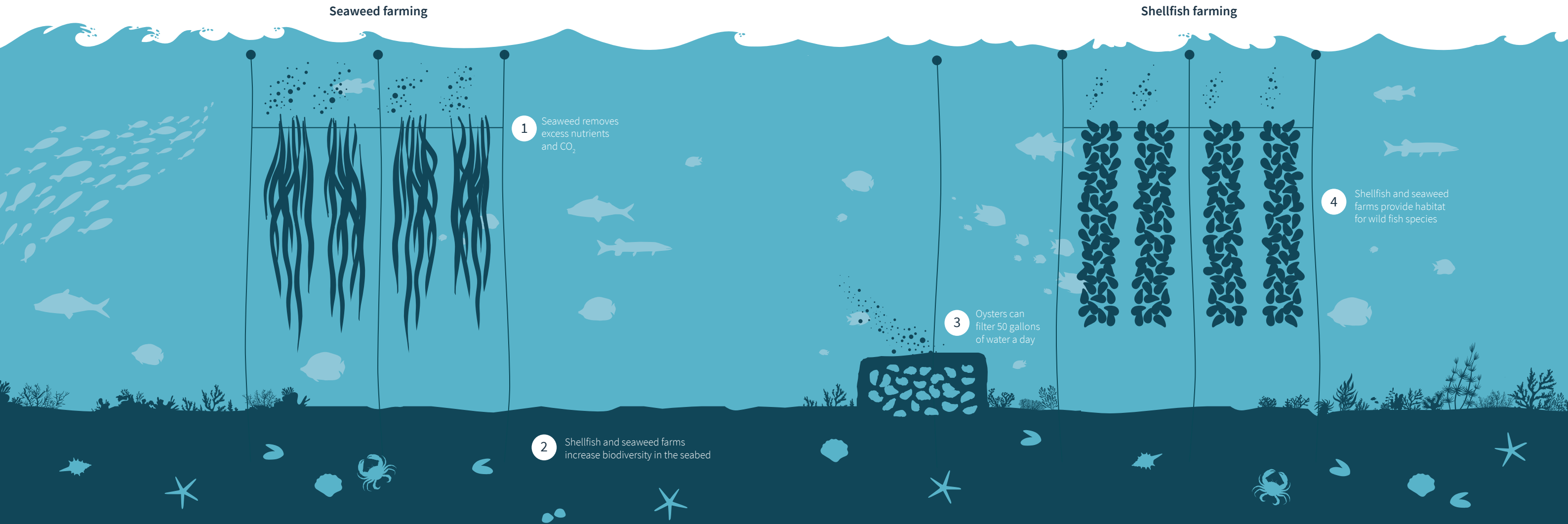
Aquaplan

The benefits of sustainable seafood

Fish and seafood provide 3.3 billion people with almost 20 per cent of their animal protein, but human activity is depleting stocks and undermining critical ecosystem services.

Sustainable aquaculture can help by mitigating pollution, protecting habitats, supporting fish populations, storing more carbon dioxide and oxygenating waterways.

Ecosystem benefits of aquaculture

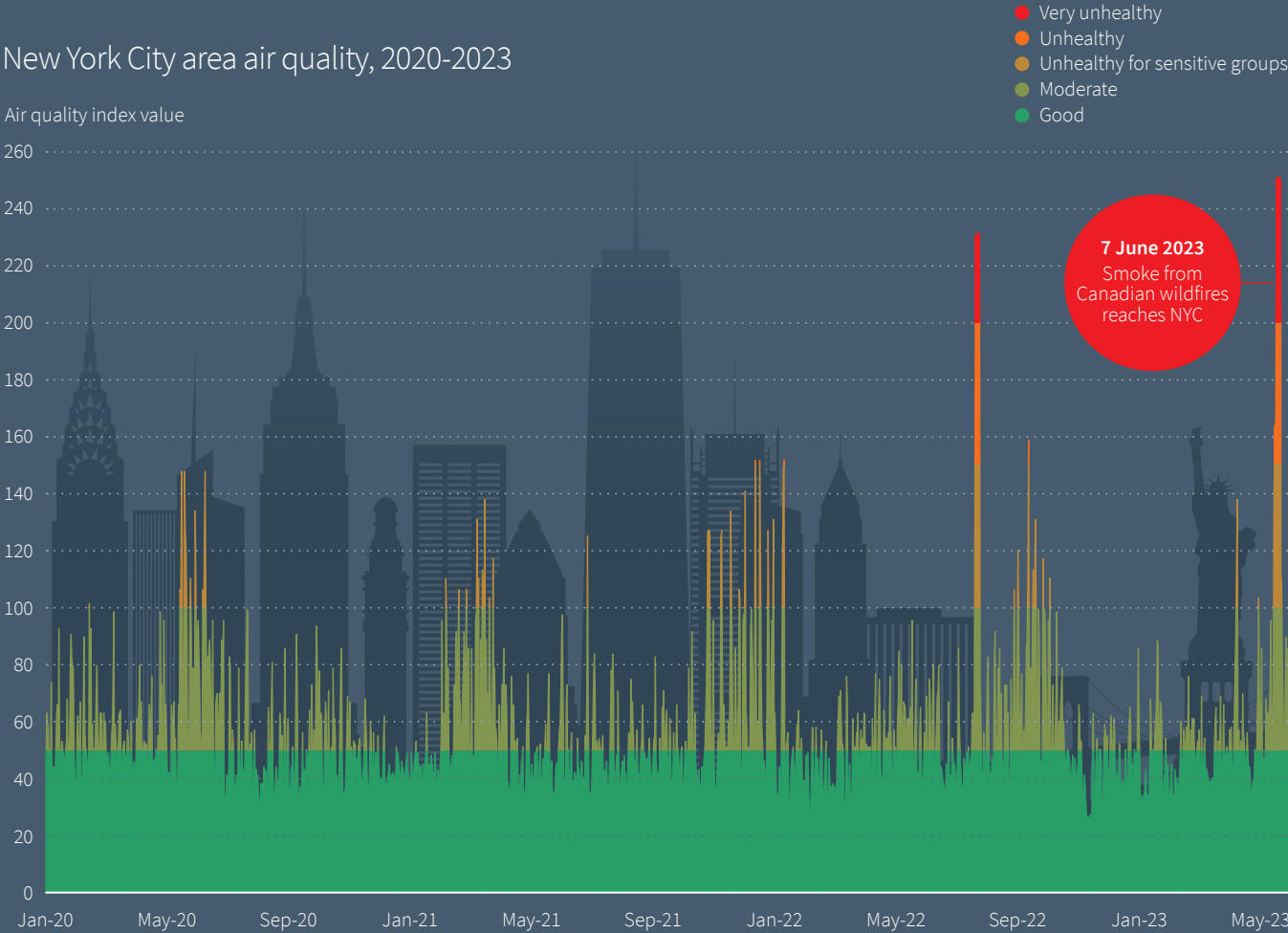


Smoke signals

Air pollution spikes

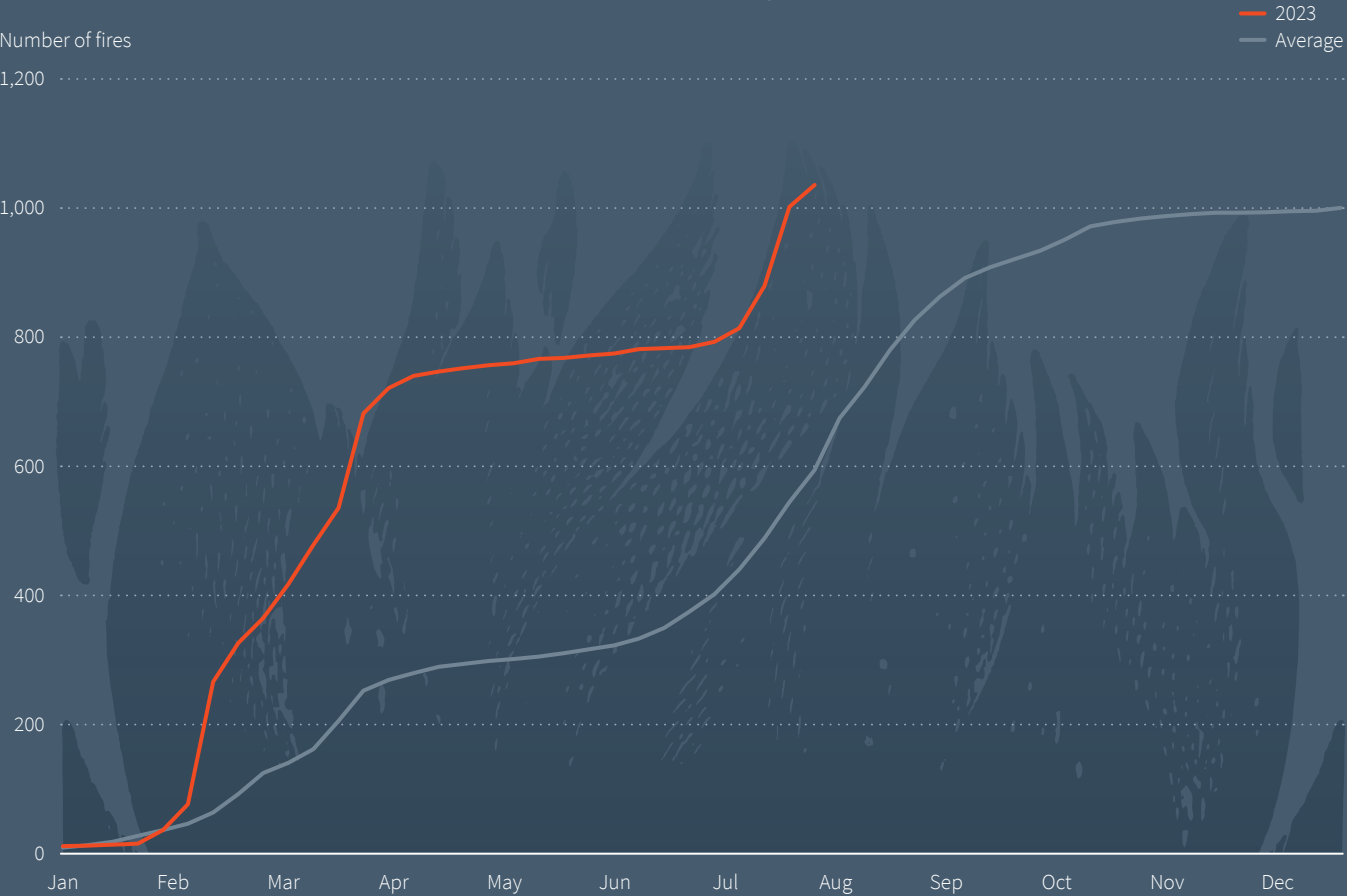
In June 2023, huge clouds of smoke from Canadian wildfires blanketed the US East Coast. At their peak, air quality in the New York City area was worse than any other major city in the world, reaching pollution levels more commonly found in megacities like Jakarta or New Delhi.

New York City area air quality, 2020-2023

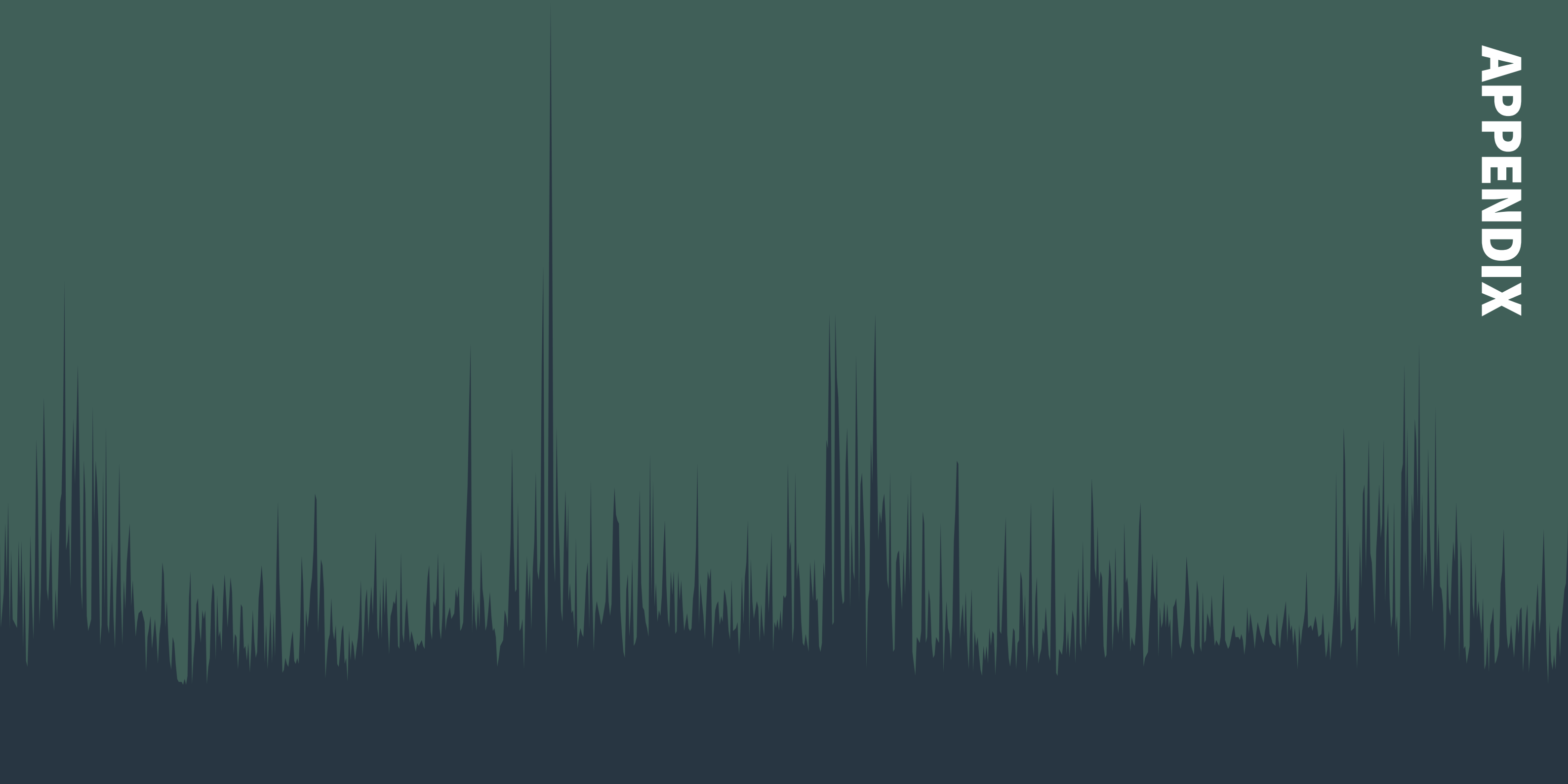


With climate-related wildfires on the rise, including in Europe, such episodes could become increasingly common.

European wildfires in 2023 compared with historical average



APPENDIX



08-09 What’s \$100 trillion between friends?
Note: Other, in order of GDP: Africa = Algeria; Morocco; Angola; Ethiopia; Kenya; Tanzania; Ghana; Côte d’Ivoire; Democratic Republic of the Congo; Sudan; Uganda; Tunisia; Libya; Cameroon; Zimbabwe; Zambia; Trinidad and Tobago; Senegal; Gabon; Guinea; Burkina Faso; Botswana; Mali; Mozambique; Benin; Equatorial Guinea; Madagascar; Niger; Mauritius; Rwanda; Republic of Congo; Malawi; Namibia; Chad; Mauritania; Togo; Somalia; South Sudan; Eswatini; Liberia; Sierra Leone; Burundi; Djibouti; Lesotho; Central African Republic; Eritrea; Cabo Verde; The Gambia; Seychelles; Guinea-Bissau; Comoros; and São Tomé and Príncipe. Asia = Taiwan; Thailand; Singapore; Bangladesh; Malaysia; Vietnam; Philippines; Pakistan; Hong Kong SAR; Kazakhstan; Uzbekistan; Turkmenistan; Sri Lanka; Myanmar; Nepal; Papua New Guinea; Cambodia; Macao SAR; Mongolia; Brunei Darussalam; Lao P.D.R.; Kyrgyz Republic; Tajikistan; Maldives; Timor-Leste; and Bhutan. Europe = Poland; Sweden; Belgium; Norway; Ireland; Austria; Denmark; Romania; Czech Republic; Finland; Portugal; Greece; Hungary; Ukraine; Slovak Republic; Bulgaria; Luxembourg; Belarus; Croatia; Serbia; Lithuania; Azerbaijan; Slovenia; Latvia; Estonia; Cyprus; Iceland; Bosnia and Herzegovina; Georgia; Armenia; Albania; Malta; Moldova; North Macedonia; Kosovo; Montenegro; Andorra; and San Marino. Middle East = Iran; Iraq; Qatar; Kuwait; Oman; Jordan; Bahrain; and Yemen. North and Central America = Puerto Rico; Dominican Republic; Guatemala; Panama; El Salvador; Honduras; Haiti; Jamaica; Nicaragua; The Bahamas; Barbados; Aruba; Belize; St. Lucia; Antigua and Barbuda; Grenada; St. Kitts and Nevis; St. Vincent and the Grenadines; and Dominica. Oceania = Fiji; Solomon Islands; Vanuatu; Samoa; Tonga; Micronesia; Marshall Islands; Palau; Kiribati; Nauru; and Tuvalu. South America = Ecuador; Venezuela; Uruguay; Costa Rica; Bolivia; Paraguay; Guyana; and Suriname. Source: Aviva Investors, August 2023. Data from: “World Economic Outlook database”, International Monetary Fund, April 2023. Available at: <https://www.imf.org/en/Publications/WEO/weo-database/2023/April/weo-report>.

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