CLIMATE CHANGE: IMPLICATIONS FOR THE ECONOMY AND THE FINANCIAL SECTOR

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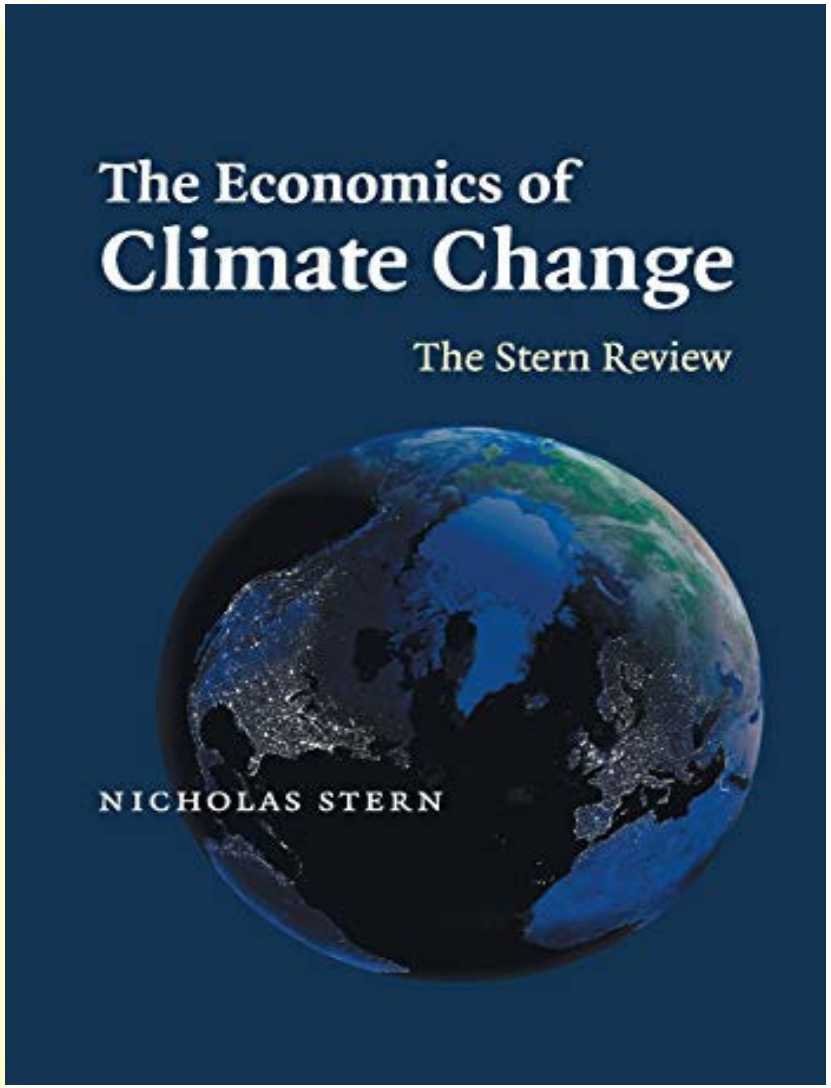
CLIMATE CHANGE: IMPLICATIONS FOR THE ECONOMY AND THE FINANCIAL SECTOR

*"Climate change is a result of the **greatest market failure** the world has seen. The evidence on the seriousness of the risks from inaction or delayed action is now overwhelming. We risk damages on a scale larger than the two world wars of the last century. The problem is global and the response must be a collaboration on a global scale."*

Nicholas Stern, 29 November 2007, Royal Economic Society public lecture, The University of Manchester, as quoted by The Guardian

CLIMATE CHANGE: IMPLICATIONS FOR THE ECONOMY AND THE FINANCIAL SECTOR



Source: Nicholas Stern, *The Economics of Climate Change*, Cambridge University Press, 2007.

CLIMATE CHANGE: IMPLICATIONS FOR THE ECONOMY AND THE FINANCIAL SECTOR

There is still time to avoid the worst impacts of climate change, if we take strong action now.

Climate change could have very serious impacts on growth and development.

The costs of stabilizing the climate are significant but manageable; delay would be dangerous and much more costly.

Action on climate change is required across all countries, and it need not cap the aspirations for growth of rich or poor counties.

A range of options to cut emissions; strong, deliberate policy action is required to motivate their take-up.

Climate change demands an international response, based on a shared understanding of long-term goals and agreement on frameworks for action.

Nicholas Stern, in Summary of Conclusions, pages xv-xix , *The Economics of Climate Change*, Cambridge University Press, 2007.

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1 **Climate change: some facts**

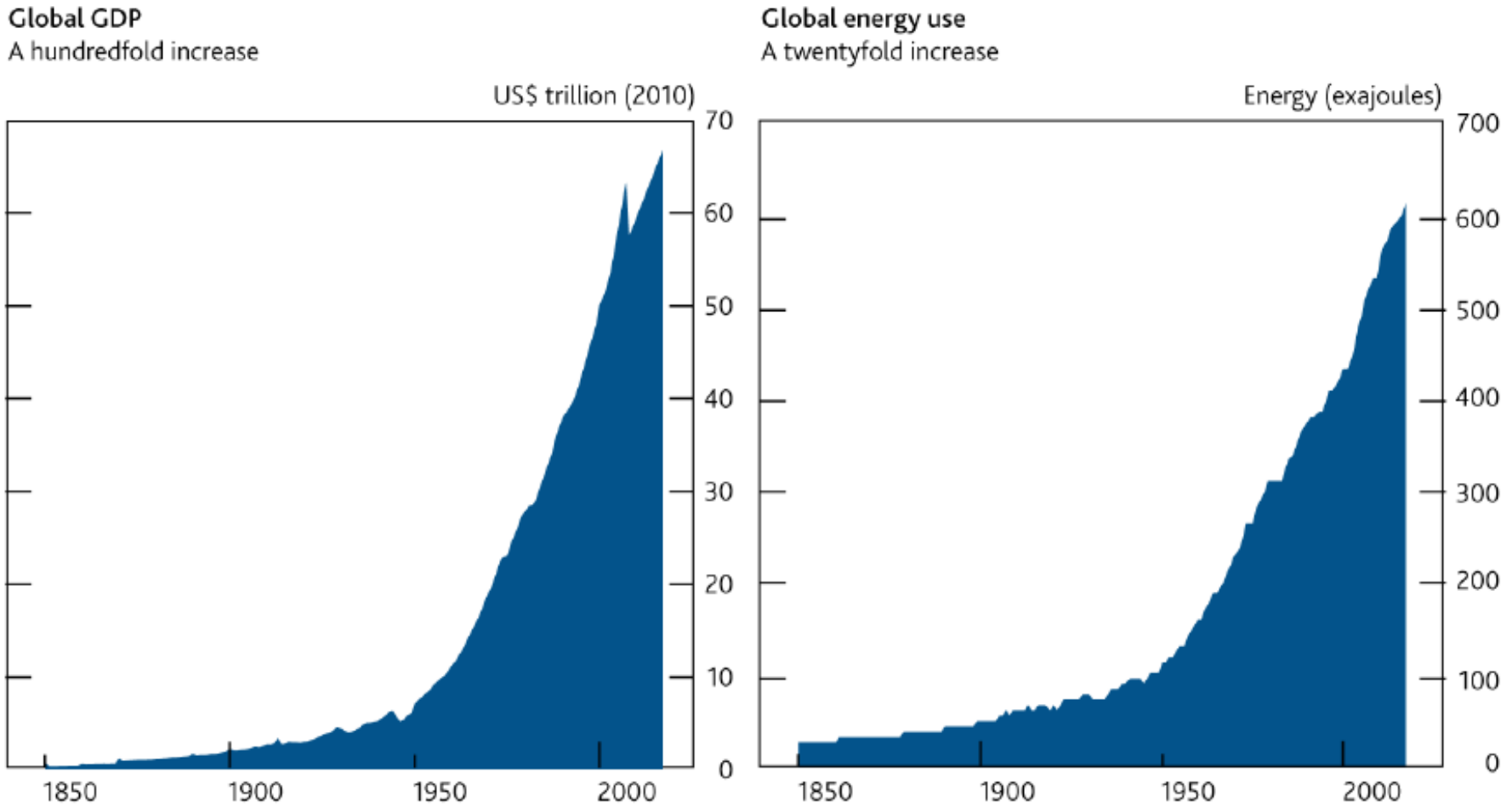
2 Climate change: long term scenarios

3 Climate change: the impact on the global economy

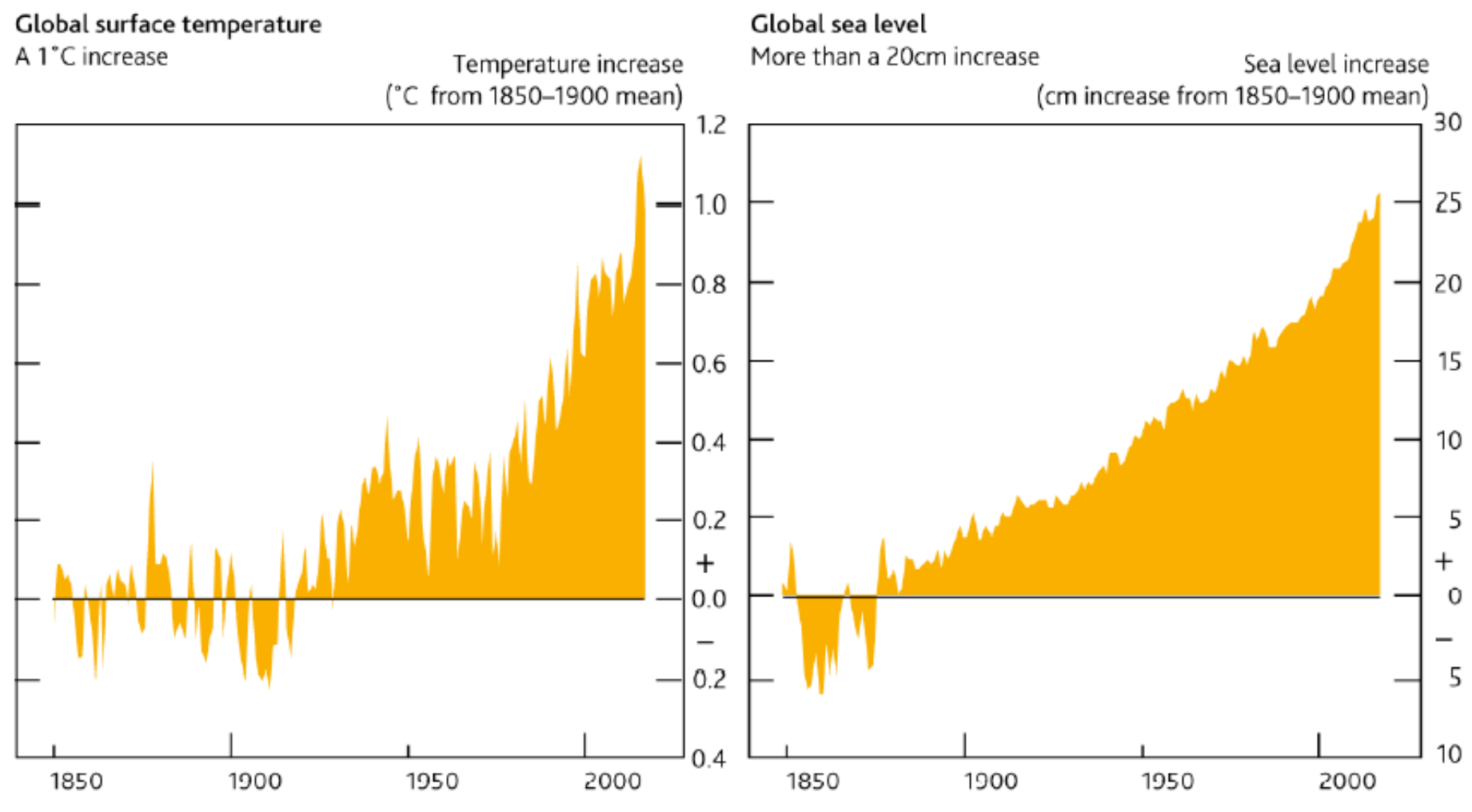
4 Climate change: risks for financial stability

5 Climate change: the role of supervision

6 Climate change: climate insurance protection gaps

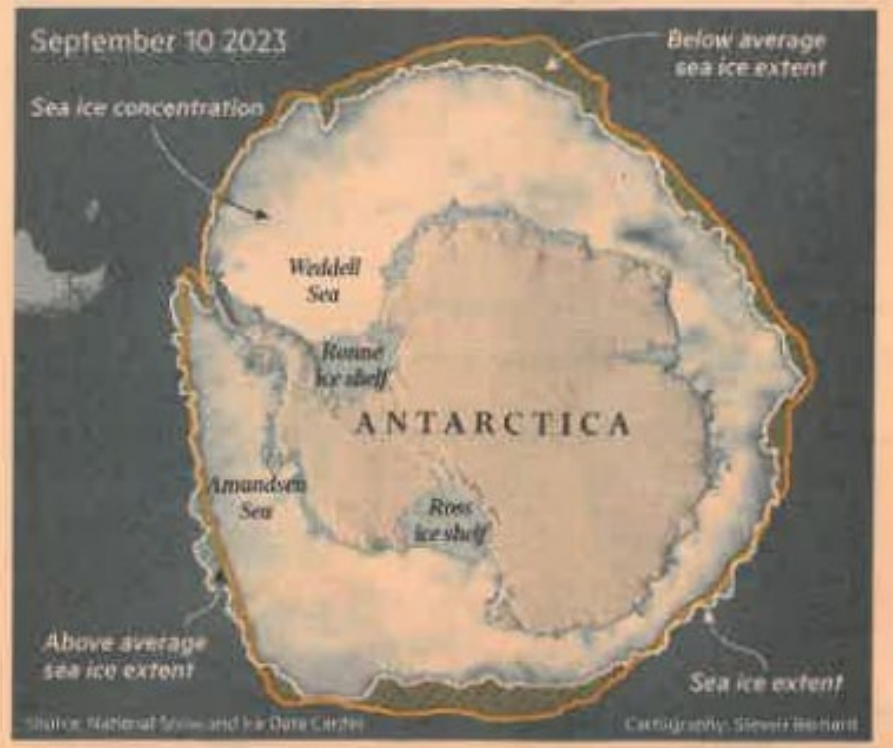


Source: *Transition in thinking: The impact of climate change on the UK banking sector*, Bank of England, September 2018.



Source: *Transition in thinking: The impact of climate change on the UK banking sector*, Bank of England, September 2018.

Extent of Antarctic sea ice remains at record lows for the time of year



The extent of daily and monthly sea ice around Antarctica hit its lowest in the satellite record in September, with the monthly extent falling to 9 per cent below average, say scientists at Copernicus, the EU's Earth observation agency.

Sea ice around Antarctica grows and shrinks throughout the year, normally reaching its maximum extent in September. This year's maximum reached just 16.96mn square kilometres, 1.03mn sq km below the previous record set in 1986 and 1.75mn sq km below the average maximum extent between 1981 and 2010.

Sea ice does not contribute to sea-level rises when it melts. But it does perform a crucial role as a protective buffer to the ice shelves and glaciers on the landmass of Antarctica.

Sign up for The Climate Graphic: Explained newsletter

Source: *Financial Times*, 7 October/8 October 2023.

FINANCIAL TIMES
9 Nov 2023

Earth on course for the warmest year on record in 2023

KENZA BRYAN AND STEVEN BERNARD
LONDON

Earth is nearly certain to experience its hottest year after October smashed temperature records, with the UN secretary-general blaming governments for "runaway climate carelessness" by failing to cut fossil fuel production.

The Copernicus European Earth observation agency said temperatures in October were 0.85C above the long-term average for the month. This monthly anomaly was more than double the September rise, and the highest on record.

The "exceptional" October followed four months of global temperature records being "obliterated", said Samantha Burgess, deputy director of Copernicus.

The succession of record-breaking heat data shows the world is no nearer to meeting the 2015 Paris agreement goal of a 1.5C long term average temperature rise, or well below 2C, since the industrial era.

"Laid out so starkly, the 2023 numbers on air temperatures, sea temperatures, sea ice and the rest look like something out of a Hollywood movie," said David Reay, a climate scientist at Edinburgh university. "If our current global efforts to tackle climate change were a film it would be called *Hot Mess*."

The latest UN report released yesterday ahead of the COP28 climate summit at the end of the month showed governments planned to produce more than double the amount of fossil fuels in 2030 than would be consistent with limiting warming to 1.5C.

"Governments are literally doubling down on fossil fuel production; that spells double trouble for people and planet," said António Guterres, UN secretary-general.

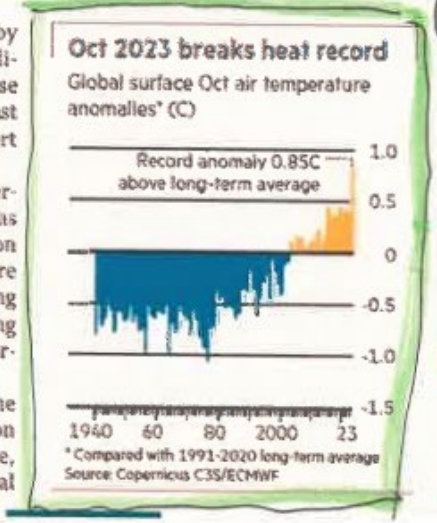
Development plans for fossil fuels by each country around the world indicated that coal output would increase until 2030, and oil and gas until at least 2050, the UN production gap report found.

It also warned of the "risks and uncertainties" around technologies such as carbon capture and storage and carbon dioxide emissions removal. These are often cited as a method for continuing production by oil and gas exporting nations, such as the United Arab Emirates, host of the climate summit.

Because of the questions about the effectiveness of deploying the carbon capture technologies at wide scale, countries should aim to phase out coal production and use by 2040, and cut oil and gas production and use by three-quarters by 2050 compared with 2020, the UN said.

The International Energy Agency's latest scenarios suggest oil demand would fall by almost half by 2050 if governments followed through on clean energy pledges.

"Our planet continues to pass through unfortunate milestones in its meteorological history," said Akshay Deoras, a meteorologist at Reading university.



Temperature records were "getting shattered by a humongous margin", he noted. October also marked the sixth consecutive month in which Antarctic sea ice fell to record low levels for the time of year.

Sea temperature anomalies caused by the El Niño weather phenomenon, which is continuing to warm the Pacific Ocean, are lower than those reached at this time of year during similar patterns in 1997 and 2015, Copernicus said.

A series of extreme weather events around the globe has accompanied the high temperatures.

In the past month, an unusual outbreak of wildfires has raged in northern parts of Australia. Copernicus said the number and intensity of the fires had been "significantly above" the 20-year average in Western Australia and the Northern Territory.

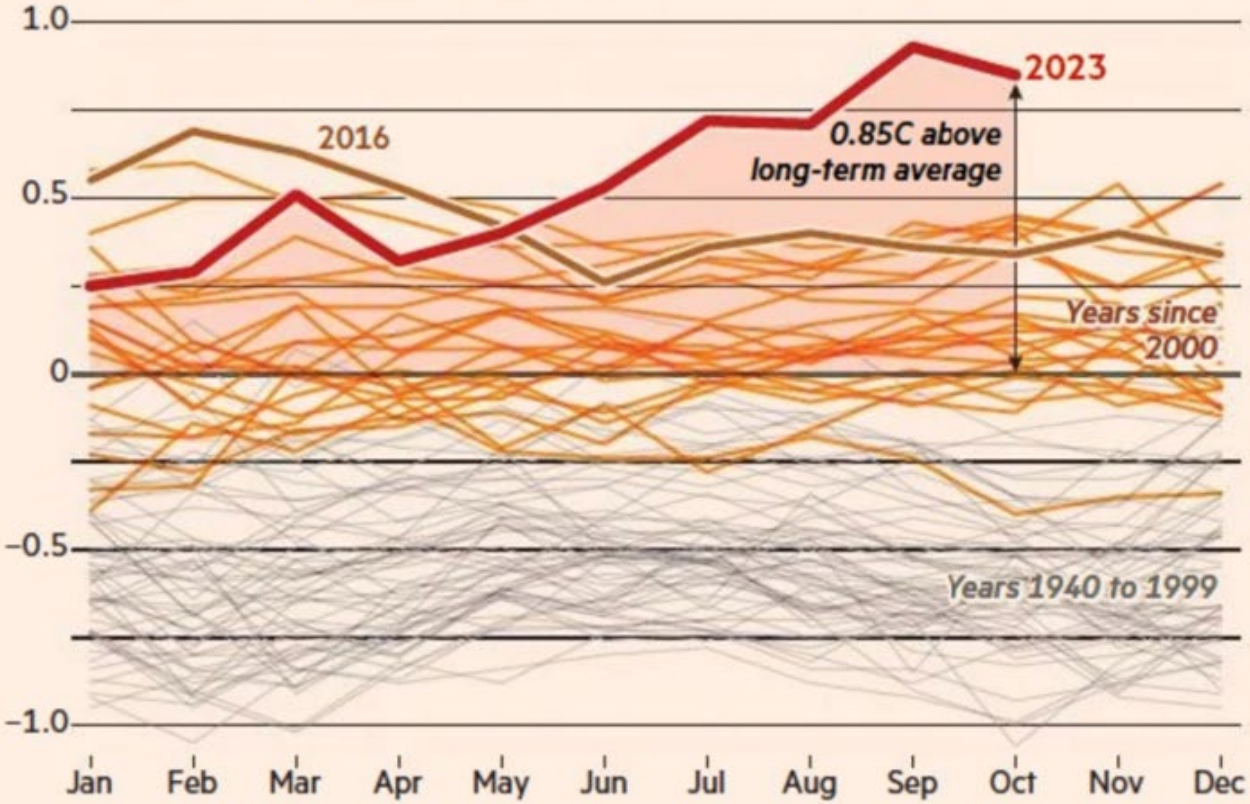
At the same time, Storm Babet in northern Europe and Storm Aline in Portugal and Spain helped to drive rain levels higher than average across most of Europe. It was also wetter than average in parts of North America and China, while a hurricane of record intensity hit Mexico's coastline last month.

Chris Giles See Opinion

Source: Financial Times, 8 November 2023

2023 is on target to be the hottest on record

Global surface air temperature anomalies* (C)



The Copernicus European Earth observation agency said temperatures in October were 0.85C above the long-term average for the month. This monthly anomaly was more than double the September rise, and the highest on record.

The "exceptional" October followed four months of global temperature records being "obliterated", said Samantha Burgess, deputy director of Copernicus.

The succession of record-breaking heat data shows the world is edging closer to the 2015 Paris agreement goal of limiting the rise in average temperatures to ideally 1.5C, or well below 2C, above pre-industrial levels.

* compared with 1991-2020 long-term average

Source: Copernicus C3S/ECMWF Follow @ftclimate on Instagram

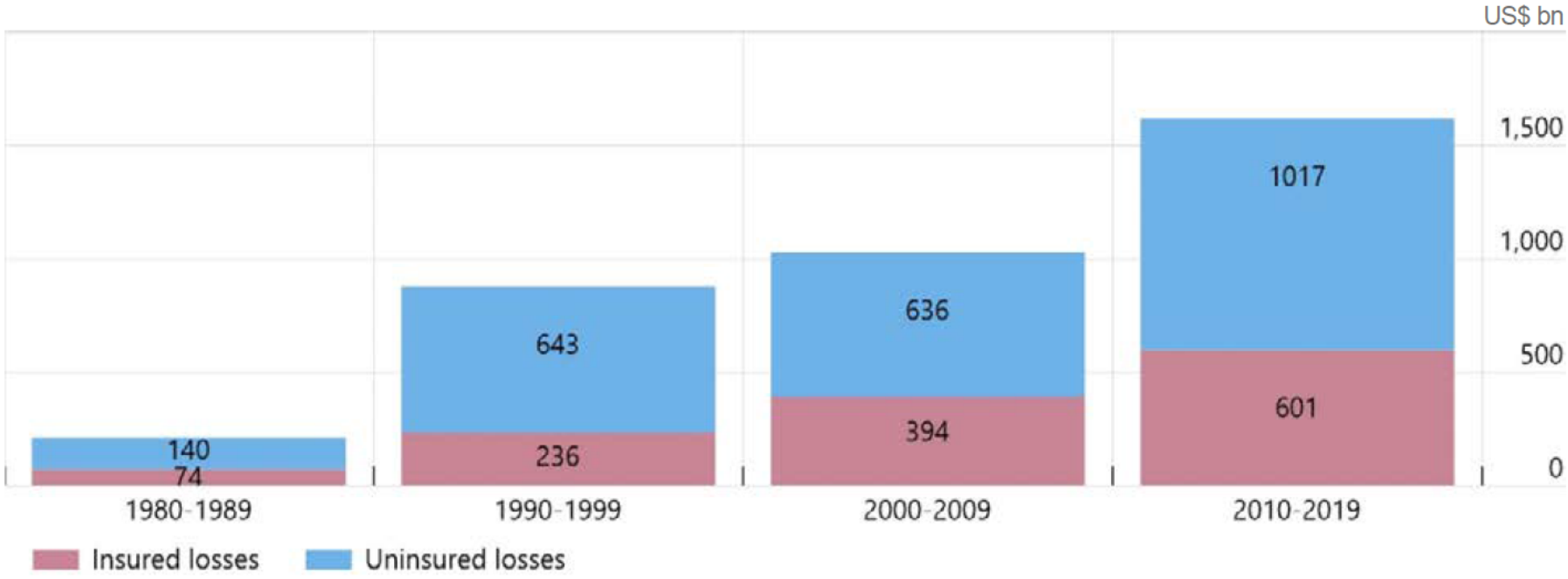
Sign up for The Climate Graphic: Explained newsletter ft.com/climate

Source: Financial Times, 11 November/12 November 2023

Economic losses resulting from weather-related catastrophes have increased significantly[1]

Graph 2

Global insured (and uninsured losses) resulting from weather-related natural catastrophes (2019 prices)



Source: SwissRe (2020).

[1] Data may not match those used in Graph 1 due to differences in the scope.

Source: *The Implications of Climate Change for Financial Stability*, Financial Stability Board, 23 November 2020

FINANCIAL RISKS STEMMING FROM CLIMATE CHANGE

Physical risk

Transition risk

Litigation risk

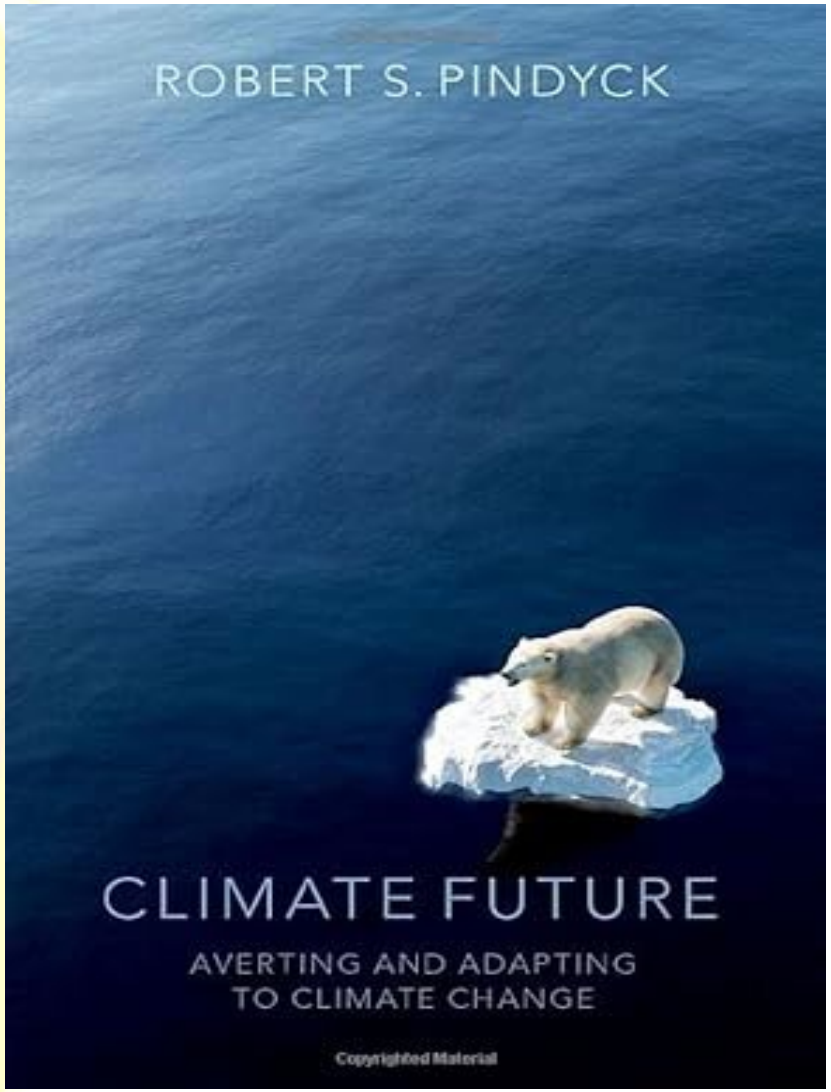
UNIQUE CHARACTERISTICS OF CLIMATE CHANGE

Far-reaching impact in terms of scope and magnitude

Heterogeneity of impacts

Dependency on short-term actions

Uncertainty



Source: Robert S. Pindyck, *Climate Future – Averting and Adapting to Climate Change*, Oxford University Press, 2022.

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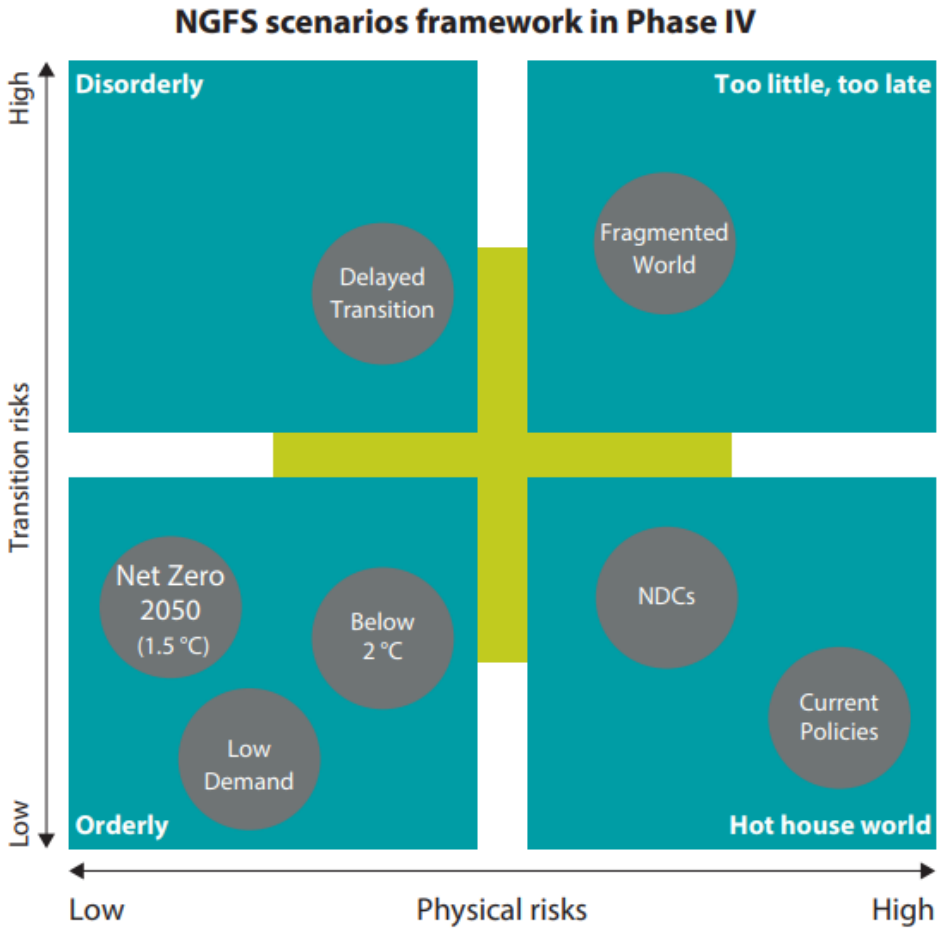


Positioning of scenarios is approximate, based on an assessment of physical and transition risks out to 2100.

Source: NGFS Scenarios for central banks and supervisors, NGFS, November 2023

2. CLIMATE CHANGE: LONG TERM SCENARIOS

Quadrant	Scenario	Physical risk: End of century warming (model averages)	Transition risk: Policy reaction	Transition risk: Technology change	Transition risk: Carbon dioxide removal -	Transition risk: Regional policy variation +
Orderly	Low Demand NEW	1.4 °C (1.6 °C)	Immediate	Fast change	Medium use	Medium variation
	Net Zero 2050	1.4 °C (1.6 °C)	Immediate	Fast change	Medium-high use	Medium variation
	Below 2 °C	1.7 °C (1.8 °C)	Immediate and smooth	Moderate change	Medium use	Low variation
Disorderly	Delayed Transition	1.7 °C (1.8 °C)	Delayed	Slow/Fast change	Medium use	High variation
Hot house world	Nationally Determined Contributions (NDCs)	2.4 °C (2.4 °C)	NDCs	Slow change	Low use	Medium variation
	Current Policies	2.9 °C (2.9 °C)	None – current policies	Slow change	Low use	Low variation
Too-little-too-late	Fragmented World NEW	2.3 °C (2.3 °C)	Delayed and Fragmented	Slow/Fragmented change	Low-medium use	High variation

Colour coding indicates whether the characteristic makes the scenario more or less severe from a macro-financial risk perspective ^

- Lower risk
- Moderate risk
- Higher risk

- The impact of CDR on transition risk is twofold: on the one hand, low levels of CDR imply an increase in transition costs, as reductions in gross emissions should be obtained in a different way; on the other hand, high reliance on CDR is also a risk if the technology does not become more widely available in the coming years.

+ Risks will be higher in the countries and regions that have stronger policy. For example, in Net Zero 2050, various countries and regions reach net zero GHG by 2050, while many others have emission of several Gt of CO_2eq.

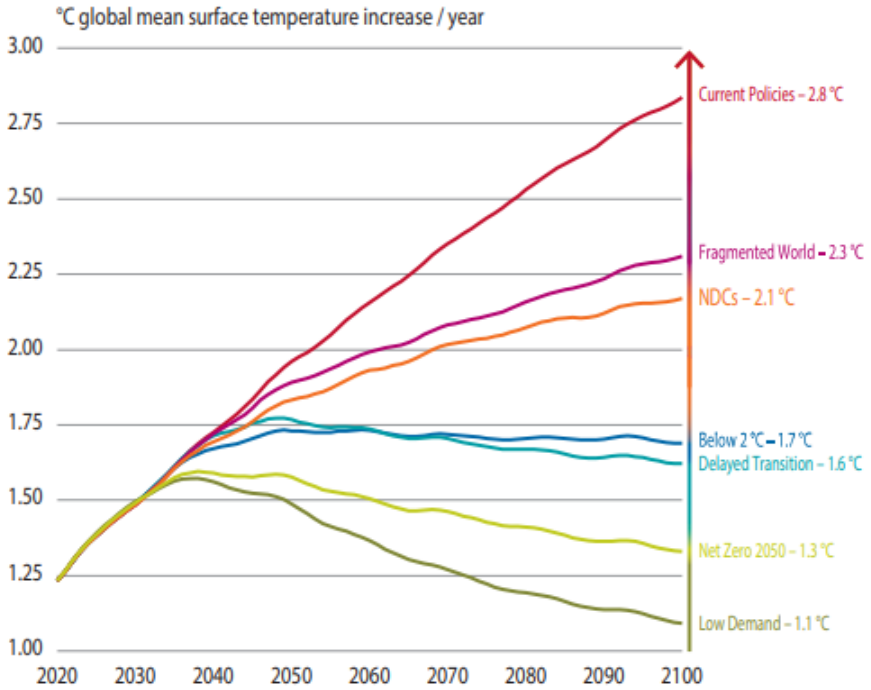
^ This assessment is based on expert judgment based on how changing this assumption affects key drivers of physical and transition risk. For example, higher temperatures are correlated with higher impacts on physical assets and the economy. On the transition side economic and financial impacts increase with a) strong, sudden and/or divergent policy, b) fast technological change even if shadow carbon price changes are modest, c) limited availability of carbon dioxide removal meaning the transition must be more abrupt in other parts of the economy, d) stronger policy in those countries and/or regions.

Source: NGFS Scenarios for central banks and supervisors, NGFS, November 2023

2. CLIMATE CHANGE: LONG TERM SCENARIOS

Temperature Evolution by Scenario

AR6 Surface Temperature (GSAT) increase (50th), MAGICC with REMIND emission inputs

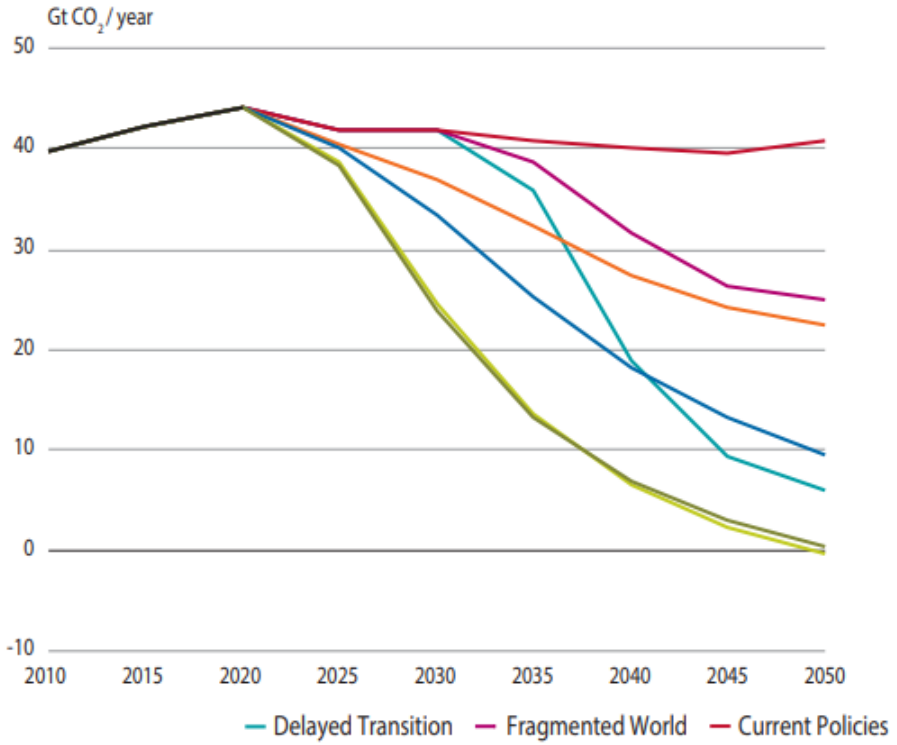


Sources: IIASA NGFS Climate Scenarios Database, MAGICC model (with REMIND emissions inputs). MAGICC provides a range of temperature increase compared to the pre-industrial levels.
The temperature paths displayed here follow the 50th percentile.

N.B. the table on the previous slide shows average temperatures across the three IAMS.

Global Yearly CO_2 Emissions

REMIND



Source: IIASA NGFS Climate Scenarios Database, REMIND model. World aggregates mask strong differences across sectors and jurisdictions. Regionally and sectorally granular information is available in the IIASA Portal. End of century warming outcomes shown. 5-year time step data.

Source: NGFS Scenarios for central banks and supervisors, NGFS, November 2023

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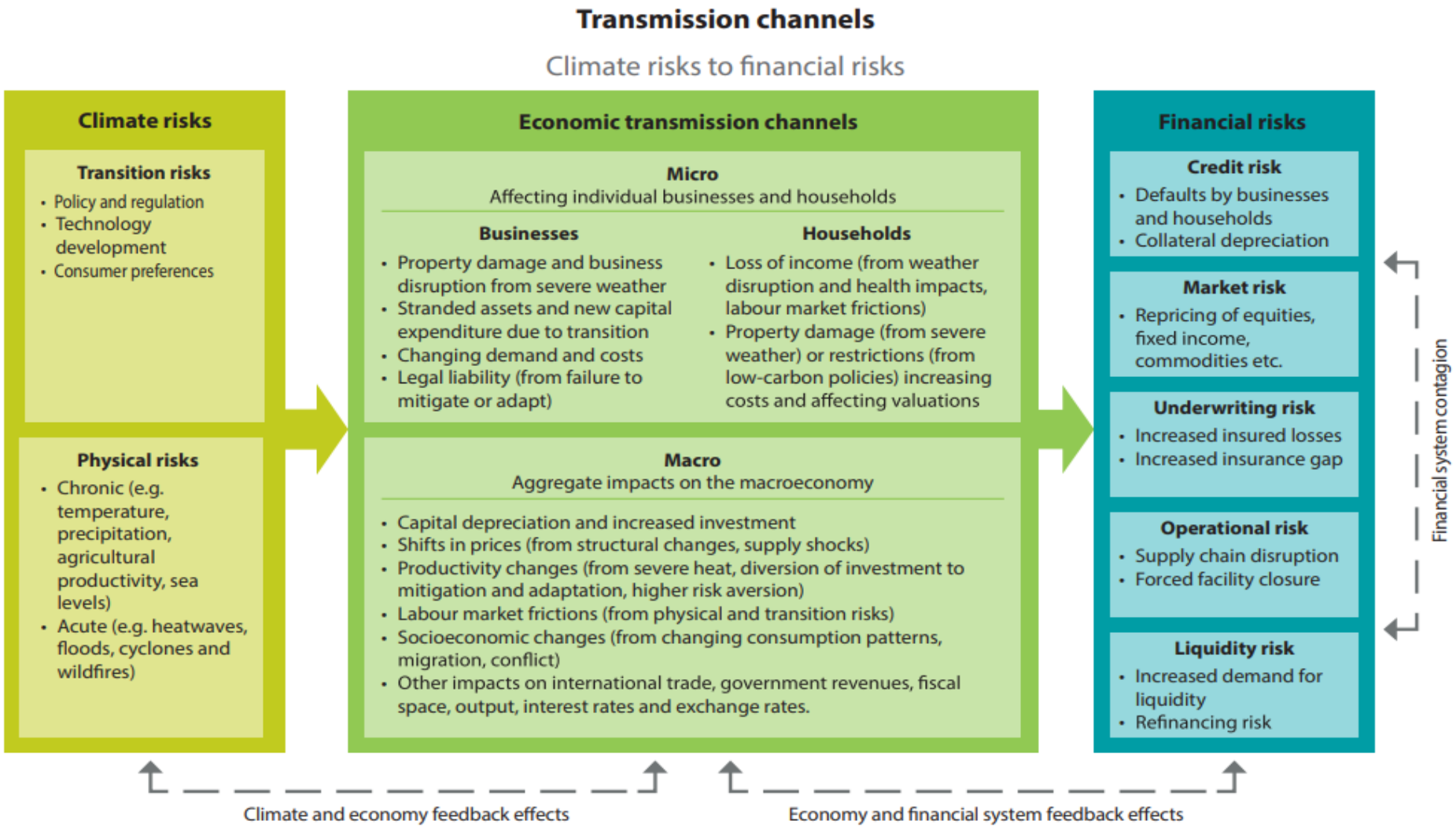
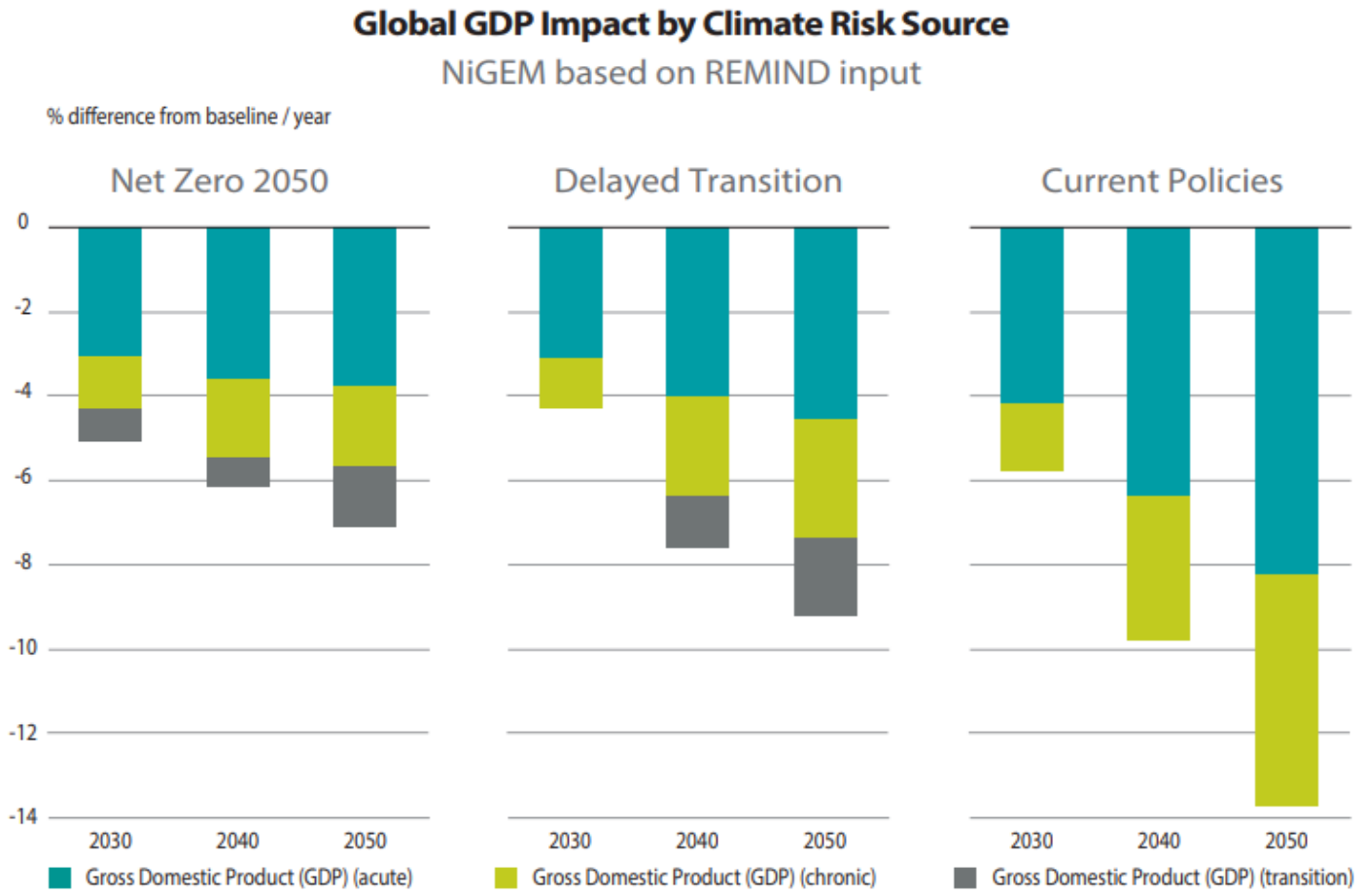


Source: NGFS Scenarios for central banks and supervisors, NGFS, November 2023

3. CLIMATE CHANGE: THE IMPACT ON THE GLOBAL ECONOMY



Note: The above figure shows how GDP is impacted across scenarios compared with a hypothetical (and impossible) baseline scenario in which no transition or physical risks occur. This baseline scenario represents a world in which climate change does not occur. Thus, climate change has a negative impact on GDP in every plausible scenario, but the magnitude of the losses differs across them.

Source: NGFS Scenarios for central banks and supervisors, NGFS, November 2023

Table A

Main features of the suite of models

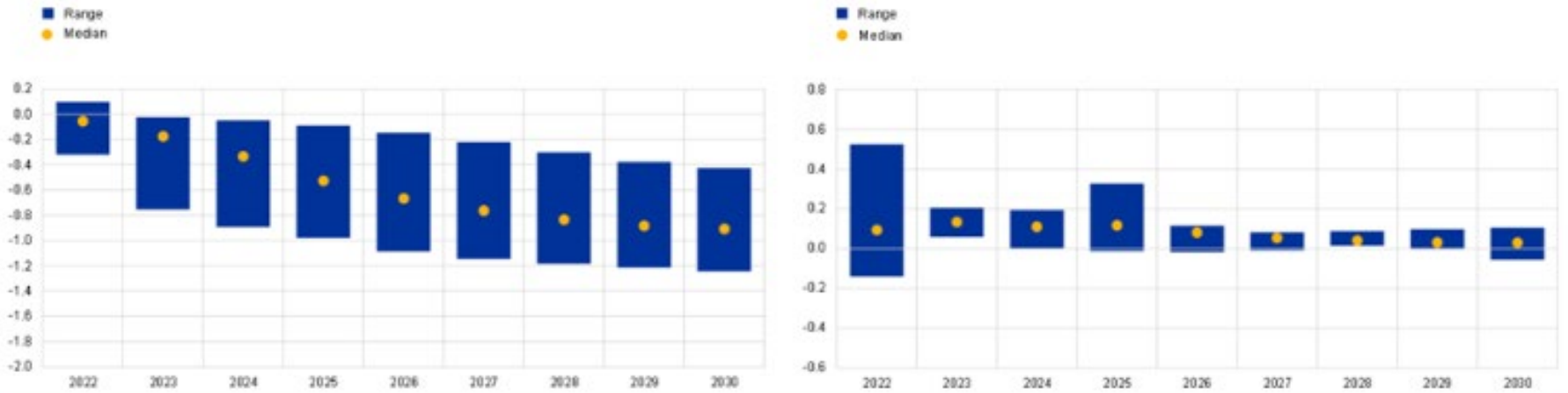
	NAWM-E	E-DSGE I (RR)	E-DSGE II (FHL)	G-Cubed	NIGEM	Oxford
Type	DSGE	DSGE	DSGE	Hybrid	Semi-structural	Semi-structural
Country coverage	Two-country: euro area and RoW	Euro area	Euro area	Multi-country global	Multi-country global	Multi-country global
Sectoral coverage	Limited	Limited	Limited	High	Limited	Limited
Energy sector	Disaggregated: two types of energy for consumption and production	Disaggregated: two types of energy for production	Disaggregated: two types of energy for production with emission abatement	Disaggregated: several types of energy for production	Aggregated: several types of energy for production	Aggregated: several types of energy for production
Carbon tax transmission	Direct and indirect	Indirect (incl. via banking sector)	Indirect	Indirect	Indirect	Direct and indirect
Forward-looking	Yes	Yes	Yes	Mix	Mix	Mix
Household heterogeneity	Yes	No	Yes	Yes	No	No
Fiscal assumption	Carbon tax revenues transferred to households			Carbon tax revenues reduce government debt		
Monetary policy	Model-specific interest rate rule					

Source: "The macroeconomic implications of the transition to a low-carbon economy", prepared by Claus Brand, Günter Coenen, John Hutchinson and Arthur Saint Guilhem, published as part of the ECB Economic Bulletin, Issue 5/2023, ECB.

Chart 1

Carbon pricing impact on real GDP (LHS) and inflation (RHS)

percentage and percentage-point deviation from baseline paths



Sources: NAWM-E, E-DSGE I + II, G-Cubed, NiGEM and Oxford.

Note: The charts display the impact (range and median across models) of the assumed carbon price increase on euro area real GDP and inflation between 2022 and 2030.

Source: Claus Brand, Günter Coenen, John Hutchinson, and Arthur Saint Guilhem, "How will higher carbon prices affect growth and inflation?", ECB Blog, 25 May 2023

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FINANCIAL RISKS STEMMING FROM CLIMATE CHANGE:

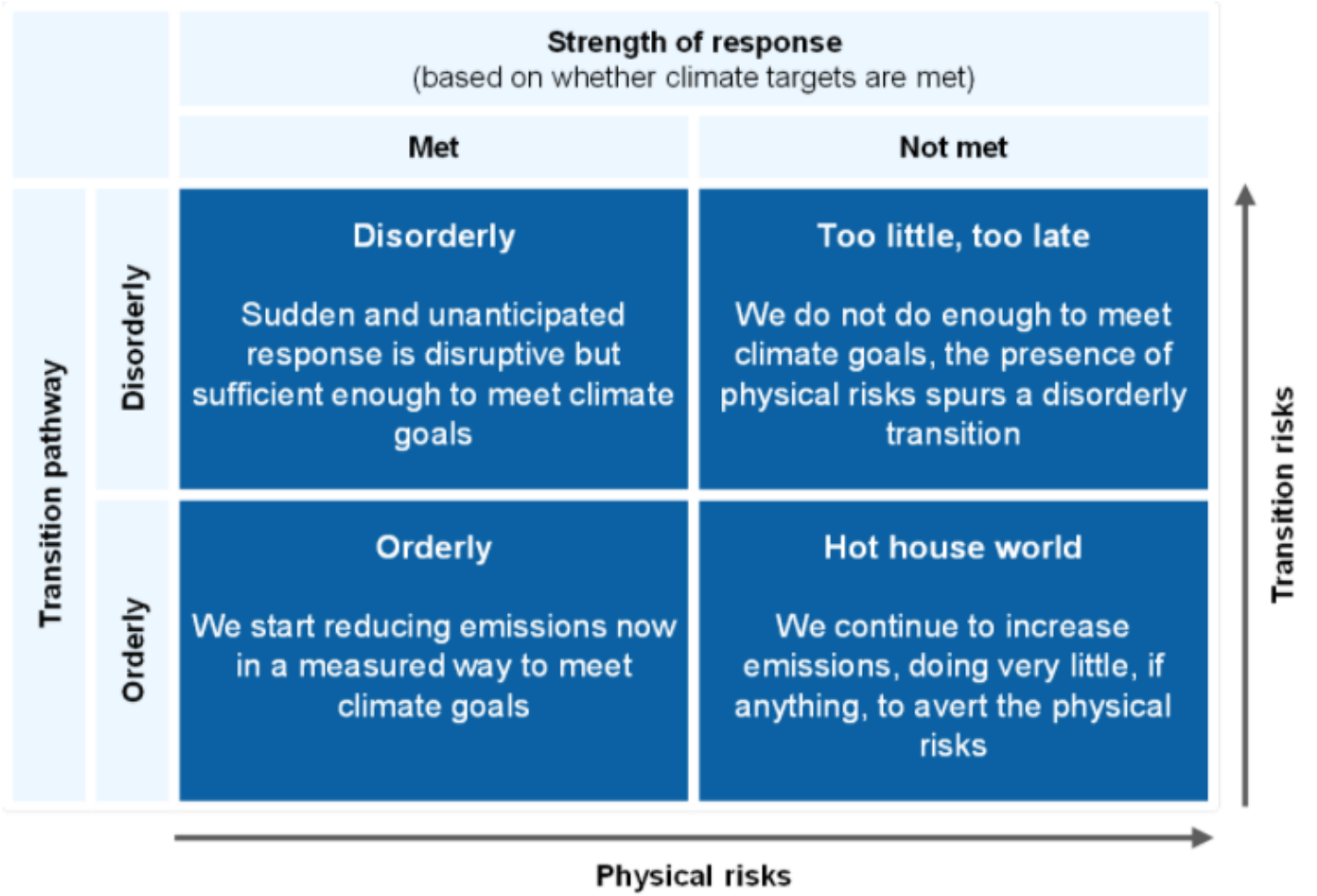
- Physical risk
- Transition risk
- Litigation risk

TRANSMISSION AND AMPLIFICATION MECHANISMS

- Changes in the pricing and management of financial risks
- Potential for pro-cyclical behavior by market participants
- Self-reinforcing reductions in bank lending and insurance provision

Source: *The Implications of Climate Change for Financial Stability,* Financial Stability Board, 23 November 2020

Physical versus transition risks: temperature scenarios and the cost of climate change

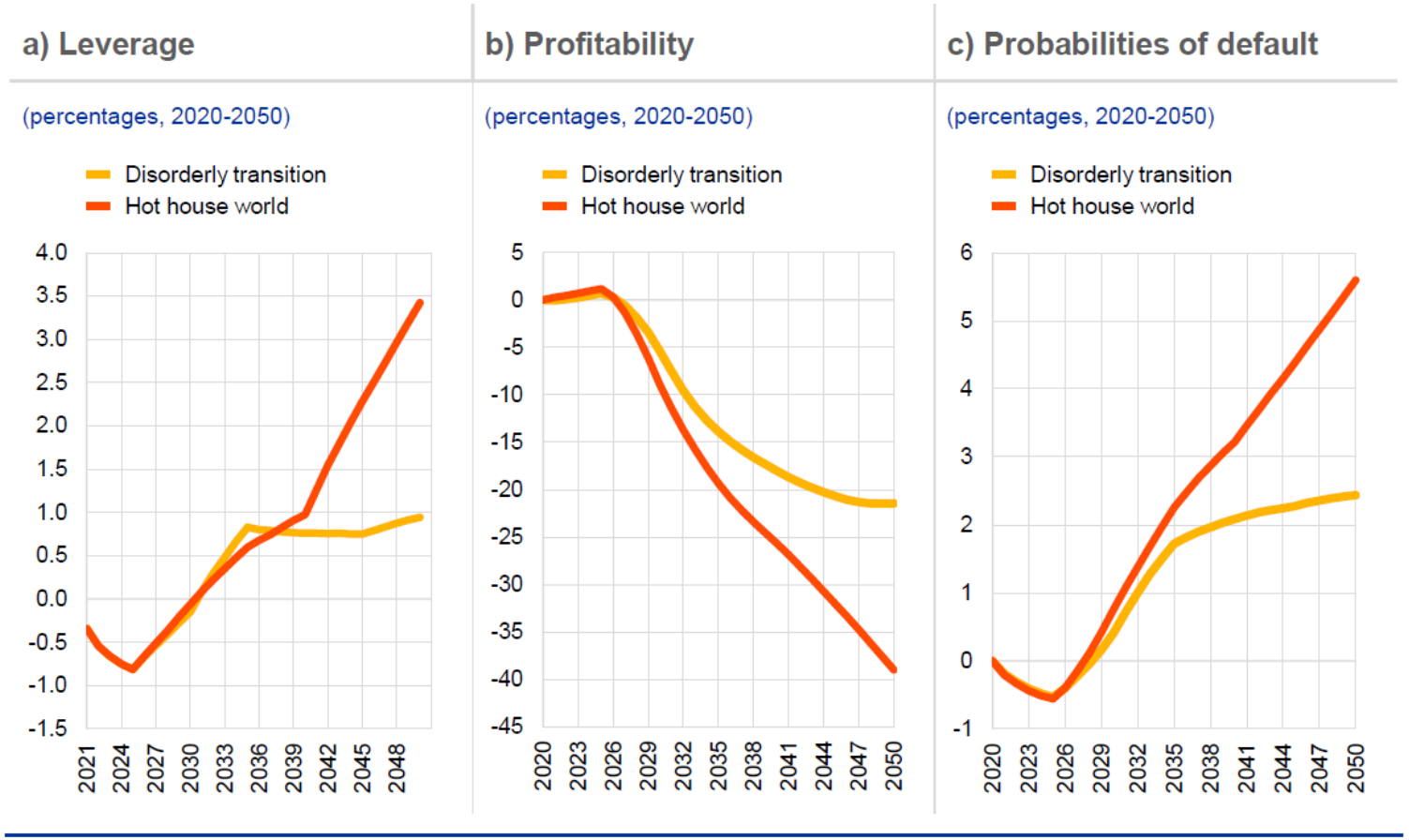


Source: NGFS (2019), op. cit.

Source: *Climate change and financial stability*, Giuzio, M. et al (2019), Financial Stability Review, ECB, May 2019

Chart 28

Projected results for the median European firm



Source: ECB calculations based on NGFS scenarios (2020b), Orbis, iBACH, Urgentem and Four Twenty Seven data (2018).
Note: All charts display median percentage changes under the disorderly transition and hot house world scenarios relative to baseline (orderly transition).

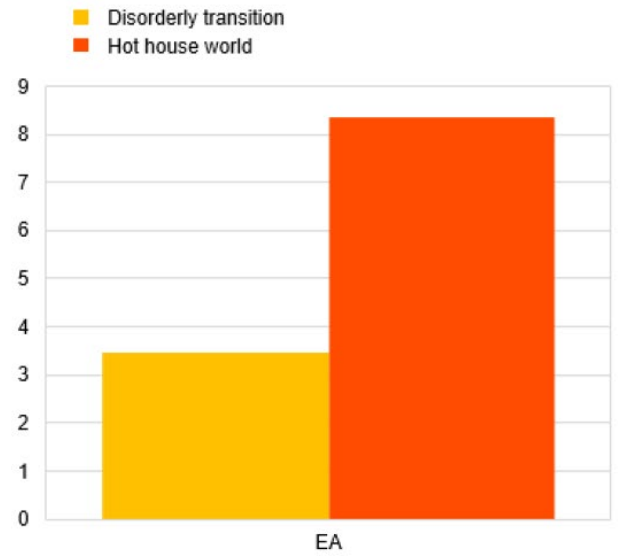
Source: "ECB economy-wide climate stress test. Methodology and results", Occasional Paper Series, No 281, ECB, September 2021

Chart 43

Distribution of expected losses by 2050

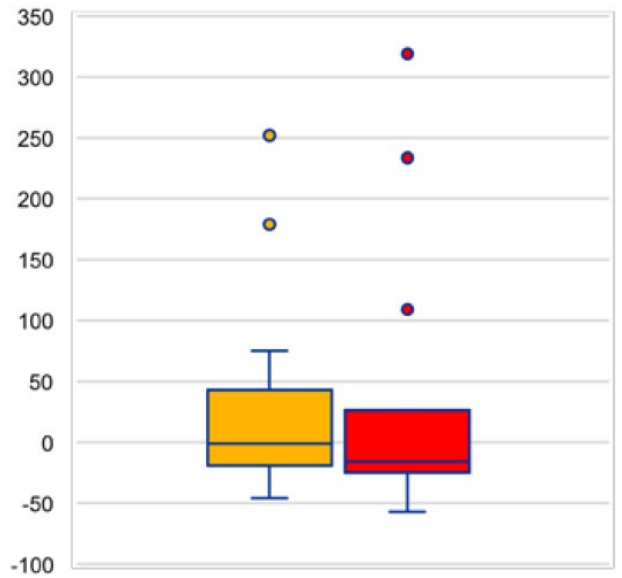
a) Total Euro area percentage changes under the disorderly transition and hot house world scenarios relative to the baseline (orderly transition)

(percentages)



b) Distribution of country-level deviations from the Euro area average

(percentages)



Source: ECB calculations based on NGFS scenarios (2020), AnaCredit, Orbis, Urgentem and Four Twenty Seven data (2018).
Notes: Total refers to the total change in bank-level expected losses between the respective scenario and the baseline between 2020 and 2050 and across euro area banks.

Source: "ECB economy-wide climate stress test. Methodology and results", Occasional Paper Series, No 281, ECB, September 2021

- … ECB economy-wide (top down) climate stress test [September 2023]
- … ECB climate risk stress test (bottom-up) [July 2022]
- … ECB report on good practices for climate stress testing [December 2022]
- … NGFS climate scenarios [last version November 2023]

- … FSB Work Program for 2023 [February 2023]
- … IMF Staff Note on how incorporates climate change in the FSAPs [July 2022]
- … EBA public consultation on the prudential framework [May 2022]

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1. Definition of supervisory expectations
   - expectations relating to business model and strategy
   - expectations relating to governance and risk apetite
   - expectations relating to risk management
   - expectations relating to disclosures

2. Implementation of stress tests
   - Bottom-up (micro-prudential)
   - Top-down (macro-prudential)

3. Incorporation of C&E risks in the SREP procedure

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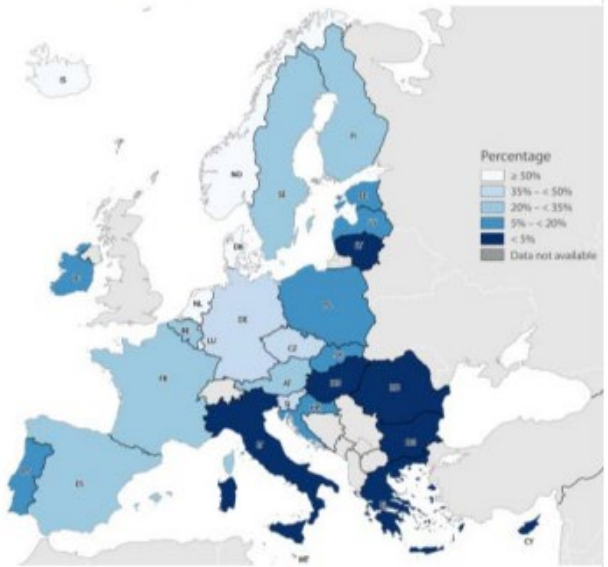
6. CLIMATE CHANGE: CLIMATE INSURANCE PROTECTION GAPS

Chart 1

The share of insured economic losses related to natural catastrophes in Europe is low and could decline in the medium to long term, while property catastrophe premium indicators have been increasing recently, albeit from historically low levels

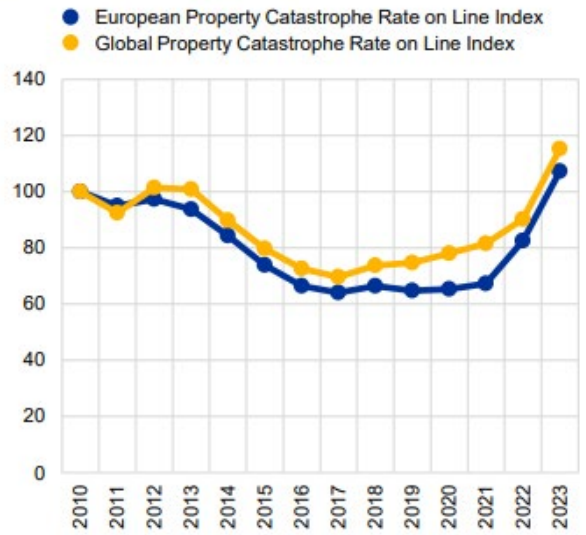
Average share of insured economic losses caused by weather-related events in Europe

(1980-2021, percentages)



Guy Carpenter's Global and Continental Europe Property Catastrophe Rate on Line Index

(2010-2023, percentage growth)



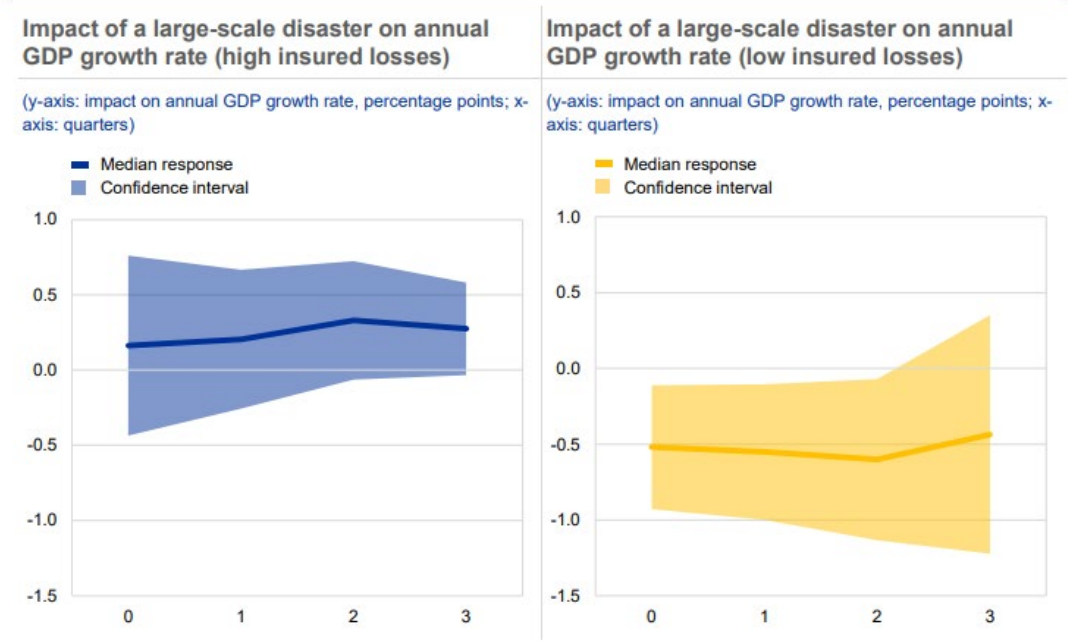
Sources: Left panel: EIOPA dashboard on insurance protection gap for natural catastrophes, European Environment Agency (EEA) CATDAT; right panel: Guy Carpenter and Artemis.
Notes: The data points in the right panel indicate the Rate on Line charged at the beginning of each year.

Source: Policy options to reduce the climate insurance protection gap, Discussion Paper, ECB and EIOPA, April 2023

6. CLIMATE CHANGE: CLIMATE INSURANCE PROTECTION GAPS

Chart 3

Insurance helps to maintain GDP growth after a natural disaster, while uninsured losses are estimated to have an adverse effect on GDP growth



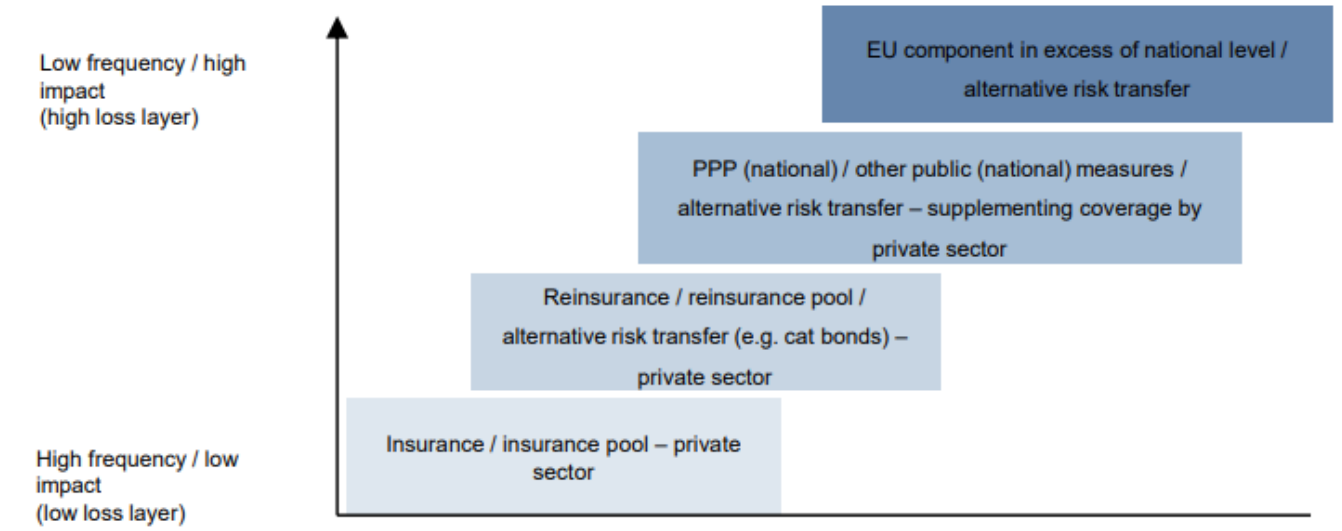
Sources: EM-DAT, Organisation for Economic Co-operation and Development (OECD) and authors' calculations (taken from Fache Rousová et al., 2021).
Notes: The sample includes 45 countries for which the OECD provides quarterly GDP data from 1996 to 2019. Insured and uninsured losses are imputed for most events where data on total damages are available. The values are imputed on the basis of country-specific regression models, where the dependent variable is the share of insured losses in total damages and the explanatory variables include the log of total damage and dummies for eight different types of disaster (drought, earthquake, extreme temperature, flood, mass movements (e.g. landslides), storms, volcanic activity, wildfire) to the extent applicable for a given country. The charts show the impact of large-scale natural disasters (i.e. with total damage larger than 0.1% of GDP, which represents the third quartile of the loss distribution) when the share of insured losses is high (above the median of 35%) (left panel) and low (i.e. below the median of 35%) (right panel). The estimates are obtained using a panel regression model where the dependent variable is the year-on-year difference in the log of GDP and the explanatory variables include two dummies capturing large-scale disasters with a high and low share of insured losses respectively (included with up to three lags) and country and quarterly fixed effects. For the quarter including the date(s) of the disaster (t=0) and the three subsequent quarters, the y-axis measures the percentage point impact of the disaster on the year-on-year annual growth rate at the end of that quarter. Results are robust to the exclusion of earthquakes and volcanic activity events from the sample, although the significance of the estimates decreases, as earthquakes tend to lead to particularly large damages.

Source: Policy options to reduce the climate insurance protection gap, Discussion Paper, ECB and EIOPA, April 2023

6. CLIMATE CHANGE: CLIMATE INSURANCE PROTECTION GAPS

Figure 1

The ladder approach to catastrophe insurance



Source: Authors.

Source: Policy options to reduce the climate insurance protection gap, Discussion Paper, ECB and EIOPA, April 2023

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