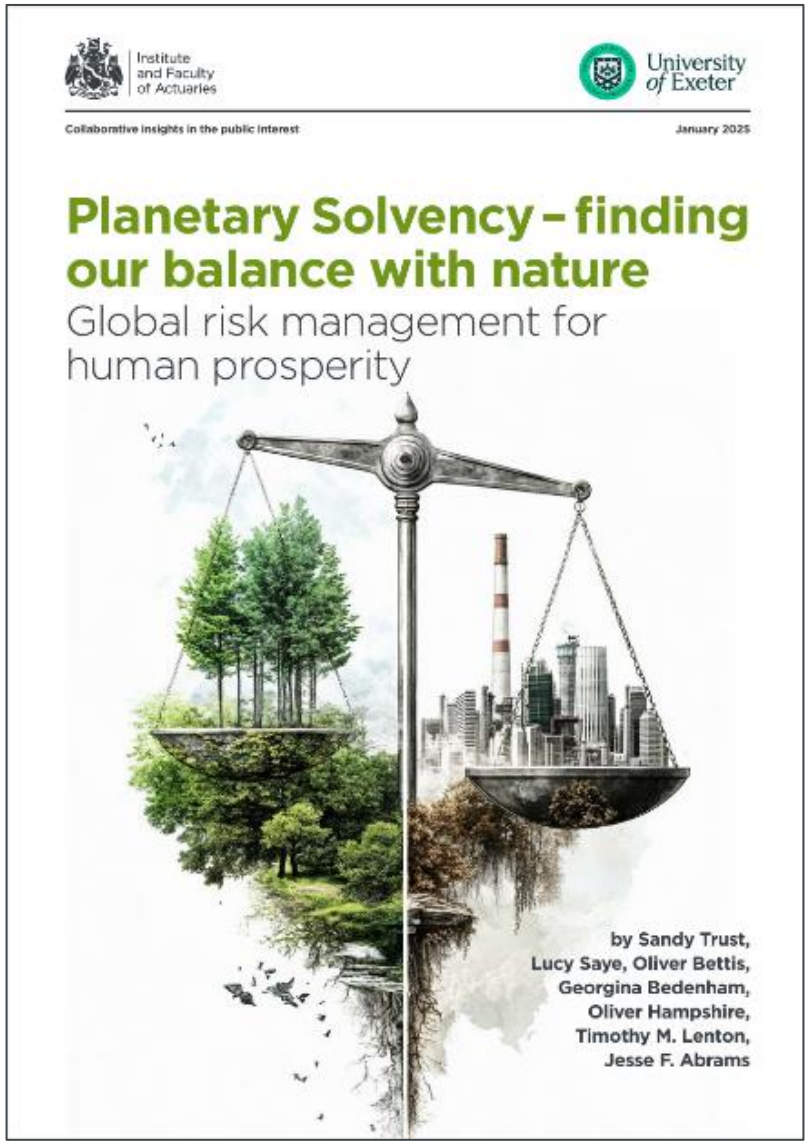
Institute and Faculty of Actuaries

Planetary Solvency

- finding our balance with nature.

Global Risk Management for Human Prosperity

University of Exeter



- Introduction
- Defining Planetary Solvency
- From financial to Planetary Solvency
- Planetary Solvency outputs
- Climate
- Nature

Institute and Faculty of Actuaries

https://actuaries.org.uk/planetary-solvency

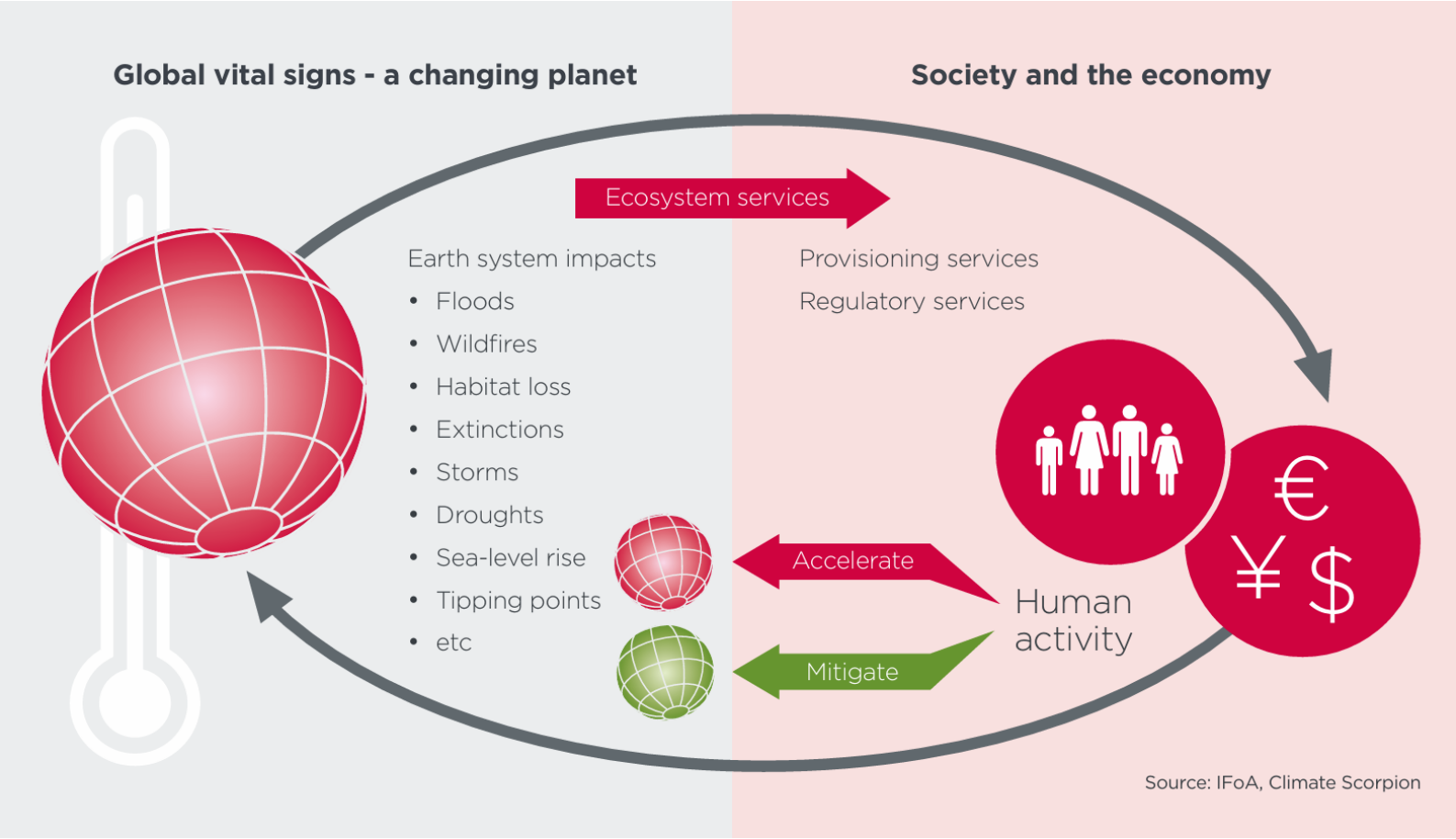
Institute and Faculty of Actuaries

Defining Planetary Solvency

Tim Lenton

University of Exeter

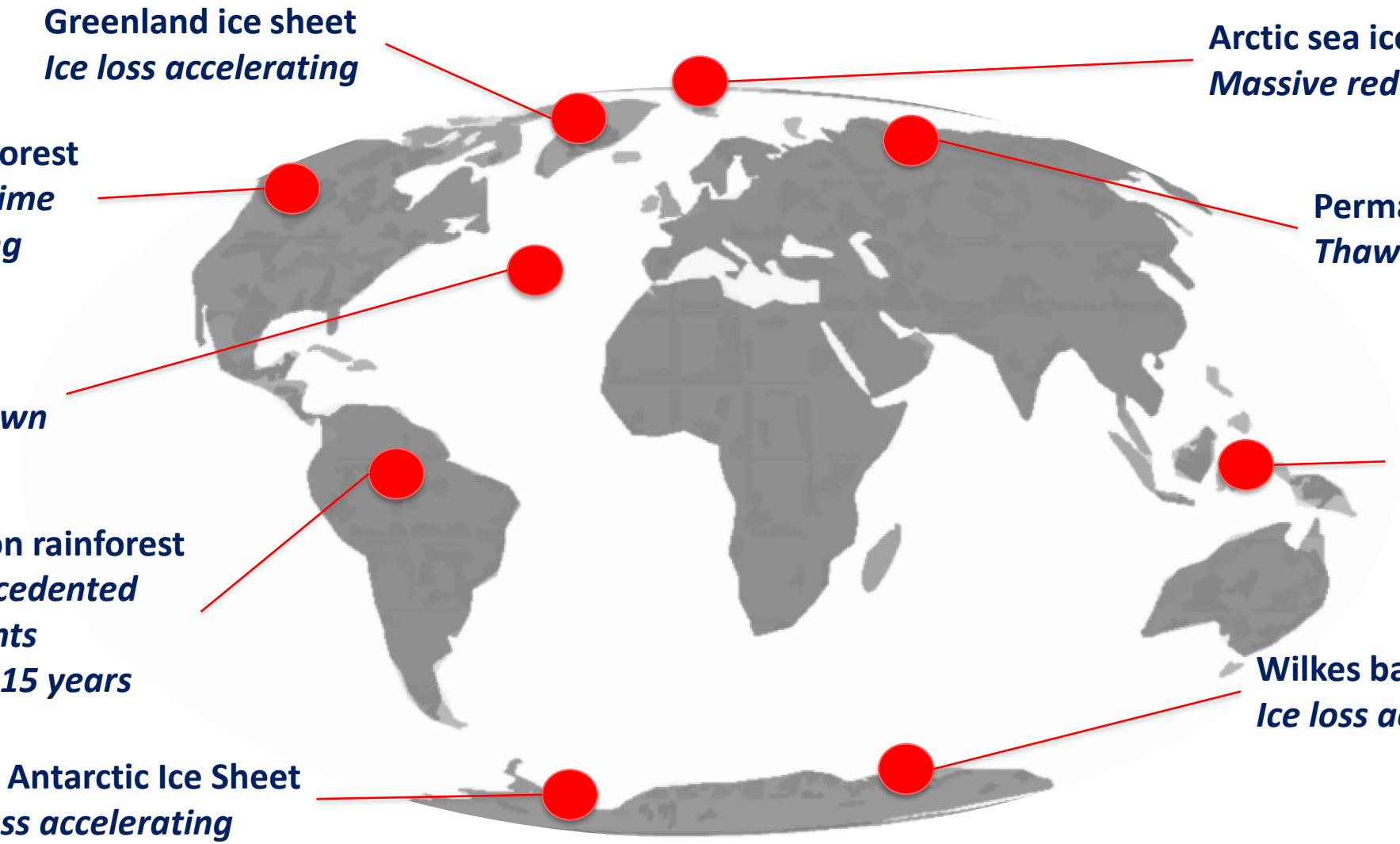
We are part of the Earth system, which we depend on



- **We fundamentally depend** on the Earth system
- **Ecosystem services are not substitutable** and must be protected
- **We need to recognise this** and manage our activity to be within planetary boundaries
- **Urgent policy response** required to maintain Planetary Solvency

and Faculty of Actuaries

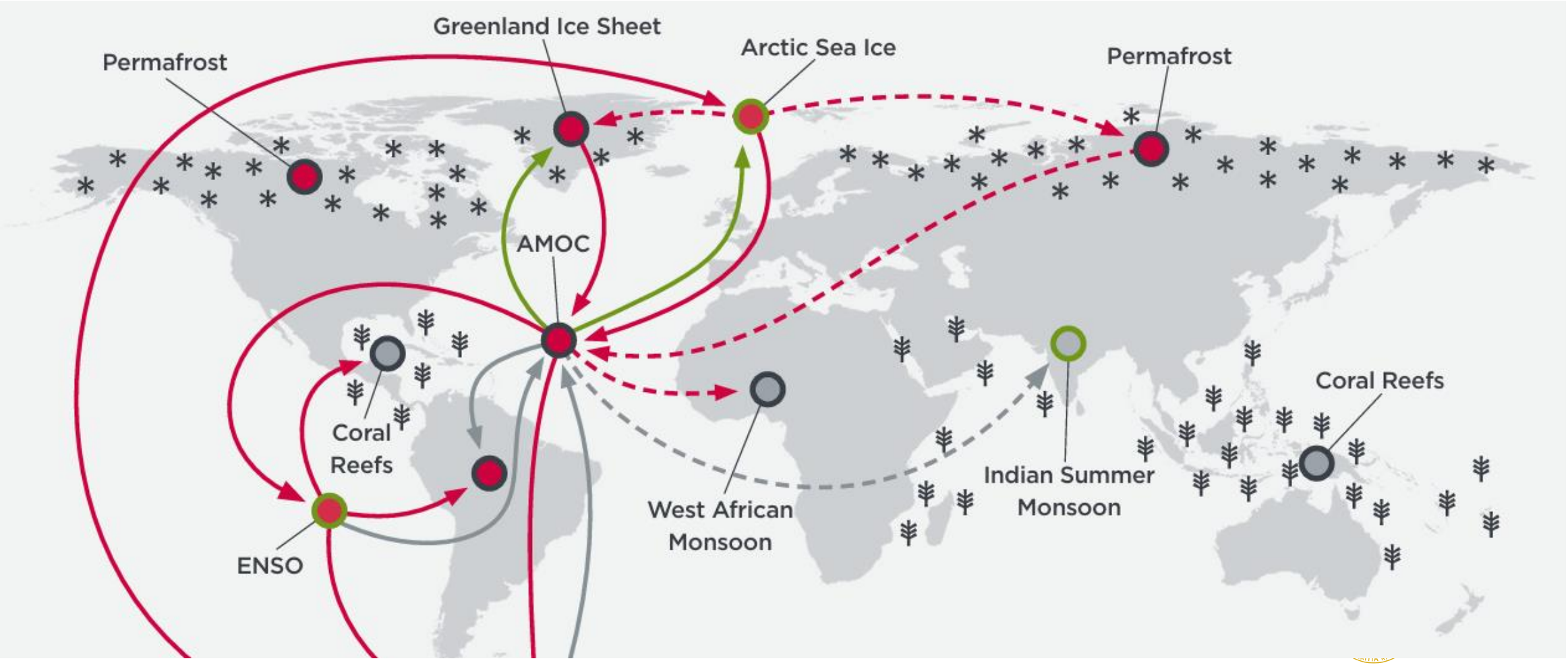
The stability of the Earth system is threatened



Institute and Faculty of Actuaries

Lenton et al. (2019) *Nature*

Tipping points can trigger each other, like dominoes



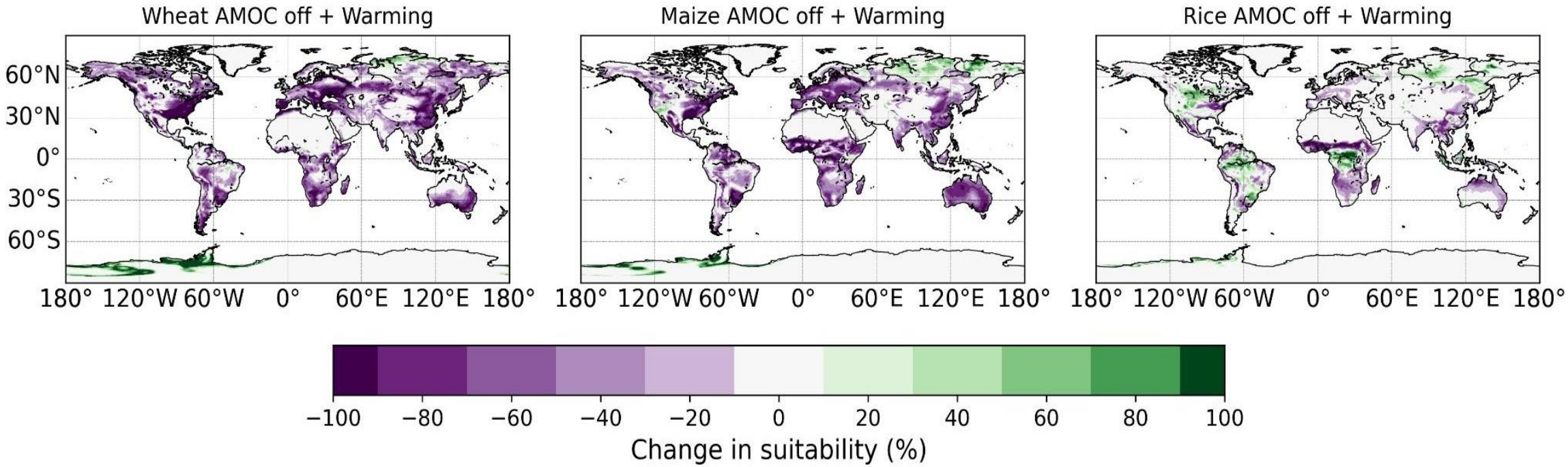
Wunderling et al. (2024) *Earth system dynamics*

Already severe impacts could become catastrophic

Wheat

Maize

Rice



Lenton et al. (contribution to OECD report 2022)

Planetary Solvency is defined as:

> ***Managing human activity,***
>
> ***to minimise the risk of societal disruption,***
>
> ***from the loss of critical support services from nature.***

Institute and Faculty of Actuaries

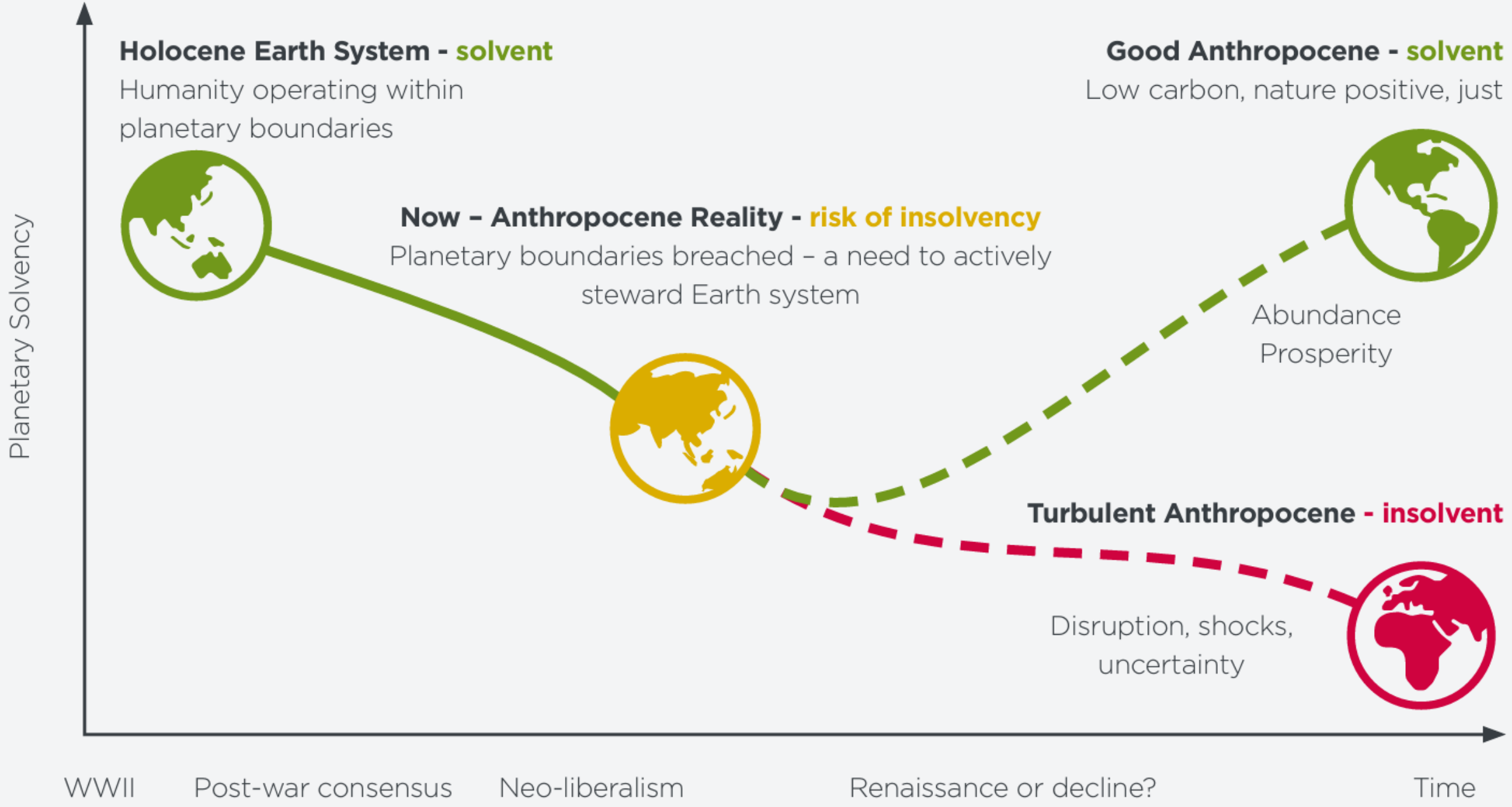
Institute and Faculty of Actuaries

From Financial to Planetary Solvency

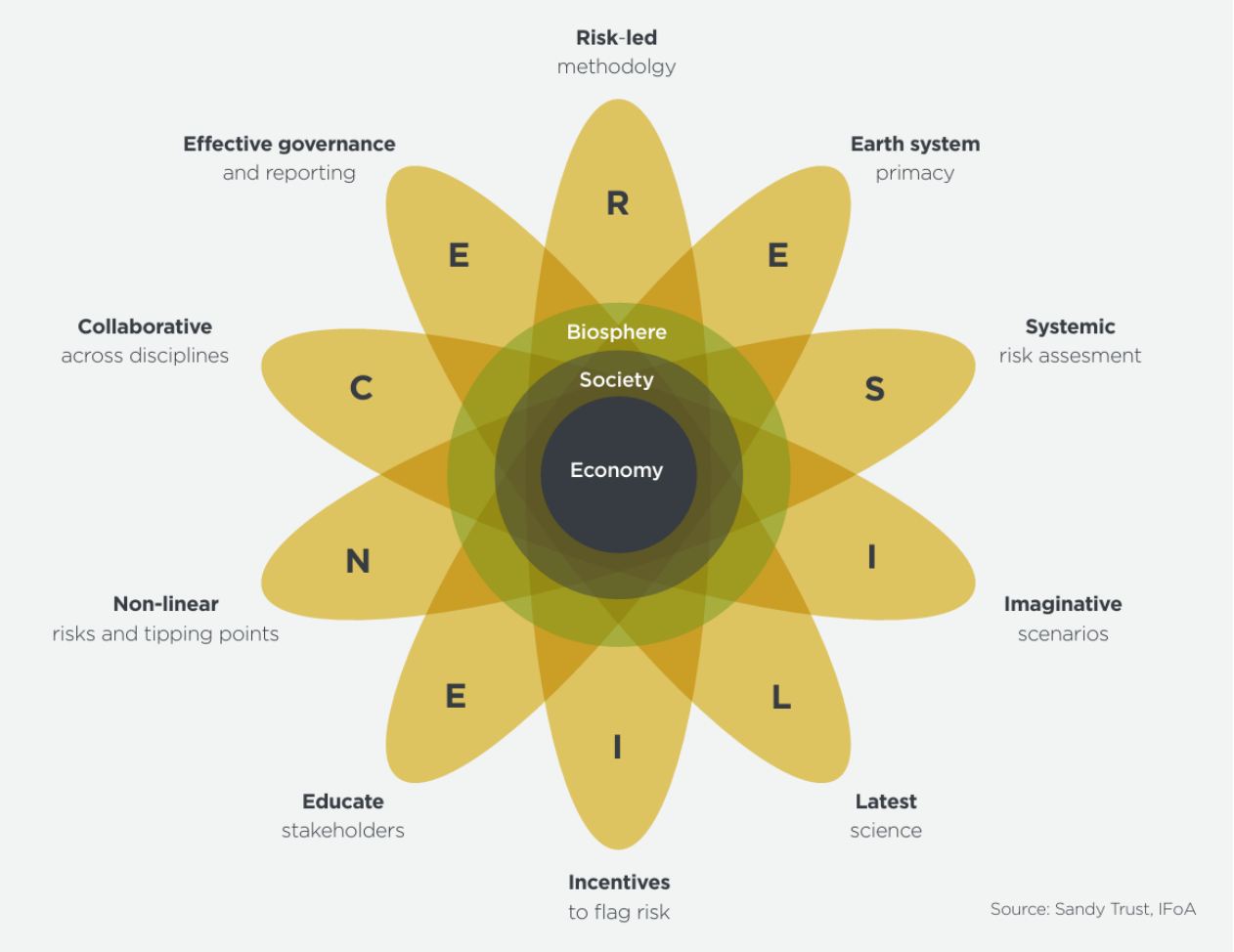
Lucy Saye

University of Exeter

Towards Planetary Solvency



The RESILIENCE principles



- The economy requires a society, which rests in the Earth system
- These systems are now deeply interconnected.
- RESILIENCE principles for realistic and effective risk management
  - Assess risks relative to objectives
  - Identify biggest risks and tail events
  - Use best available information
  - Consider interconnections
  - Non-linearity, range of timeframes

Planetary Solvency Risk Appetite

“

Minimise the risk of significant societal disruption driven by climate and nature risks, including:

i. Crossing Earth system tipping points and triggering tipping cascades

ii. Habitat loss and species extinctions

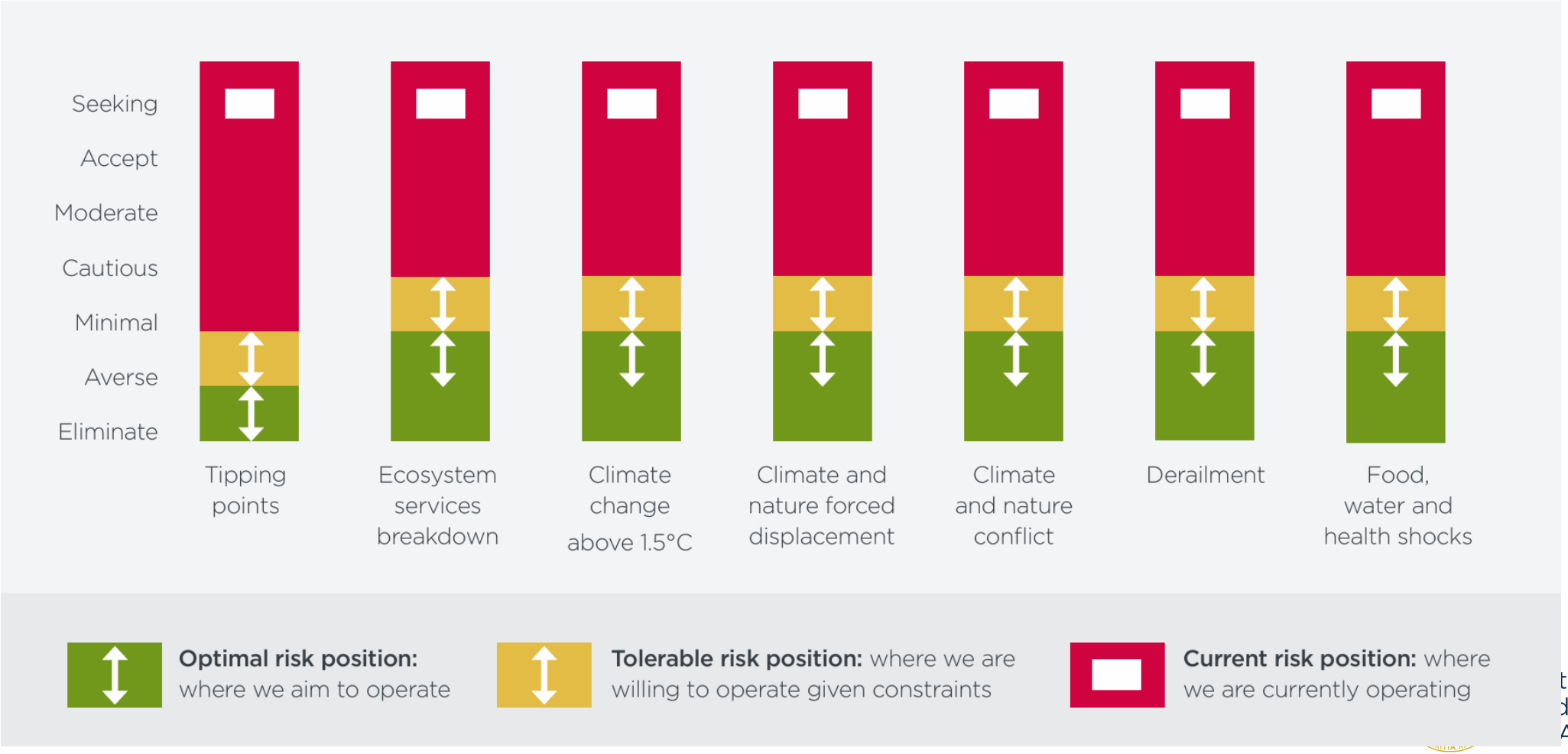
iii. Breakdown of critical ecosystem services

iv. Climate change above 1.5°C

v. Climate and nature driven forced displacement, conflict and mass mortality events

vi. Derailment risk (society is too distracted by escalating crises to address root causes)

Planetary Solvency Risk Appetite Assessment



titute
d Faculty
Actuaries

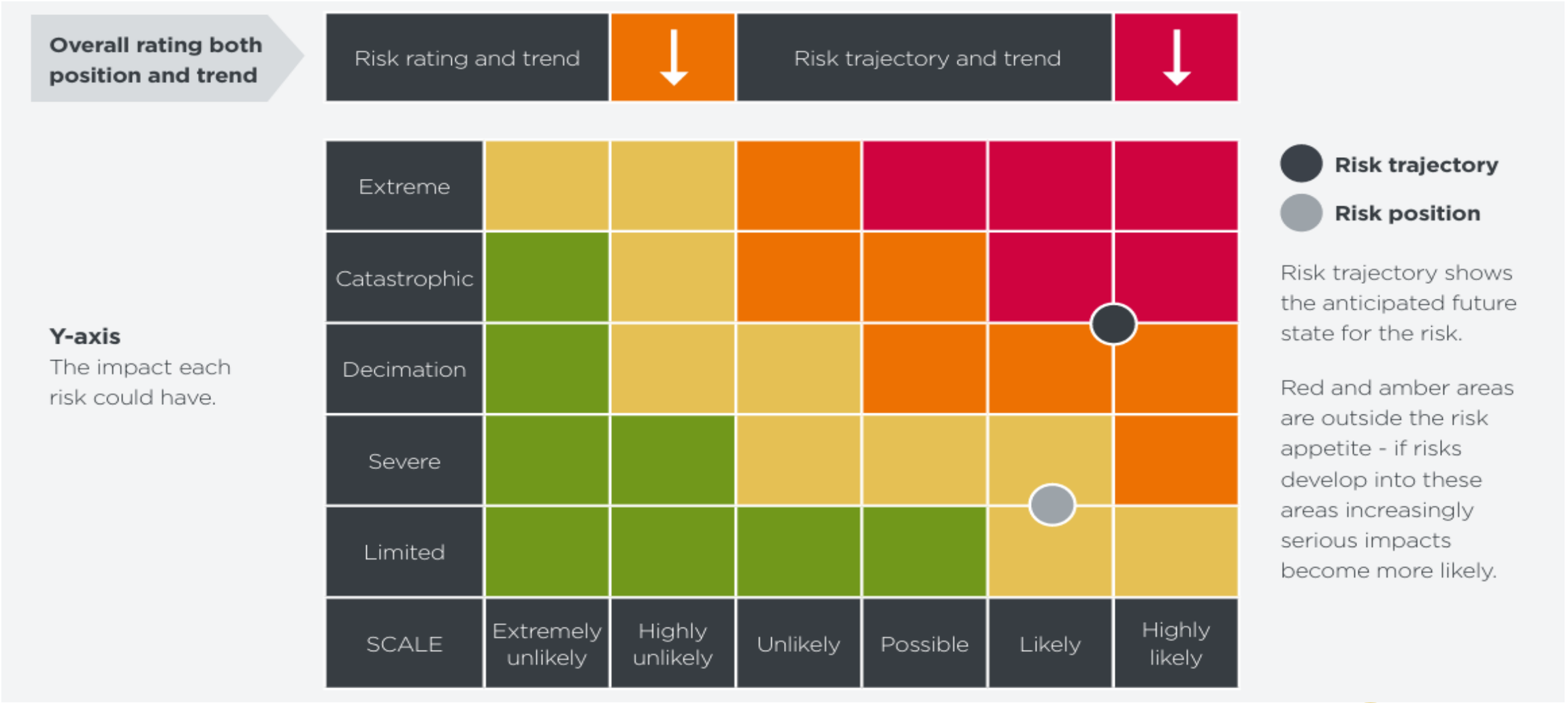
Planetary solvency risk impact and likelihood matrix

RATING	Financial Impact	Non-Financial Impact			
	GDP losses	Human mortality	Climate	Nature	Societal
EXTREME	≥50%	≥50% > 4 billion deaths	3C or more by 2050 Multiple climate tipping points triggered, tipping cascade.	Breakdown of several critical ecosystem services and Earth systems. High level of extinction of higher order life on Earth.	Significant socio-political fragmentation worldwide and/or state failure with rapid, enduring, and significant loss of capital, and systems identity. Frequent large scale mortality events.
CATASTROPHIC	≥25%	≥25% >2 billion deaths	2C or more by 2050 High number of climate tipping points triggered, partial tipping cascade.	Breakdown of some critical ecosystem services and Earth systems. Major extinction events in multiple geographies. Ocean circulation severely impacted.	Severe socio-political fragmentation in many regions, low lying regions lost. Heat and water stress drive involuntary mass migration of billions. Catastrophic mortality events from disease, nutrition, thirst and conflict.
DECIMATION	≥10% >$10 trillion annual losses	≥10% > 800 million deaths	Global warming limited to 2C by 2050 Several climate tipping points triggered.	Severe reduction in several critical ecosystem services. Major extinction events in some geographies. Frequent global food and water crises.	Severe socio-political fragmentation in regions exposed to climate and/or nature impacts. Failure of vulnerable states and mass mortality events in impacted areas.
SEVERE	≥5% >$5 trillion annual losses	≥5% > 400 million deaths	Global warming limited to 1.5C by 2050 following overshoot Some proximate climate tipping points triggered	Some impacts to critical ecosystem services. Ongoing species extinction. Regular global food and water crises.	Some socio-political fragmentation in most vulnerable states, where adaptation has been limited. Fragile states exposed to climate risks see mass migration and mortality events from heat, water stress and weather events.
LIMITED	≥1% >$1 trillion annual losses	≥1% > 80 million deaths	Global warming below 1.5C by 2050, with limited overshoot Climate tipping points largely avoided	Mass extinction avoided and ecosystem services largely functional. Occasional global food crisis and widespread water crises.	Ongoing significant climate impacts with many hundreds of billion dollar + loss events annually and associated mortality and socio-political stress.

Institute and Faculty of Actuaries

LIKELIHOOD The likelihood of the risk occurring over a certain timeframe	EXTREMELY UNLIKELY	HIGHLY UNLIKELY	UNLIKELY	POSSIBLE	LIKELY	HIGHLY LIKELY
	<1%	1-10%	10-40%	40-60%	60-90%	≥90%

Risk dashboard plotting risk position and trajectory



Institute and Faculty of Actuaries

Planetary Solvency illustrative outputs

Sandy Trust, Nicola Ranger

Oliver Bettis

University of Exeter

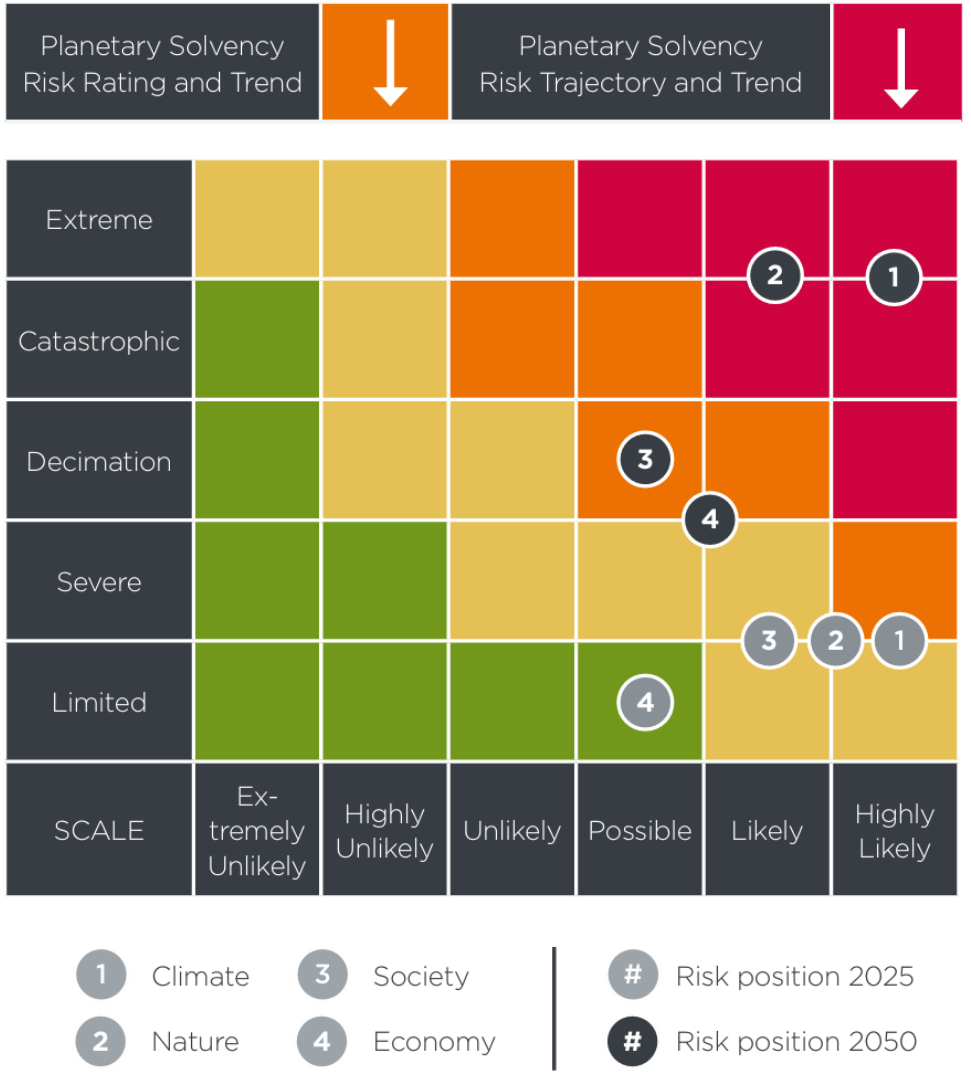
Planetary Solvency Top Level Dashboard – 2025

Planetary Solvency risk position:

- Significant increase in 2025 risk position, with overall position now outside risk appetite.
- Global climate impacts **Severe,** Nature impacts anticipated **Severe** imminently.
- Societal impacts **Limited**, trending to **Severe**.
- Economic and Mortality impacts **Limited**.

Planetary Solvency risk trajectory:

- Risk trajectory pushes all risks further out of appetite soon, with increased breaches of risk tolerances Likely.
- Immediate policy action required to mitigate risks of **Catastrophic** level or greater impacts before 2050.
- Cascading and interconnecting nature of risks requires systemic approach and solution.

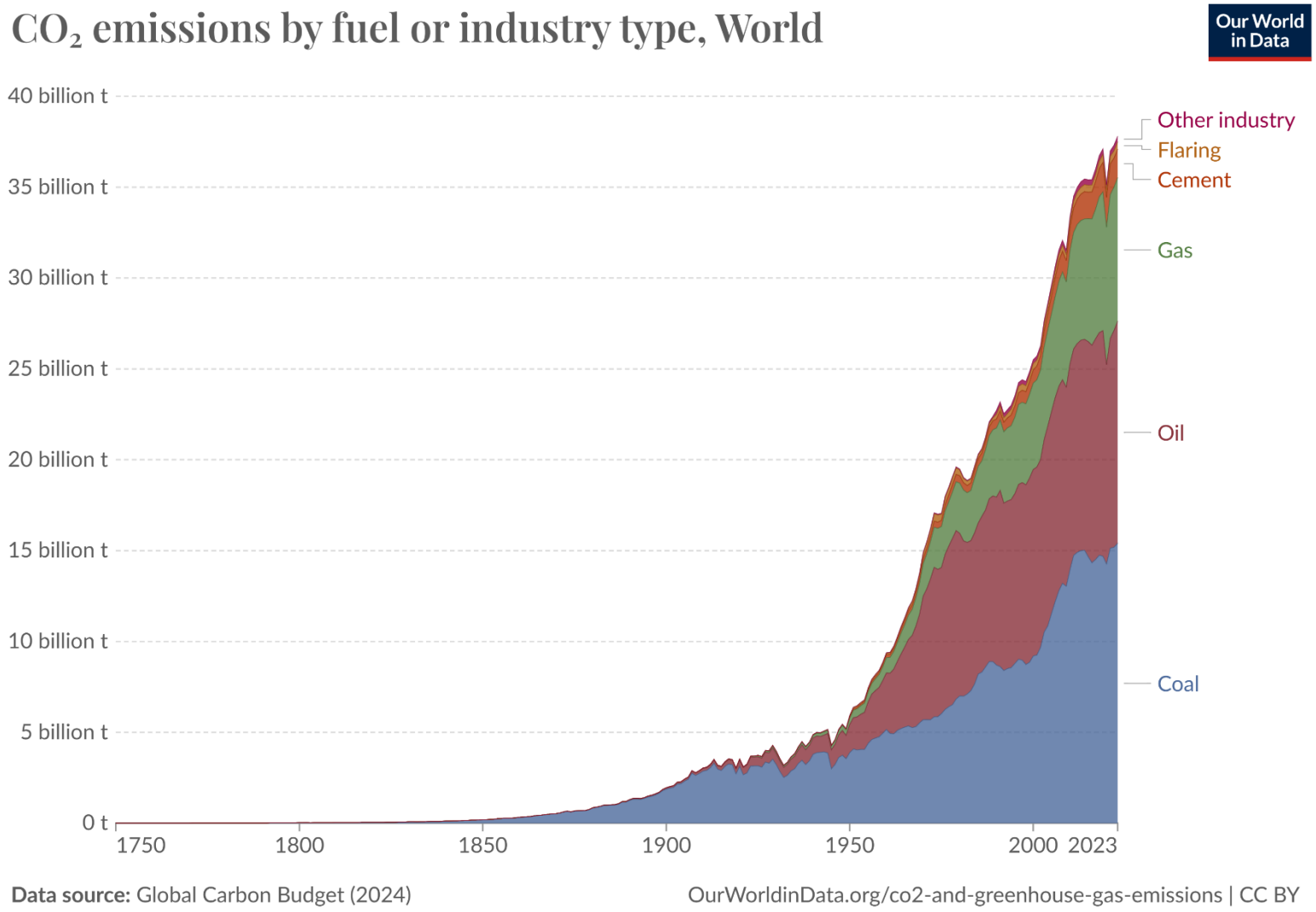


Refresher – impact ratings

RATING	Financial Impact	Non-Financial Impact			
	GDP losses	Human mortality	Climate	Nature	Societal
EXTREME	≥50%	≥50% > 4 billion deaths	**3C or more by 2050** **Multiple climate tipping points triggered, tipping cascade.**	**Breakdown of several critical ecosystem services and Earth systems.** **High level of extinction of higher order life on Earth.**	Significant socio-political fragmentation worldwide and/or state failure with rapid, enduring, and significant loss of capital, and systems identity. Frequent large scale mortality events.
CATASTROPHIC	≥25%	≥25% >2 billion deaths	**2C or more by 2050** **High number of climate tipping points triggered, partial tipping cascade.**	**Breakdown of some critical ecosystem services and Earth systems.** **Major extinction events in multiple geographies.** **Ocean circulation severely impacted.**	Severe socio-political fragmentation in many regions, low lying regions lost. Heat and water stress drive involuntary mass migration of billions. Catastrophic mortality events from disease, nutrition, thirst and conflict.

Institute and Faculty of Actuaries

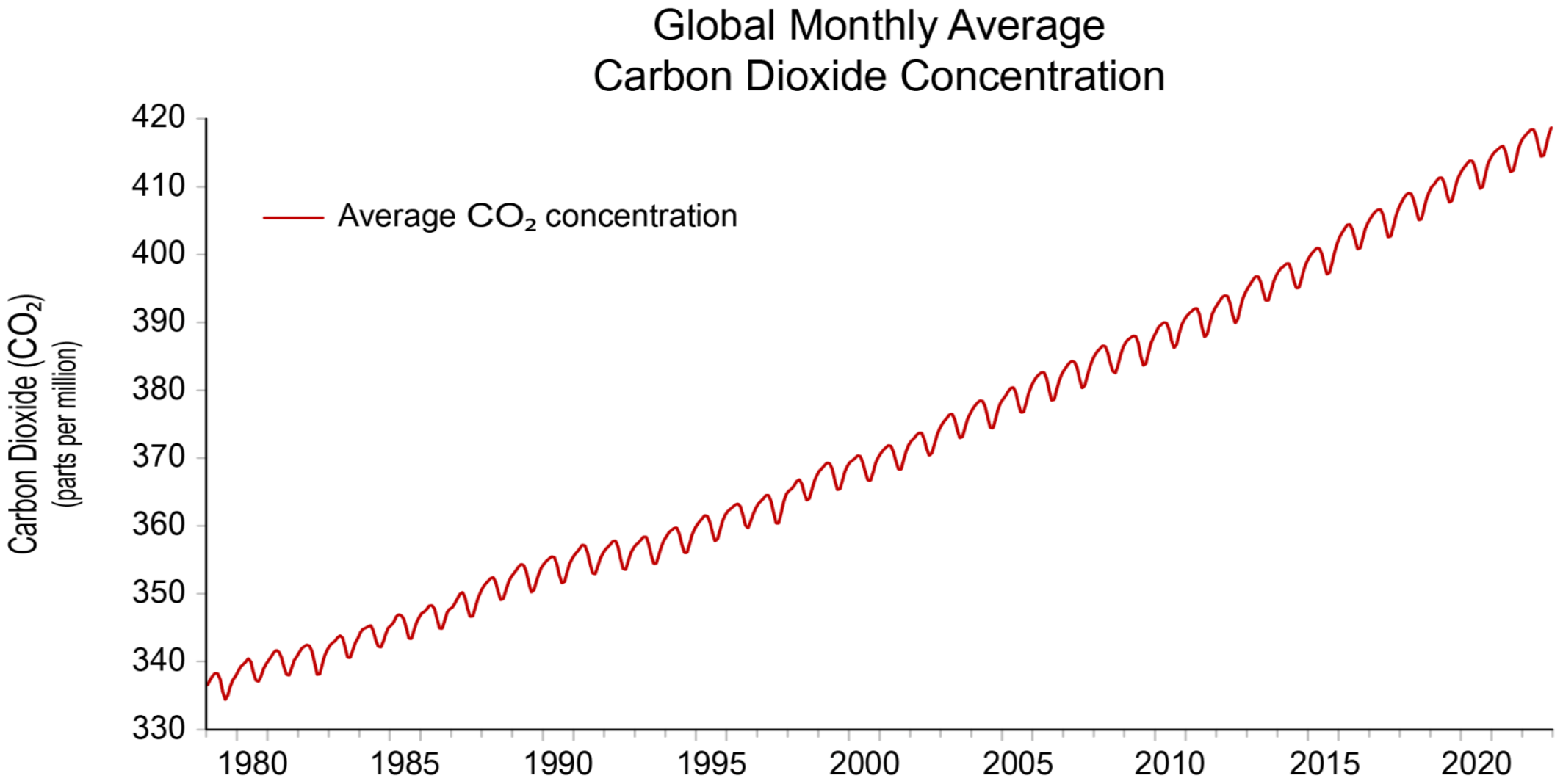
Climate Change risk – emission trends



Institute and Faculty of Actuaries

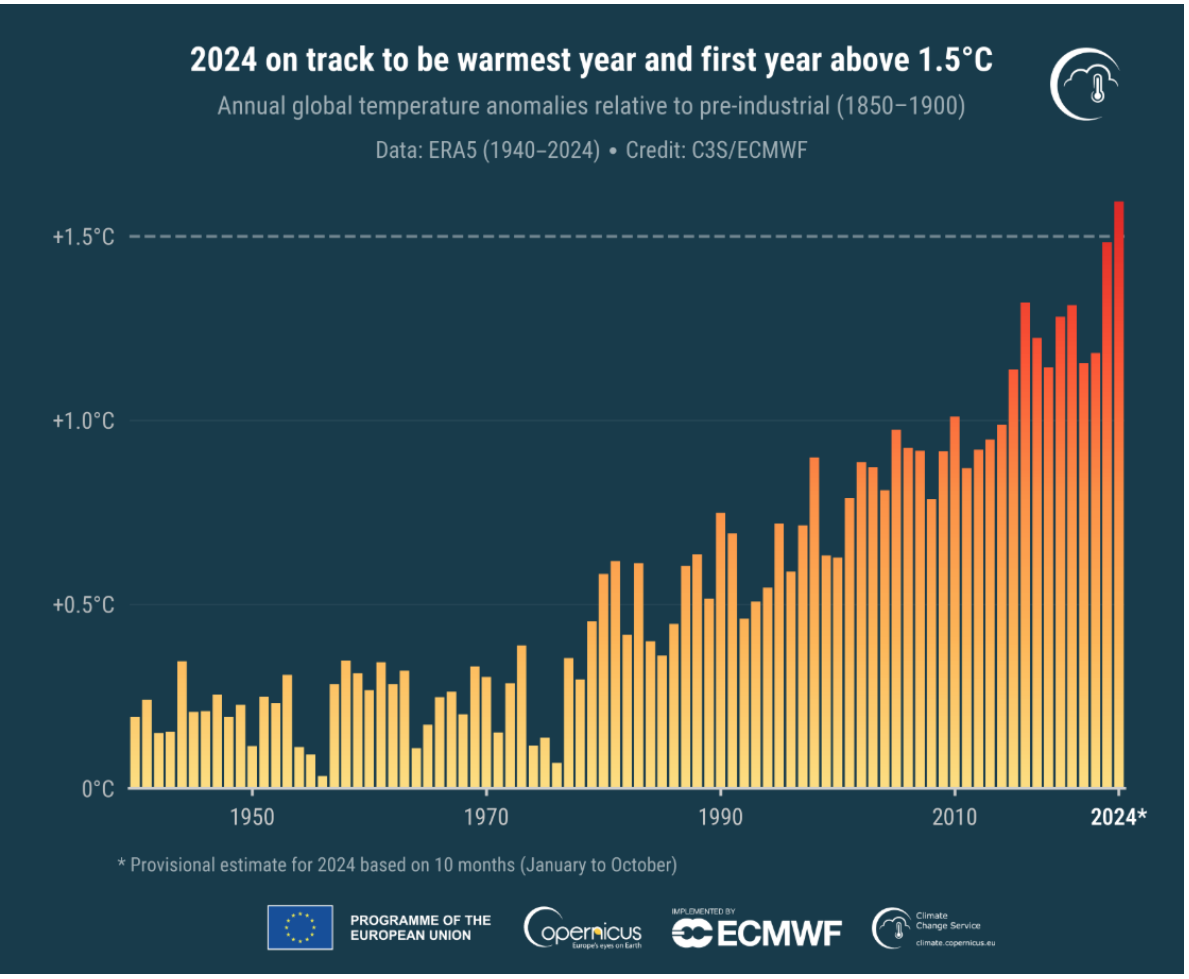
Source: Our World in Data https://ourworldindata.org/emissions-by-fuel

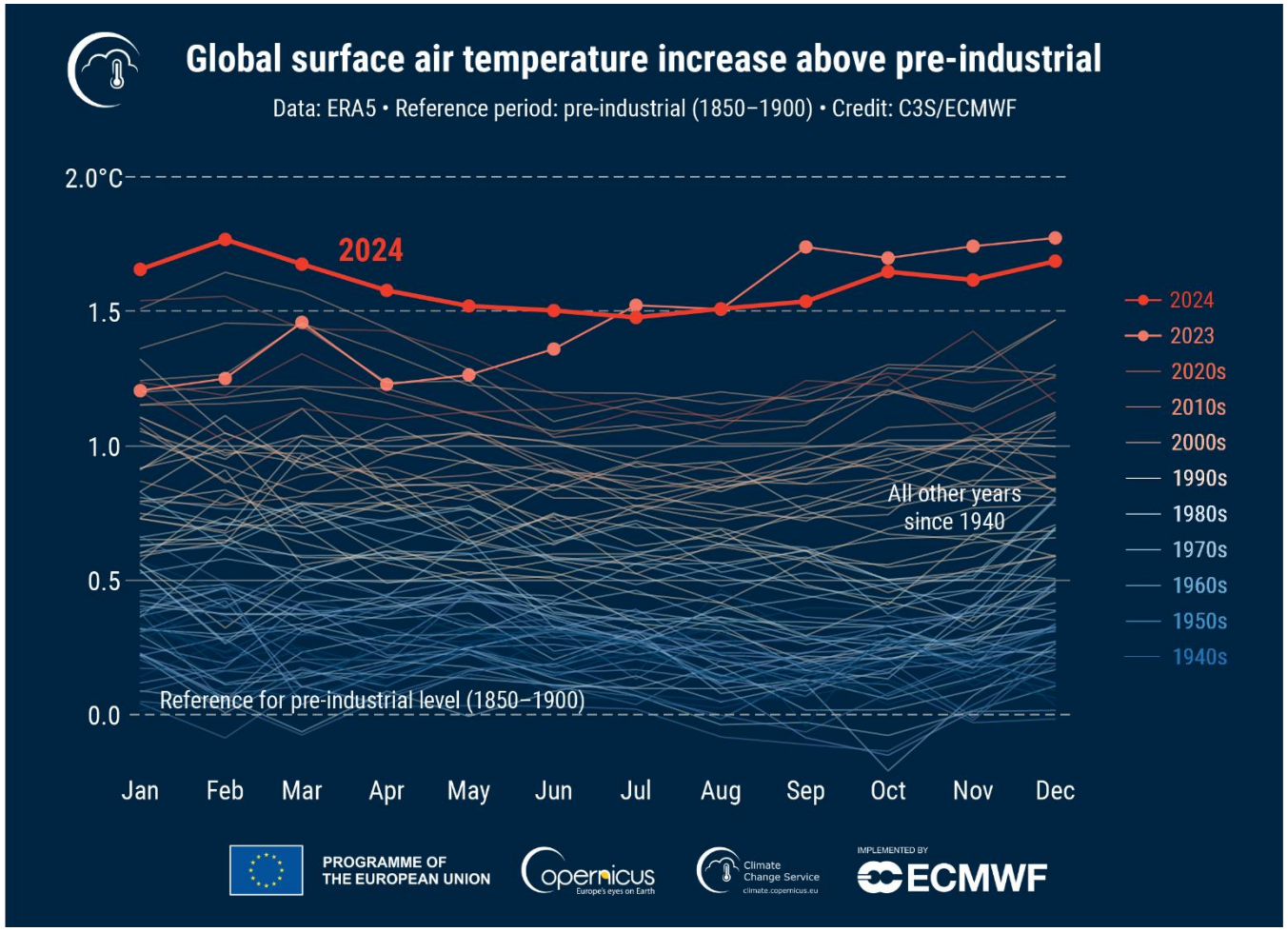
Climate Change risk – atmospheric CO2



Source: US Global change research program https://www.globalchange.gov/indicators/atmospheric-carbon-dioxide

Climate Change risk – global temperature





Source: Copernicus https://climate.copernicus.eu/copernicus-2024-first-year-exceed-15degc-above-pre-industrial-level

Planetary Solvency Climate Risk Dashboard – 2025

Paris Agreement goals will not be met without immediate policy action, risking ruin

	2025	2050
Risk Rating and Trend	↓	↓

a) Risk position: **AMBER**

Impact ***Severe*** in 2024 with globally increased $billion+ loss events and 10k+ mortality events. Now >1.5C (12 mth average) implying overshoot of Paris goals. Ongoing increase of emissions and GHG levels, continued fossil fuel investment. Transition is accelerating.

b) Risk trajectory: **RED**

Tipping points increase risk exponentially past 1.5C. Emissions and GHG levels imply >2C by 2050. Highly likely ***Catastrophic*** warming levels experienced pre 2050 with ***Extreme*** warming Possible. Policy support required to radically accelerate transition, reduce emissions and leverage natural solutions.

PHYSICAL CLIMATE RISK

- Warming accelerated in 2023, above 1.5°C on 12 mth average, overshoot.
- GHGs + emissions also breaking records, more warming in pipeline.
- Climate impacts increasingly severe globally: fire, flood, heat, drought.
- Nature an undervalued ally that continues to be degraded.

ENERGY TRANSITION

- Energy transition accelerating supported by rapid scaling of transition finance.
- $1 trillion investment in fossil fuels and an all time record for coal investment.
- GDP requires energy, implying more fossil fuel use if renewables absent.
- Energy security and geo-political implications if transition is executed.

RISK & UNCERTAINTY

- Tipping point risk increases >1.5C and several tipping points now triggered.
- Climate sensitivity, Earth may be much more sensitive to GHGs than we think.
- Additional factors driving accelerated warming - aerosol cooling, loss of albedo
- Climate models understate risk, miss non-linear risk impacts and cascading risks.

POLICY ACTION REQUIRED TO BEND RISK TRAJECTORY TO AMBER

1. Implement realistic risk assessment to complement science and communicate risk position and trajectory clearly to policymakers.
2. Prepare for faster than expected warming and higher sensitivity. Revisit carbon budgets, decarbonisation pathways and temp ratings.
3. Adaptation required for increasingly severe and unprecedented risk environment, link resilience to national security agenda.
4. Policy support to accelerate S-curves of energy transition and reduce emissions. Consider nuclear and other alternatives as key mitigants.
5. Incorporate nature and justice into national and corporate transition plan requirements, with supporting education on these topics.

Planetary Solvency Nature Risk Dashboard – 2025

Food, water and health shocks likely as ecosystem services disrupted due to nature loss

Risk Rating and Trend	2025	2050
	↓	↓

a) Risk position: **AMBER**

2024 impacts trending to ***Severe***. Water and food system stress increasing. Ongoing degradation of nature assets, multiple planetary boundaries breached, high extinction rates, multiple ecosystem threats and major ecoservices at risk. Global agreement to mitigate biodiversity loss but limited progress on implementation.

b) Risk trajectory: **RED**

Extractive economy drives increasing risk of multiple ecosystem and related ecoservice failures, exacerbated by climate, with ***Catastrophic*** risks likely and ***Extreme*** risks possible pre-2050. Policy support required to mitigate risks and global governance over global commons required, linked to and supporting climate policies.

PHYSICAL NATURE RISK

- Unprecedented rates of biodiversity loss and ecosystem degradation, drive risks and accelerate climate change.
- Increasingly disruptive impacts on food and water security likely.
- Reduced resilience to natural disasters.
- Human health impacts include zoonotic diseases and reduced health benefits.

NATURE POSITIVE

- Economy drives loss through land-use change, resource exploitation, climate change and ongoing pollution.
- Global agreement and some bright spots – nature can bounce back quickly.
- Need for systemic co-ordinated policy response to achieve 30*30 goals.
- Nature based solutions critical for climate.

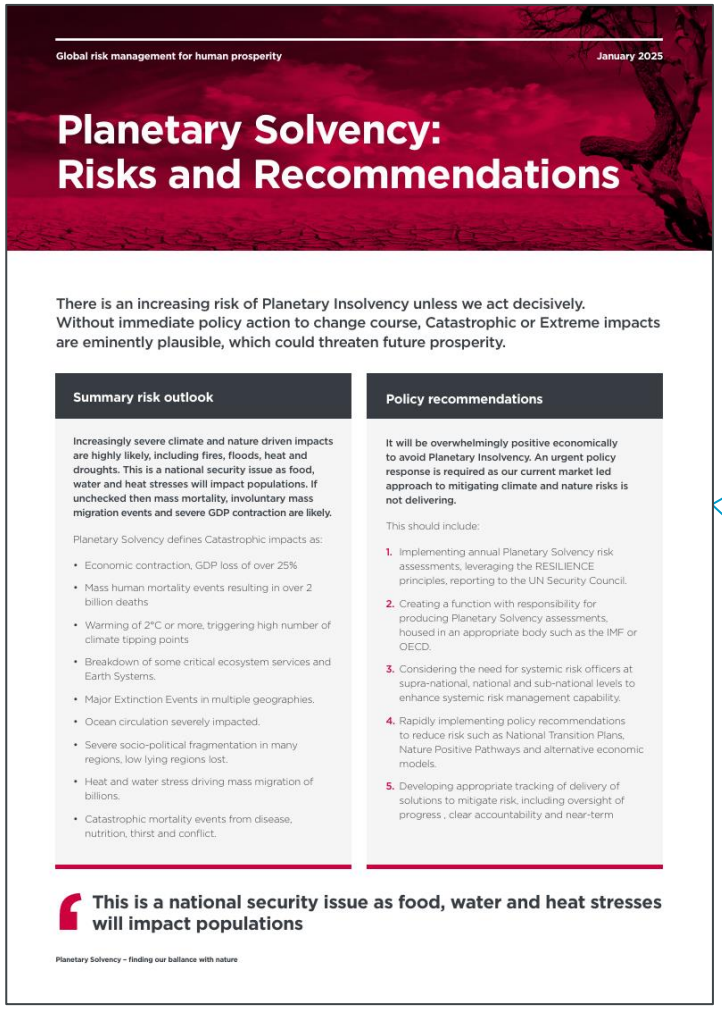
RISK & UNCERTAINTY

- Ecosystem collapse can occur quickly due to ecosystem tipping points.
- Lack of forward looking risk indicators around critical ecosystem services.
- Food and water networks are vulnerable and lack resilience.
- Uncertainty around risk interconnectivity, cascades and unprecedented events.

POLICY ACTION REQUIRED TO BEND RISK TRAJECTORY TO AMBER

1. Implement realistic risk assessment to complement science and communicate risk position and trajectory clearly to policymakers.
2. Prepare for food and water system disruption due to nature loss, assess vulnerabilities and take pro-active action to build resilience.
3. Systemic policy response required to protect and restore ecosystems, strengthen regulation and address drivers of nature loss.
4. Consider how to evolve economic system to measure, report, manage and incentivise a nature positive future.
5. Broad based education from top and bottom to build awareness of our reliance on Earth System and risks of ongoing degradation.

Planetary Solvency – Risks and Recommendations



Global risk management for human prosperity

January 2025

Planetary Solvency: Risks and Recommendations

There is an increasing risk of Planetary Insolvency unless we act decisively. Without immediate policy action to change course, Catastrophic or Extreme impacts are eminently plausible, which could threaten future prosperity.

Summary risk outlook

Increasingly severe climate and nature driven impacts are highly likely, including fires, floods, heat and droughts. This is a national security issue as food, water and heat stresses will impact populations. If unchecked then mass mortality, involuntary mass migration events and severe GDP contraction are likely.

Planetary Solvency defines Catastrophic impacts as:

- Economic contraction, GDP loss of over 25%
- Mass human mortality events resulting in over 2 billion deaths
- Warming of 2°C or more, triggering high number of climate tipping points
- Breakdown of some critical ecosystem services and Earth Systems.
- Major Extinction Events in multiple geographies.
- Ocean circulation severely impacted.
- Severe socio-political fragmentation in many regions, low lying regions lost.
- Heat and water stress driving mass migration of billions.
- Catastrophic mortality events from disease, nutrition, thirst and conflict.

Policy recommendations

It will be overwhelmingly positive economically to avoid Planetary Insolvency. An urgent policy response is required as our current market led approach to mitigating climate and nature risks is not delivering.

This should include:

1. Implementing annual Planetary Solvency risk assessments, leveraging the RESILIENCE principles, reporting to the UN Security Council.
2. Creating a function with responsibility for producing Planetary Solvency assessments, housed in an appropriate body such as the IMF or OECD.
3. Considering the need for systemic risk officers at supra-national, national and sub-national levels to enhance systemic risk management capability.
4. Rapidly implementing policy recommendations to reduce risk such as National Transition Plans, Nature Positive Pathways and alternative economic models.
5. Developing appropriate tracking of delivery of solutions to mitigate risk, including oversight of progress , clear accountability and near-term

This is a national security issue as food, water and heat stresses will impact populations

Planetary Solvency – finding our ballance with nature

Summary risk outlook

- **Increasingly severe climate and nature driven impacts are highly likely, including fires, floods, heat and droughts.**
- **This is a national security issue as food, water and heat stresses will impact populations.**
- **If unchecked then mass mortality, involuntary mass migration events and severe GDP contraction are likely.**

Policy recommendations

- **It will be overwhelmingly positive economically to avoid Planetary Insolvency.**
- **An urgent policy response is required as our current market led approach to mitigating climate and nature risks is not delivering.**

https://actuaries.org.uk/planetary-solvency

Institute and Faculty of Actuaries

Questions?

University of Exeter