



Society of Actuaries in Ireland

The Emperor's New Climate Scenarios – why commonly used climate scenarios are understating risk

Sandy Trust

7th February 2024

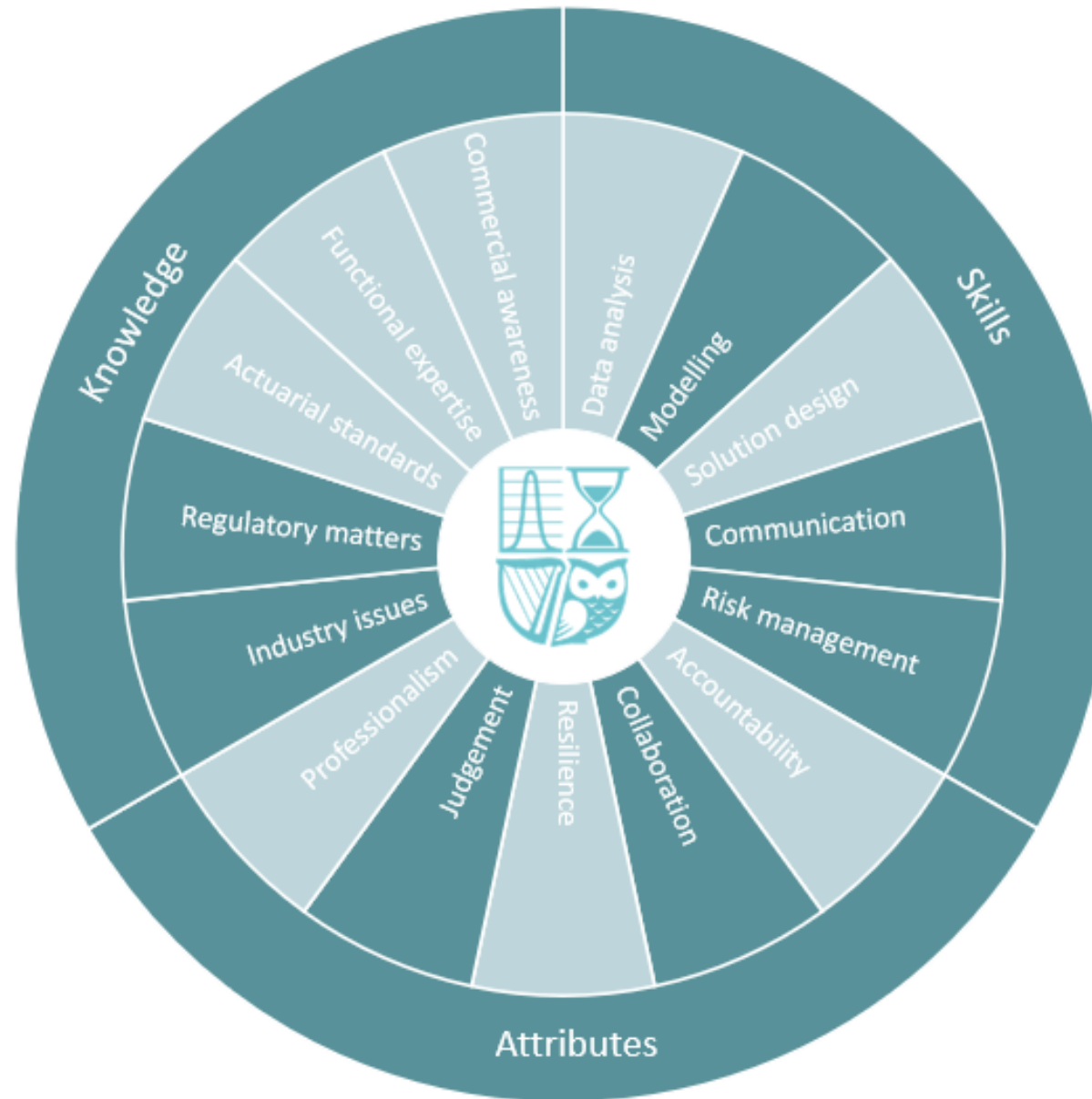


Disclaimer

The views expressed in this presentation are those of the presenter(s) and not necessarily those of their employer(s) (if any) or the Society of Actuaries in Ireland.



Competency Framework Wheel





Q&A

Please click on the **'Raise Hand'** icon
to ask a question aloud
and
wait to be unmuted

or

Use the **Q&A function** to ask a question



Institute
and Faculty
of Actuaries

SAI – Tipping Points and Climate Scenarios

Sandy Trust

February 2024



Two questions:

1. How can I think about climate change in my role?

2. How can actuaries help society on climate change?





Institute
and Faculty
of Actuaries

CCAG
Climate Crisis
Advisory Group

Climate Emergency – tipping the odds in our favour

A climate-change policy briefing for COP27

Authors: Sandy Trust, Lucy Saye, Sir David King,
Riti Patel, Alex Martin



Pathways to
Sustainability
November 2022

www.actuaries.org.uk



Institute
and Faculty
of Actuaries

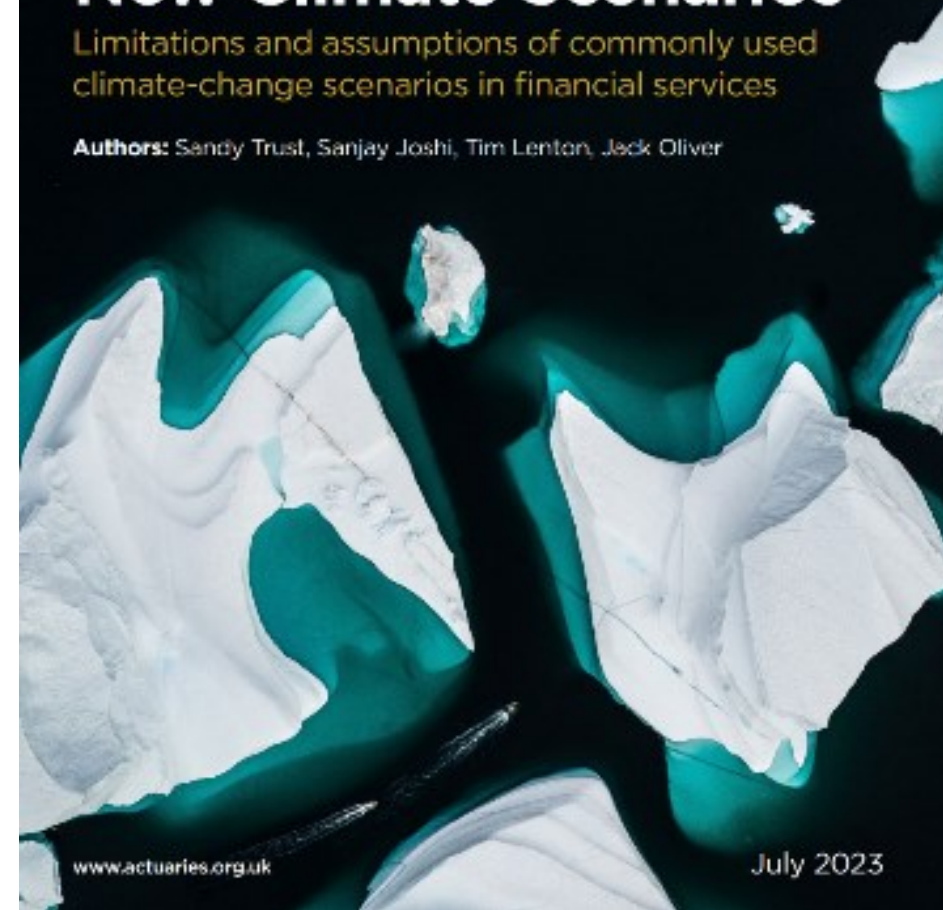


University
of Exeter

The Emperor's New Climate Scenarios

Limitations and assumptions of commonly used
climate-change scenarios in financial services

Authors: Sandy Trust, Sanjay Joshi, Tim Lenton, Jack Oliver



www.actuaries.org.uk

July 2023

Institute
and Faculty
of Actuaries

Planet: Critical + Subscribe

Planet: Critical
Our Global Economy Won't Survive | Sandy Trust

1x 15 30 ...

0:00 -58:05

Our Global Economy Won't Survive | Sandy Trust

Financial Services Dramatically Underestimate Impact of Climate Change

RACHEL DONALD
NOV 30, 2023

Planet: Critical
Planet: Critical is the podcast for a world in crisis. We face severe climate, energy, economic and political breakdown. Journalist



All Shorts Videos Unwatched Watched Recently uploaded Live Under 4 mins 4-20 mins Over 20 mins

The money men know the truth about planetary boundaries!
220K views · 3 months ago

Just Have a Think

Scientists have identified nine so-called 'Earth System boundaries' beyond which life on our planet will become ex...

4K Subtitles

Introduction | Conservative vs averaging | Publication | Modeling | Net Zero | Double Materiality |...

Financial models on climate risk 'implausible', say actuaries

Lack of understanding of full economic damage caused by 'hotshot' conditions, report finds



Sebastian Well FPFS TEP • 1st
B Corp Financial Planner, Advisory Board Member SOLLA, Co-Chair...

What happens when the professions start to listen to the scientists?

This report from from the Institute and Faculty of Actuaries and University of Exeter is a strong contender for the most important read of 2023!

If you are interested in politics, business, economics, financial planning, investment management, or simply living a good life, then I would argue this is essential reading.

Do you agree?

#actuaries #financialadvice #financialplanning #sustainability #politics #business

The Emperor's New Climate Scenarios
Limitations and assumptions of commonly used climate scenario models

POLITICO Confidential PODCAST

PROFESSIONAL PENSIONS

News Topics Events Invest

The green transition is more urgent than solution.

A traffic-light taxonomy will help to drive billions into environmental action.



08 February 2024



CURRENT EDITION
IPF magazine
July/August 2023

IPF REAL ASSETS Global Investor Conference & Awards 2023

Postillion Hotel | Amsterdam
14-16 SEPTEMBER

Floating Pathways:
Energy Transition, Digitalisation, Transport and Natural Capital

Register Now

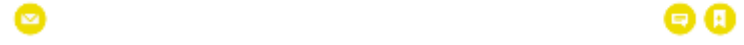
VIEW OUR UPCOMING CONFERENCES

LEARN MORE

NEWS

Current climate scenario analysis 'makes fiduciary duty arguments harder' for net zero investors, warn actuaries

BY SOPHIE ROBINSON-TILLET | 4 JULY 2023



The Institute & Faculty of Actuaries (IFoA) has urged investors and supervisors to rethink their approach to climate scenario analysis, warning that it is currently based on "implausible" assumptions that could delay action and create fiduciary duty challenges.

OUTLOOK

Consistency drives strong long-term returns.

Find Out More

Become a Professional Pensions member

Climate scenario models underestimating risk

IFoA report finds modelling excludes risks like sea level rises and civil unrest

Janine Upton
04 July 2023 • 3 min read

Climate scenario models in financial services "significantly underestimate" risk, a report by the Institute and Faculty of Actuaries (IFoA) and the University of Exeter has found.

BlackRock

AUGUST 11, 2023

AUGUST 11, 2023

Private markets in turbulence find optimism

Listen now

Insurance

Channels Events

Home News / IPF News

Approaches to climate scenario analysis could create challenges for investors: study

climate scenario analysis could es for investors: study



SUBSCRIBE

Knowledge Magazine EBook

CONNECT

in

BusinessGreen

Become a BusinessGreen member

Study: Financial sector climate scenario models 'significantly underestimate' risk

4 July 2023

IFoA fires climate modelling warning to financial services sector

But why are actuaries working with scientists?

Science

- We should not typically say that there is an iceberg until we are fully confident there is one present
- Concerned with making predictions
- This is what informs economists
- Which informs policy



Risk

- There could be an iceberg, so we should typically steer well clear of it
- Concerned with 'what is the worst that could happen'
- This is no-one's job...
- Could the actuarial profession play a role?



1. ABSURD

2. SCARY

3. HOPE

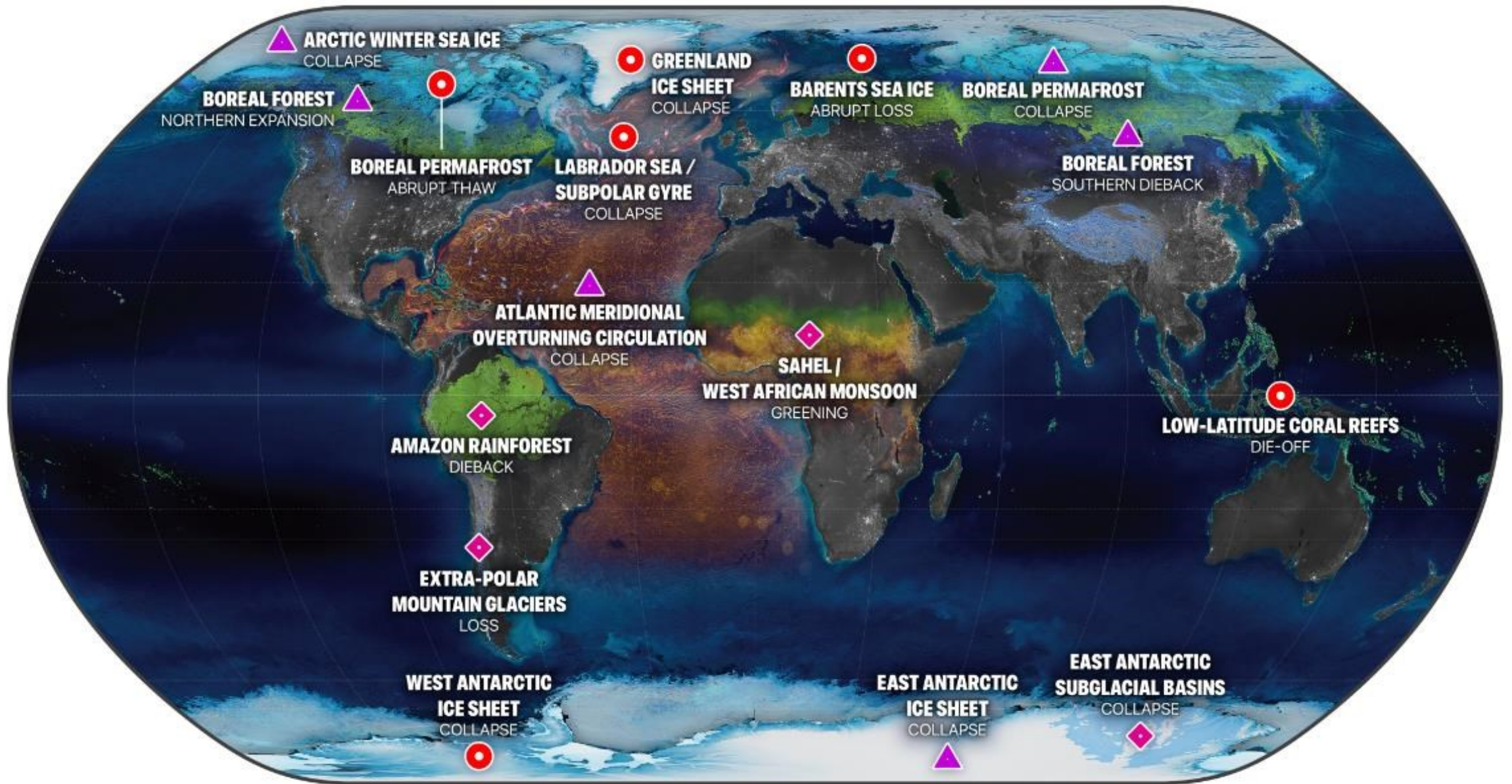


CLIMATE EMERGENCY



TIPPING POINTS





GLOBAL WARMING THRESHOLDS

 $<2^{\circ}\text{C}$

 $2-4^{\circ}\text{C}$

 $\geq 4^{\circ}\text{C}$

Map by Earth Commission/Globaia based on data from [Armstrong McKay et al. \(2022\)](https://climatetippingpoints.info/2022/09/09/climate-tipping-points-reassessment-explainer/). Available online at: <https://climatetippingpoints.info/2022/09/09/climate-tipping-points-reassessment-explainer/>

**There is a level of warming that will cause
a 100% loss of GDP.**

**We have not yet taken sufficient action to
eliminate that as a possibility.**



Institute
and Faculty
of Actuaries

HELP THE PRESIDENT!



Institute
and Faculty
of Actuaries

Economists have estimated the economic losses from climate change in a hot-house scenario to be “as low as 2.1% of global economic production for a 3°C rise in global average surface temperature, and 7.9% for a 6°C rise.”

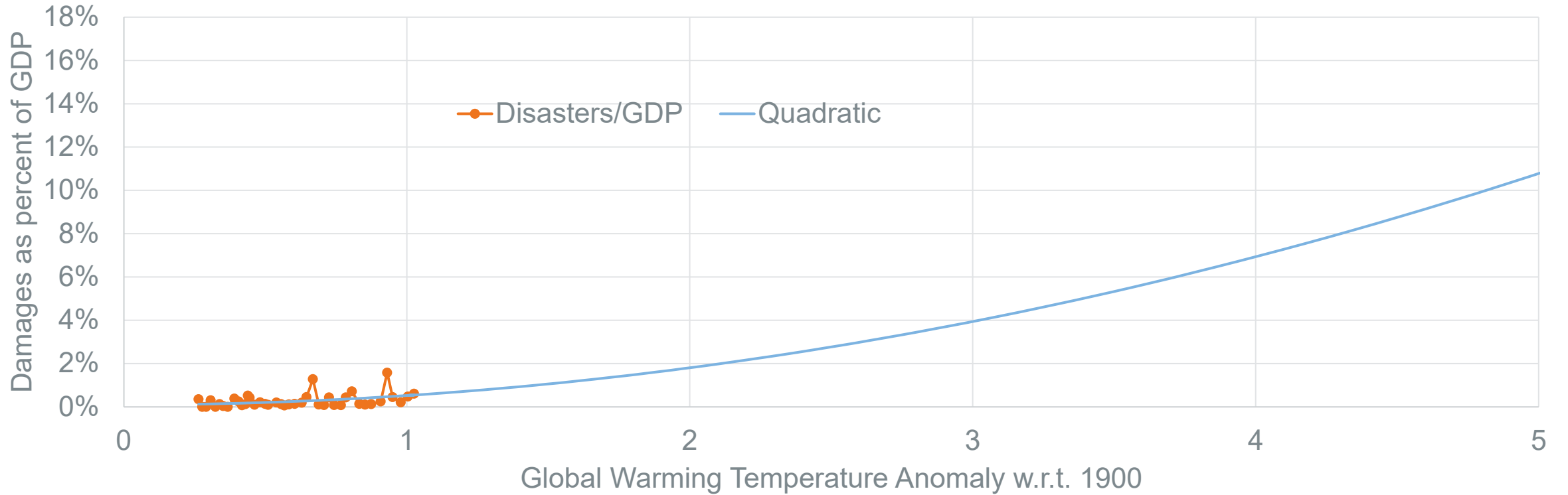
How?

- **A striking disconnect between climate science and economics**
- **Models exclude many of the risks we expect to face, such as tipping points, sea level rise or involuntary mass migration.**
- **Estimates exclude sectors of the economy that work inside, 87% of economy**
- **General equilibrium models have a number of underpinning assumptions that do not hold**
- **So modelling ‘what happened in the past when it became a little warmer’**
- **With impacts restricted to a small proportion of the economy**



Meaning no amount of global warming impacts GDP...

Damage Functions vs Temperature Anomaly



Why don't these results make sense?

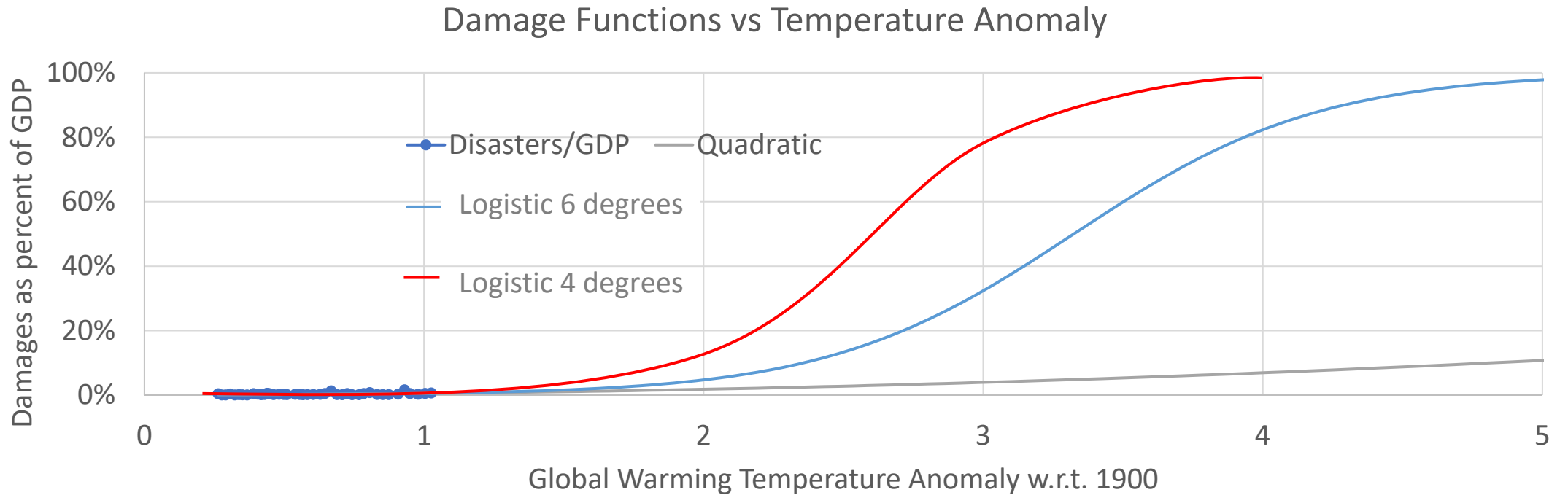
Sample TCFD results from UK investors, impact on portfolio returns per annum, long term

Institution	Orderly	Disorderly	Hot House
Institution 1	-0.2%	-0.2%	-0.1%
Institution 2	-0.1%		-0.1%
Institution 3	-0.1%		-1.0%
Institution 4	0.7%		-0.5%
Institution 5	-0.1%	-0.5%	-0.4%
Institution 6	0.0%		-0.2%

“benign results for the hot-house world are deeply flawed and underestimate the impact of the risks we expect to face”



Something a little more realistic?

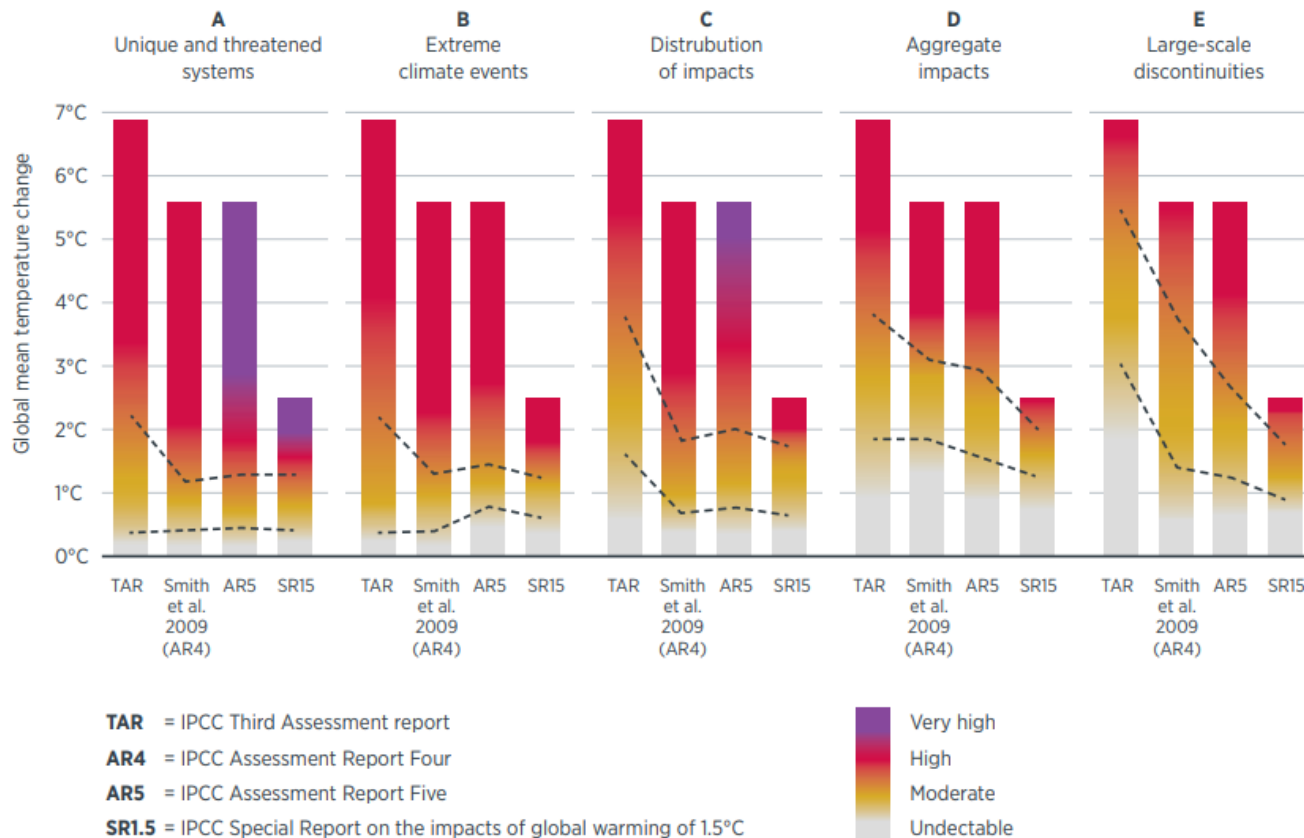


Key Findings – Risky Business



1. We have underestimated climate change. It is progressing faster than expected, driving severe impacts which we need to adapt to as further warming occurs.
2. Multiple climate change tipping points, which may be irreversible, are likely to be triggered at 1.5°C.
3. Net-zero carbon budgets only give a 50% chance or less of limiting warming to 1.5°C, which represents an unreasonable risk of not meeting our objectives.
4. Delivering a stable climate will require removing GHGs from the atmosphere. It will be overwhelmingly economically and socially positive to mitigate climate change.
5. Tipping points mean there is even more uncertainty which we need to plan for by exploring tail risks and introducing prudence.

Climate change is progressing faster than expected

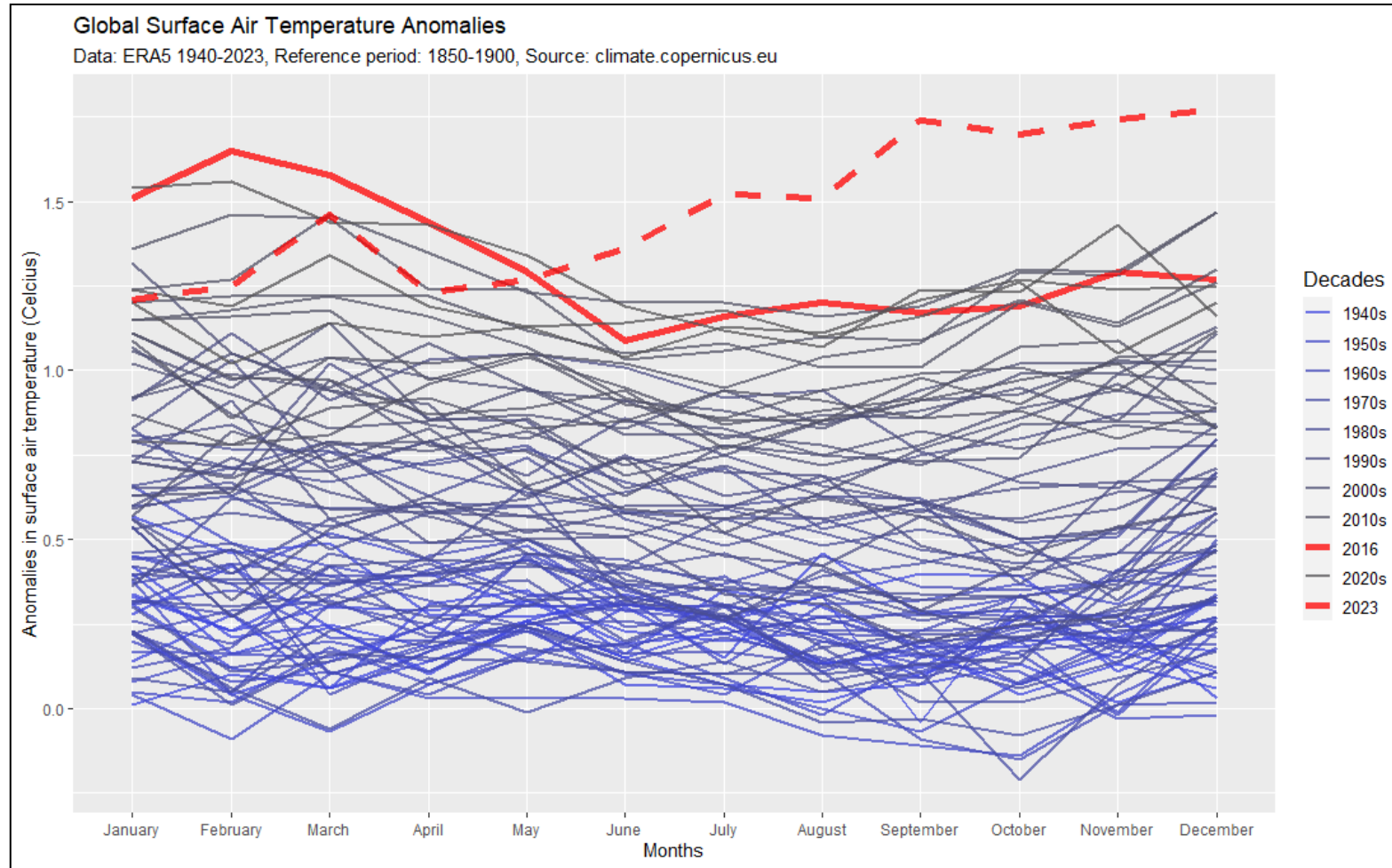


The risks associated with temperature rise in successive IPCC reports

- Estimates of the temperature at which severe impacts occur consistently reduce over time.
- Climate change impacts we are experiencing today exceed what we would expect at 1.2°C warming
- Arctic amplification with permafrost thawing 70 years sooner than model projections
- Sea level rise has been tracking near the upper IPCC limits
- **Emissions are in line with RCP8.5 – a high emissions scenario**



2023 – Gobsmackingly bananas



Net-zero budgets give 50% chance or less of limiting warming to 1.5°C

IPCC scenario statistics

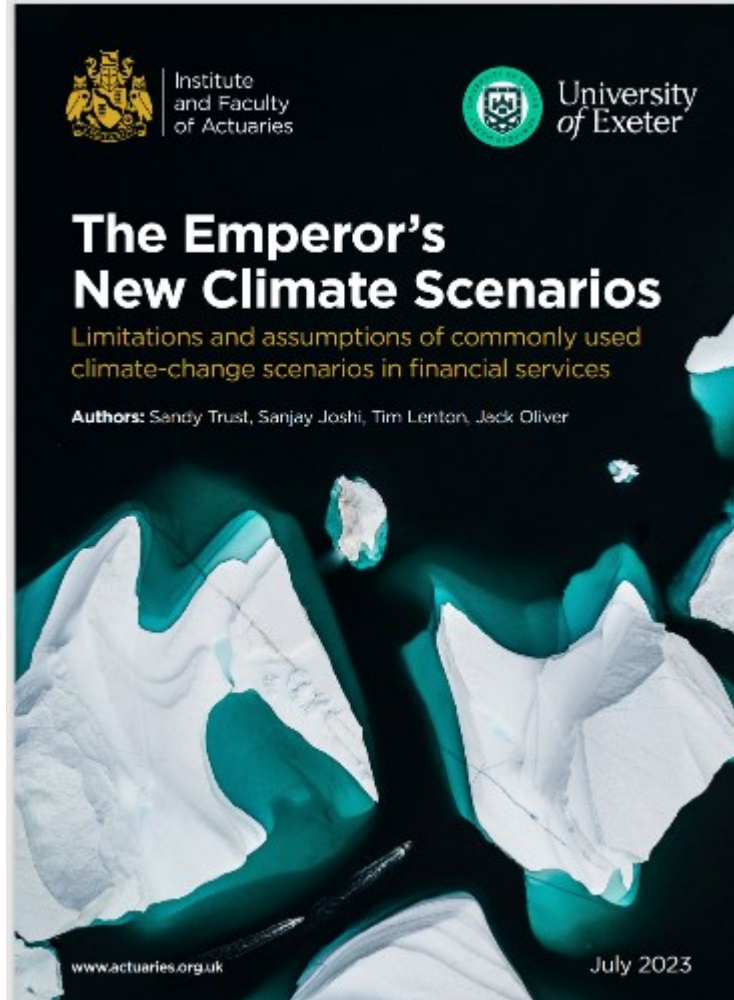
Scenario	Temp rise 2100 (°C) (50th (5th-95th) percentile values)	Peak temp rise (°C) (50th (5th-95th) percentile values)	Likelihood of staying below (%)			2000 year sea level rise
			<1.5°C	<2°C	<3°C	
SSP1-1.9 (very low)	1.3 (0.8-1.5)	1.6 (1.3-1.6)	38	90	100	2-3m for 1.5°C
SSP1-2.6 (low)	1.6 (1.1-1.8)	1.7 (1.4-1.8)	20	76	99	
SSP2-4.5 (intermediate)	2.7 (2-2.9)	2.7 (2-2.9)	0	8	71	4-10m for 3°C
SSP3-7.0 (high)	3.5 (2.5-3.9)	3.5 (2.5-3.9)	0	0	22	12-16m for 4°C
SSP5-8.5 (very high)	4.2 (3.3-5)	4.2 (3.3-5)	0	0	4	19-22m for 5°C

- Large margins for error: 420GtCO₂ +/-650GtCO₂
- Assume no surprises
- May already be negative

- Low probability of limiting warming to 1.5°C
- Reliance on negative emissions and GHG removal



Emperor's New Climate Scenarios



University
of Exeter

Climate models are
understating risk



Institute
and Faculty
of Actuaries

Everyone who cares about the stability of our financial system should read this paper.

Failing to include known non-linear effects in strategic thinking about climate change will lead to complacency, heightened risk and missed opportunities. So the scenarios that are used as part of TCFD processes really matter - both because economic damage will grow much faster and because the transition to clean technologies will happen much faster than conventional economic modelling suggests.

Nigel Topping, UK Climate Action Champion, COP26



Institute
and Faculty
of Actuaries

Key Findings – Climate Models are understating risk



1.

Many climate-scenario models in financial services are significantly underestimating climate risk.

2.

Carbon budgets may be smaller than anticipated and risks may develop more quickly.

3.

Regulatory scenarios introduce consistency but also the risk of group think, with scenario analysis outcomes being taken too literally and out of context.



I: Scenario choice and emissions

Observations

- I.** Most firms begin by using three climate scenarios, often NGFS or regulators.
- II.** Limited consideration of the impacts of higher temperature with benign modelled results for a hot-house world.
- III.** Stock of greenhouse gases in atmosphere now double pre-industrial – tracking RCP8.5 (high emissions).
- IV.** The flow of GHGs continue with record levels of CO2 and methane
- V.** The assumptions underpinning carbon budgets do not hold

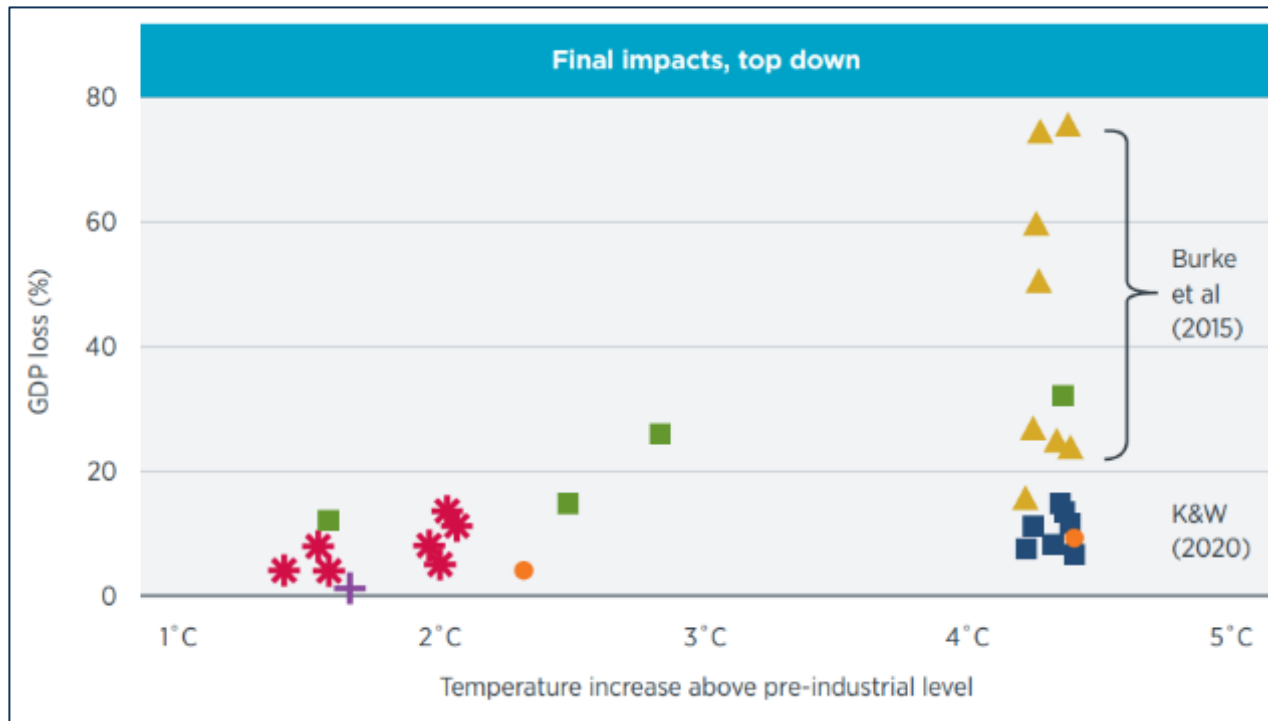
- I.** Regulatory scenarios provide consistency but may not:
 - reflect experience
 - fully capture risks
 - be realistic or likely
 - are not stress or tail scenarios
- II.** More mature firms developing bespoke scenarios to address some of these challenges.
- III.** Firms also developing best estimates – a thesis on what is likely.
- IV.** Mix of qualitative and quantitative – recognising limits of modelling (spurious accuracy).



II: Damage functions and model choice drive estimates of loss

Parameterising the damage function

Comparison of GDP losses by 2100 based on two different methodologies



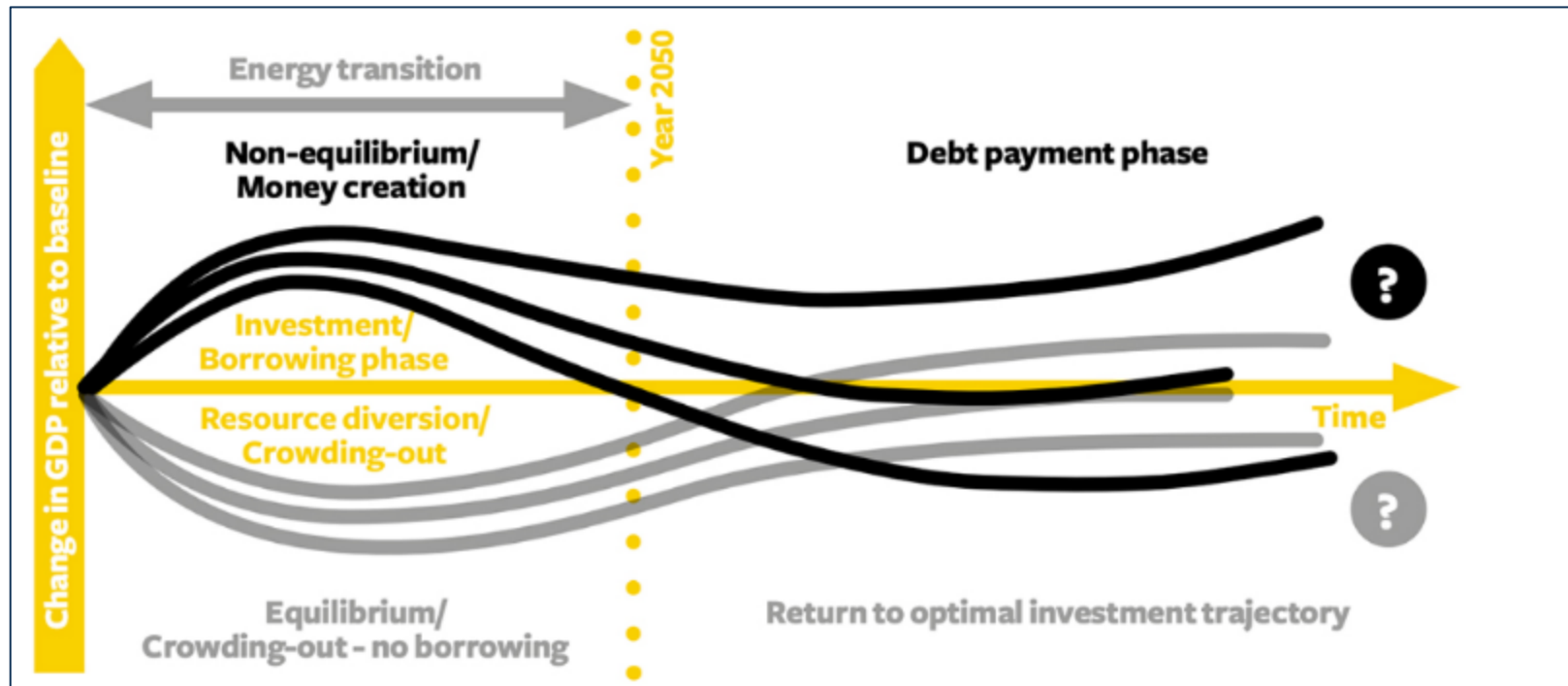
- NGFS calibrated to K&W (Kalkuhl & Wenz), estimates impact on productivity of higher temperatures on **GDP level**
- Burke-Tanutama assumes higher temperature level has negative impact on **GDP growth, as well as GDP level**
- **Both exclude risks such as tipping points, because they work from historical data – so is this still a conservative estimate of the damage function?**



III: Damage functions and model choice drive estimates of loss

To equilibrium or not to equilibrium?

How model choice impacts outcomes



- Final results reflects the choice of model type
- In non-equilibrium models the macro-economic benefits arise first, and costs are incurred later due to debt financing and no investment crowding out



As an actuary you must be clear on this

“*Actuaries have been warned by external parties and their profession about the need to appropriately consider climate change in their professional advice, **a warning reinforced by the FRC’s updated Technical Actuarial Standards , which specifically call out climate change as a material external factor that may influence actuarial work.***”

TAS100 – Principles for Actuarial Work to support the Reliability Objective

- Practitioners must ensure actuarial information, **including communication of inherent uncertainty**, is relevant, based on transparent and appropriate assumptions, complete and comprehensible
- Risk ID: A1.2 “Relevant material factors to be allowed for...in technical actuarial work should include all internal or external environmental factors that have the potential to influence the technical actuarial work either directly or indirectly...**External factors may, for example, include climate change.**



Moving forwards – recommendations



1.

Education on the assumptions underpinning the models and their limitations. (FCA DP23/1)

2.

Development of realistic qualitative and quantitative climate scenarios is required.

3.

Model development required to better capture risk drivers, uncertainties and impacts.

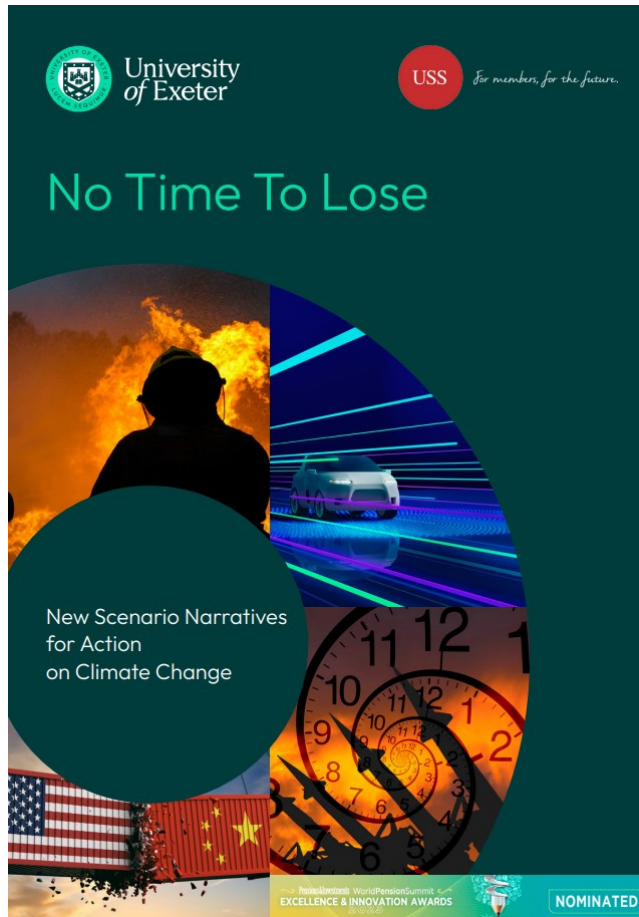


Development of rich qualitative scenarios

- Global warming will impact a number of interconnected risk drivers, which in turn will impact factors that influence financial markets and financial institution solvency.
- Firms should develop qualitative scenarios that explore how these risks could cascade and what actions could be taken.



As if by magic...real world and decision useful...



Provides four short term narrative scenarios combining climate, geopolitics and other risks.

- a) Real world volatility in climate – extreme weather – and in politics, economics, markets, technology and consumer behaviour.
- b) Shorter horizons (2030) relevant to financial decision-making and goal of halving emissions by 2030
- c) Financial implications missed from current scenarios.

Physical risk is fixed (increasing) to 2030 and strong description of how that might play out – the scenarios play around with different geopolitical reactions, including factors like Ukraine and China and US election results.



Institute
and Faculty
of Actuaries



Institute
and Faculty
of Actuaries



University
of Exeter

The Emperor's New Climate Scenarios

Limitations and assumptions of commonly used
climate-change scenarios in financial services

Authors: Sandy Trust, Sanjay Joshi, Tim Lenton, Jack Oliver

www.actuaries.org.uk

July 2023

The earth's climate may
be more sensitive than
we thought...



Institute
and Faculty
of Actuaries

The Earth's climate may be more sensitive than we thought

How much will we warm – and how fast?

Equilibrium Climate Sensitivity (ECS)



The warming we expect if we double GHGs from pre-industrial levels – once Earth reaches energy balance

- ECS now estimated at 3°C (IPCC)
- Range given of 2.5°C to 4°C
- **Heavy tailed – 18% chance ECS > 4.5°C**
- **Excludes** long-term feedbacks such as changes in ice sheets and vegetation

Earth System Sensitivity (ESS)



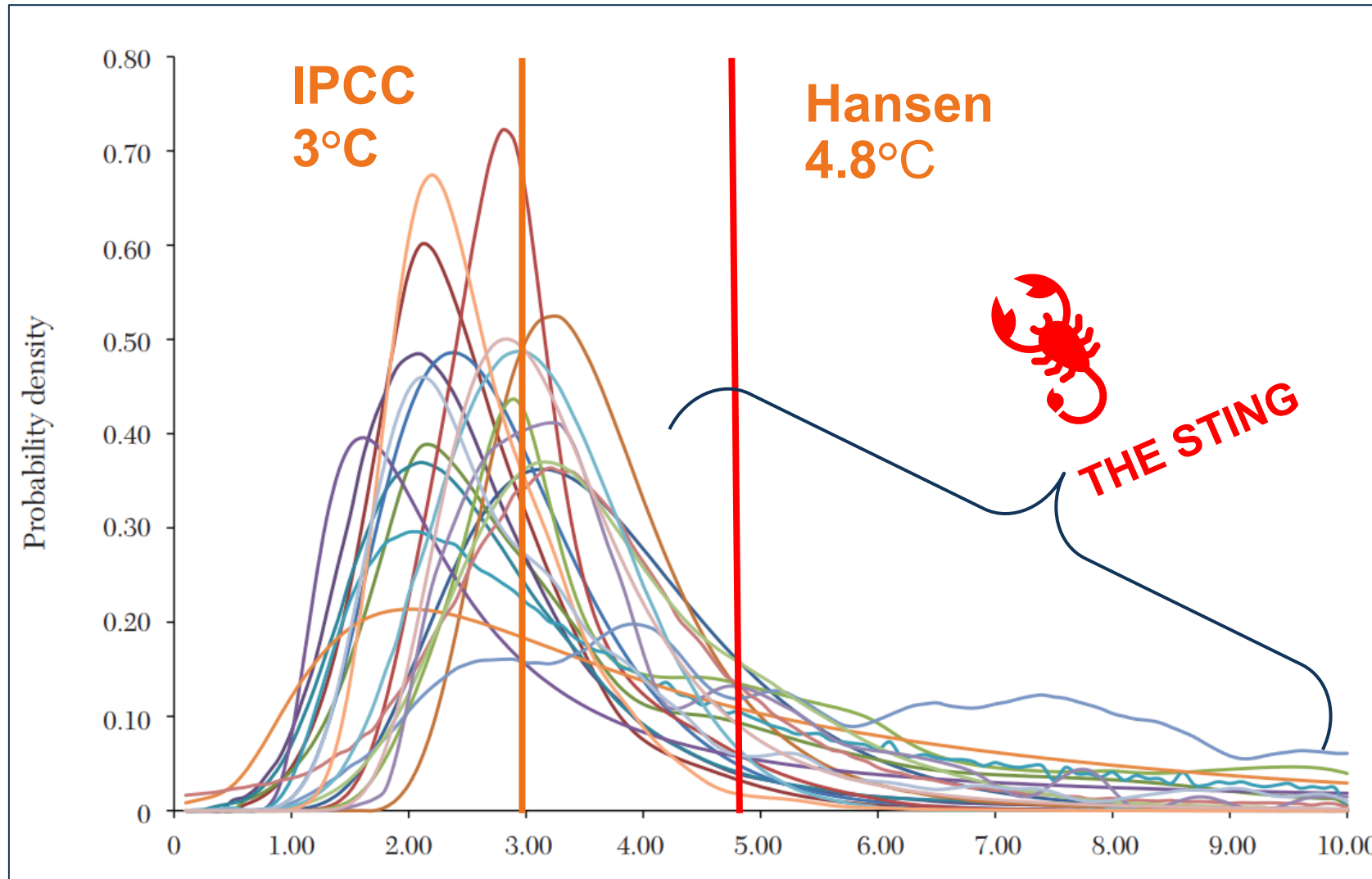
What will actually happen taking into account all changes

- ESS > ECS, some scientists think double
- **Implies 6°C to 10°C warming with today's GHG levels**
- Current rate of warming may increase to 0.3°C per decade

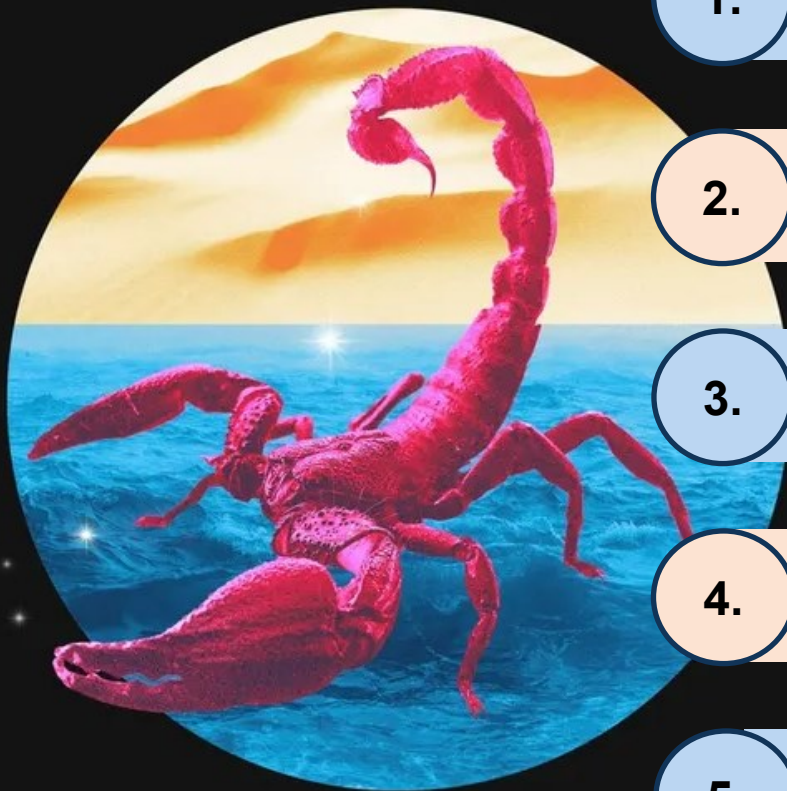


Institute
and Faculty
of Actuaries

The sting in the tail of ECS



Climate scorpion – the sting is in the tail



1.

The rate of global warming accelerated in 2023, there is early indication this is not temporary.

2.

Life in the tail - increased warming is now driving more severe impacts across the planet .

3.

An overshoot of the 1.5°C temperature threshold is likely.

4.

The sting in the tail of the Earth's climate sensitivity.

5.

Warming above 1.5°C is dangerous, increasing the risk of triggering multiple climate tipping points.

Alaska Robotics

In a Pickle

We're in a real pickle.

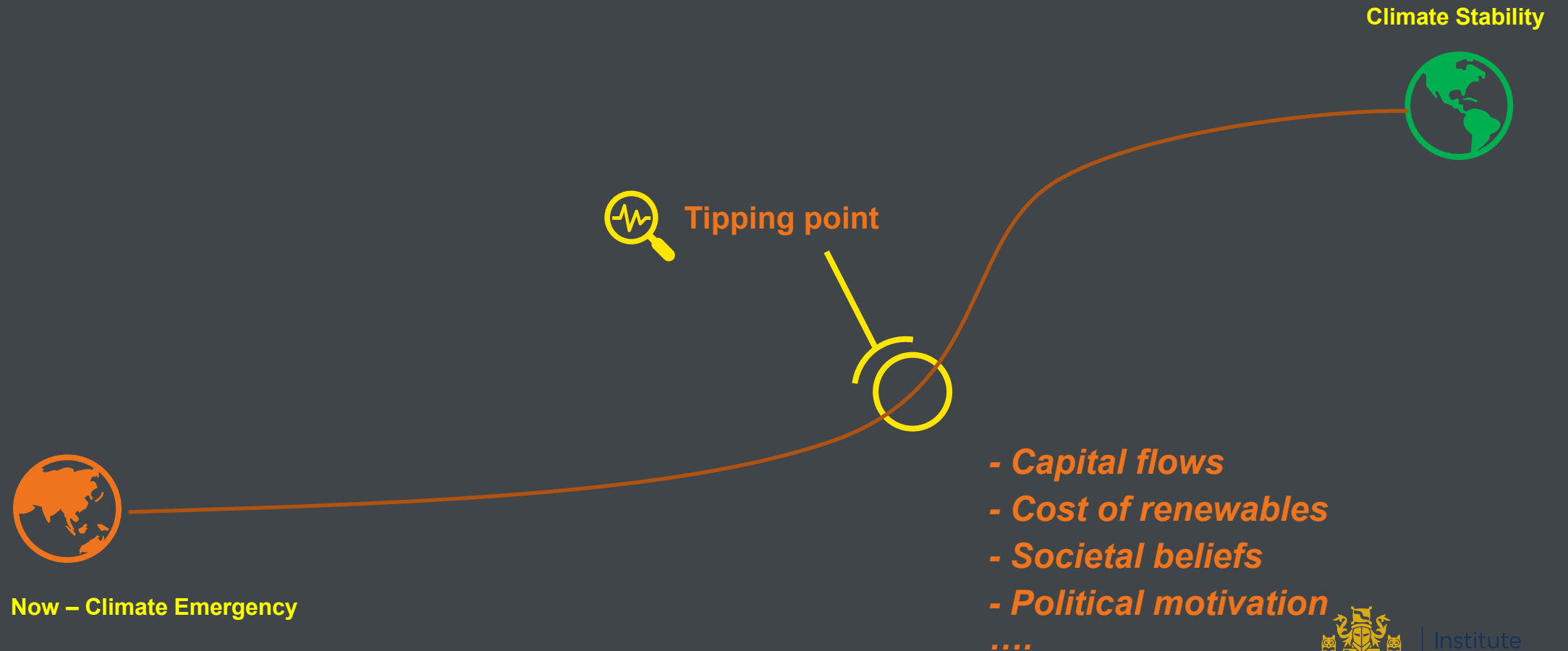
Yep.

No escape.

Nope.

Damn.

Reasons for hope – agency and tipping points



Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenters.



Institute
and Faculty
of Actuaries



Institute
and Faculty
of Actuaries

Thank you





Q&A

Please click on the **'Raise Hand'** icon
to ask a question aloud
and
wait to be unmuted

or

Use the **Q&A function** to ask a question