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Why Climate Change is a Survival Issue for Pension Schemes: The Maths!

Sandy Trust, Ernst & Young
Lisa Eichler, Ortec Finance

19 June 2019

Agenda

1. Climate change and capital market impacts
2. Climate scenarios and their relevance for investors
3. Quantification of climate scenarios
4. Scheme level impacts

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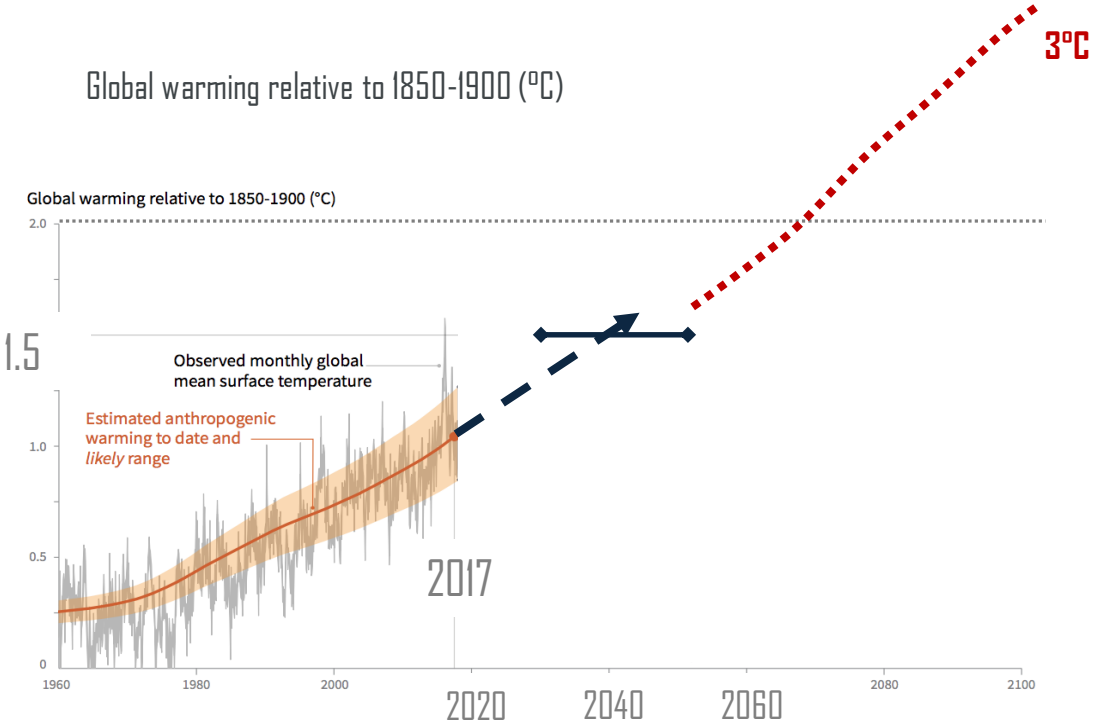
1. Climate change and Capital Market impacts

1. The world is warming, the climate is changing, and it is due to humans



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2. Today's atmosphere is unprecedented in human history, pre-history and beyond (1/2)

Olduvai stone chipping tool – 1.8 million years old

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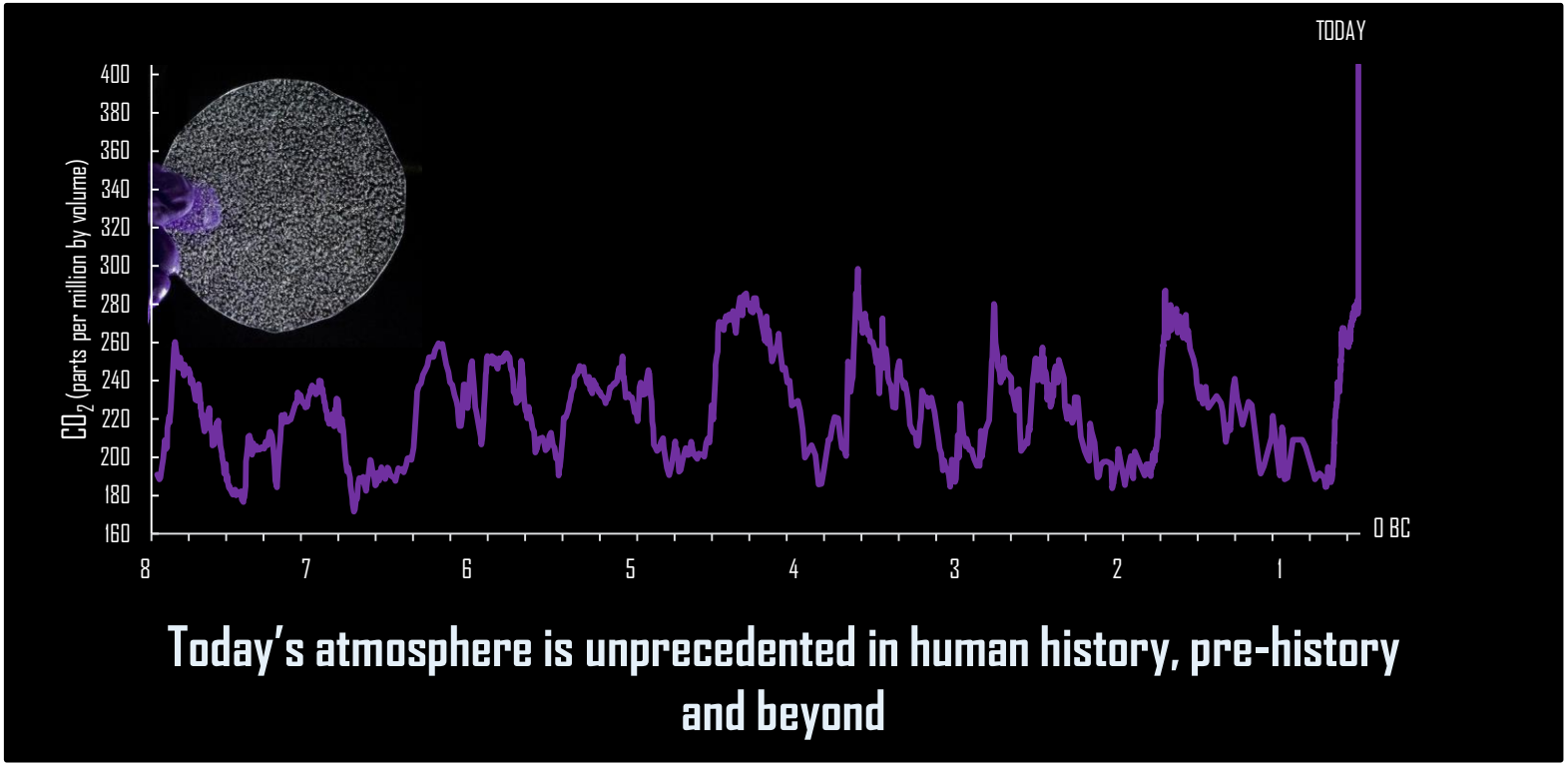

Today's atmosphere is unprecedented in human history, pre-history and beyond

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3. We are already experiencing physical and transition risks, which will increase in the future (1/2)

Physical risks

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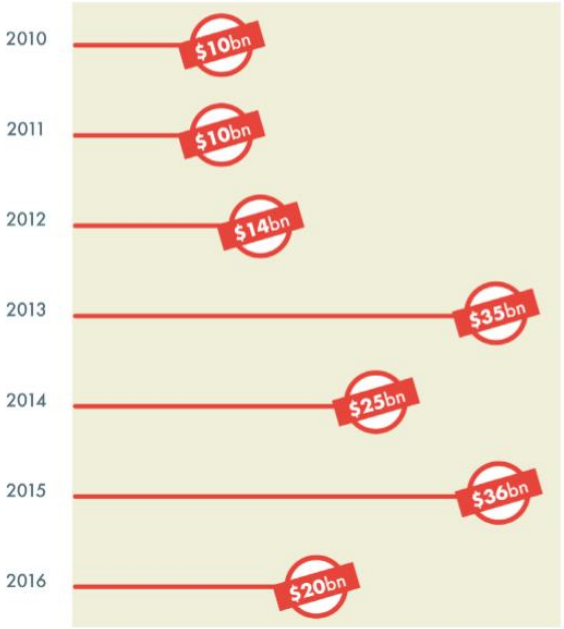
3. We are already experiencing physical and transition risks, which will increase (2/2)

Transition risks

Euro electric sector write downs



RWE Share Price

GE Share Price

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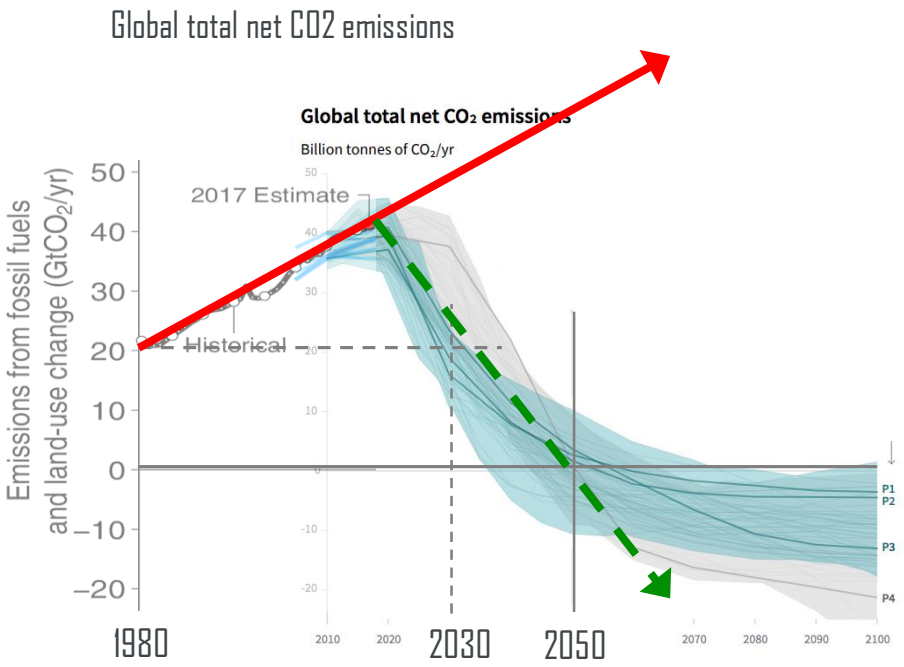
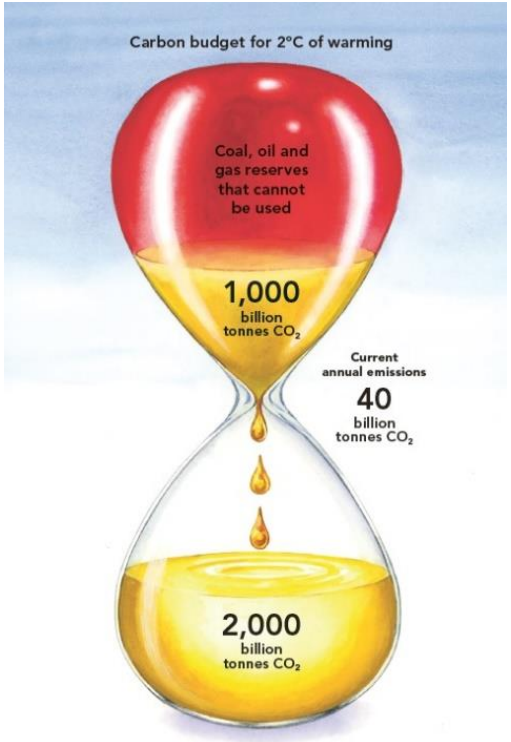
Sources: Carbon Tracker, 2020 Vision, September 2018
IEEFA, General Electric mis-read the energy transition: A cautionary tale, 2019

4. Time is running out: we are currently on track for 3°C by end of century, yet global emissions continue to rise





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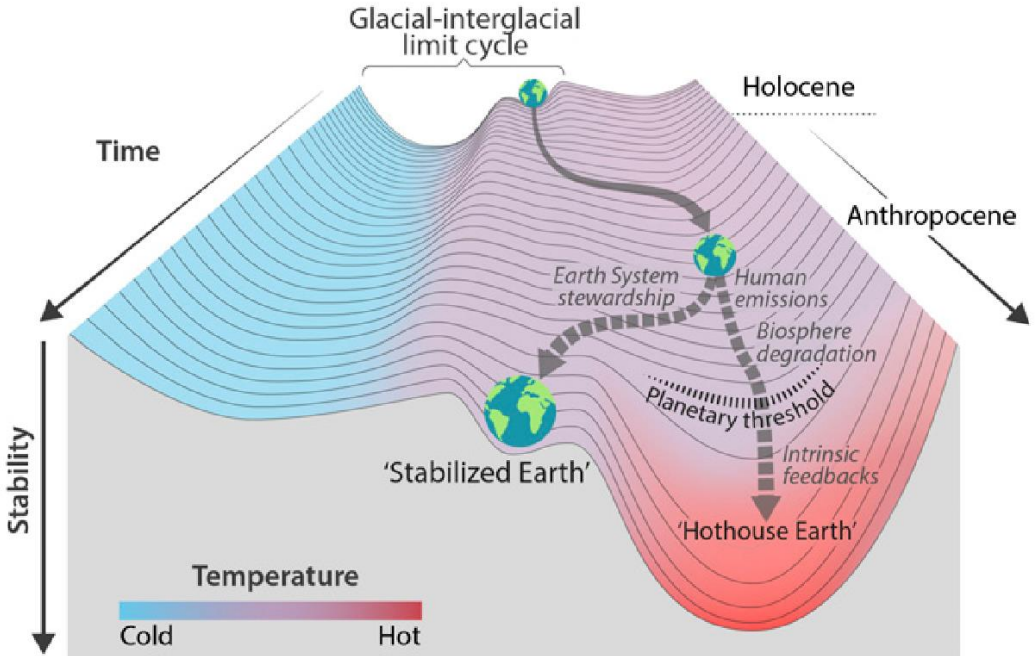
5. So what's in a degree…hothouse Earth!



Source: "Trajectories of the Earth System in the Anthropocene", Steffen et al, 2018 https://www.pnas.org/content/115/33/8252

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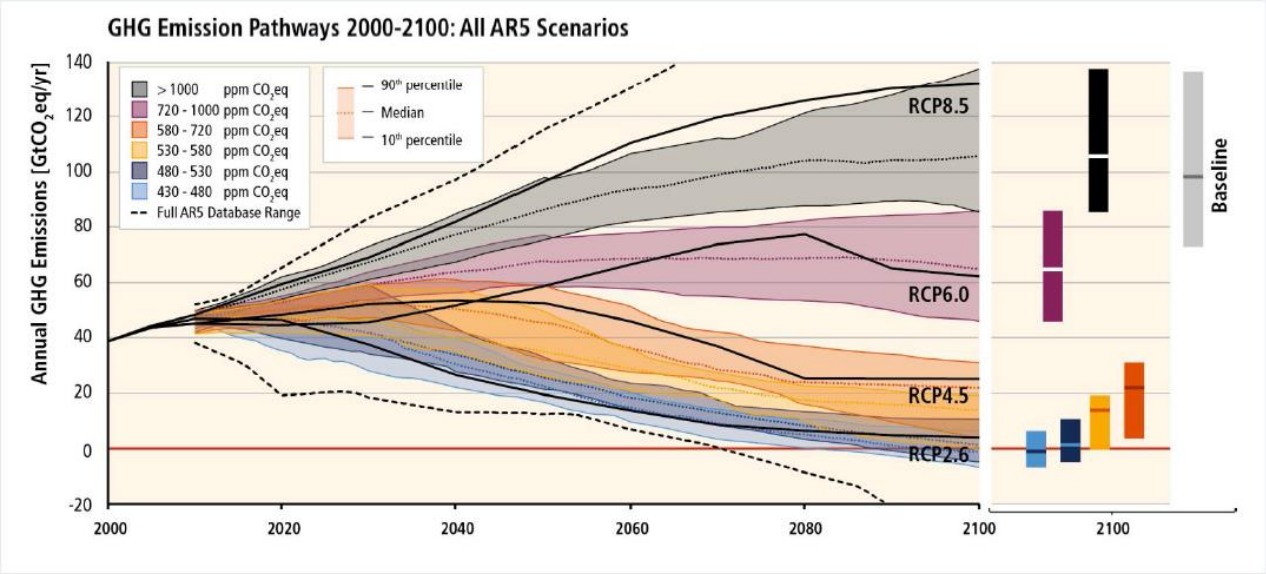
2. Climate Change Scenarios and their relevance for investors

Emissions scenarios

Figure 1: **Emissions scenarios reviewed in the Fifth Assessment Report of Working Group 3 of the IPCC. Scenarios are grouped according to their CO_2 equivalent concentrations in the year 2100 (see colour legend).**[ix] Source: IPCC Fifth Assessment Report Working Group III Figure 6.7[2]



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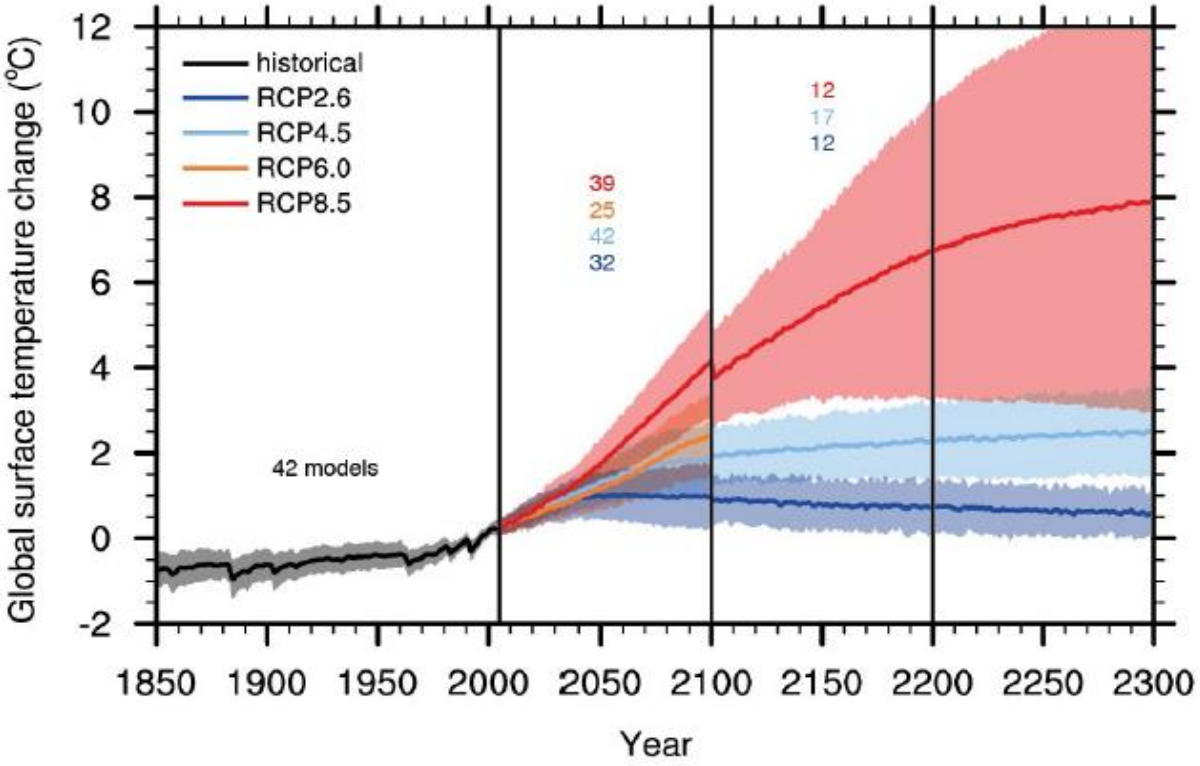
Lead to temperature scenarios



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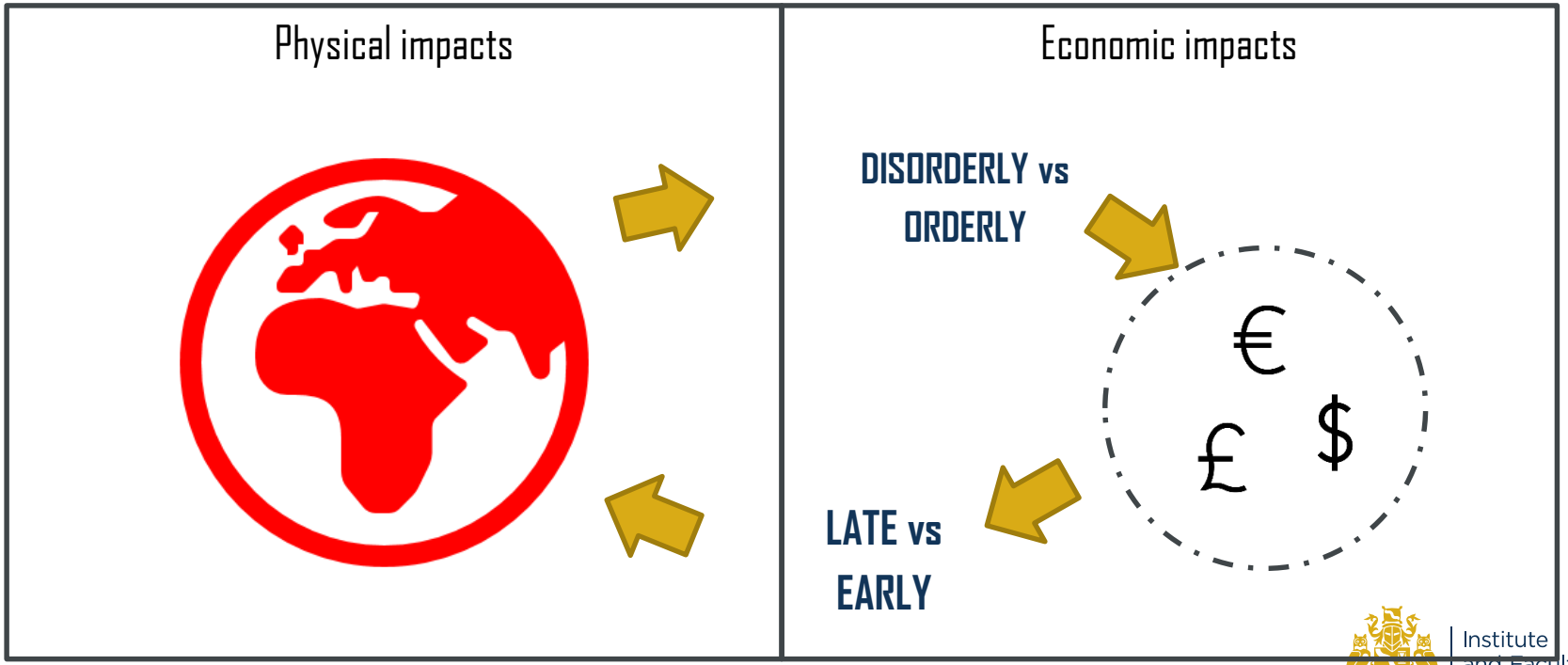
And transition scenarios, which in turn drive temperature (physical risk) scenarios



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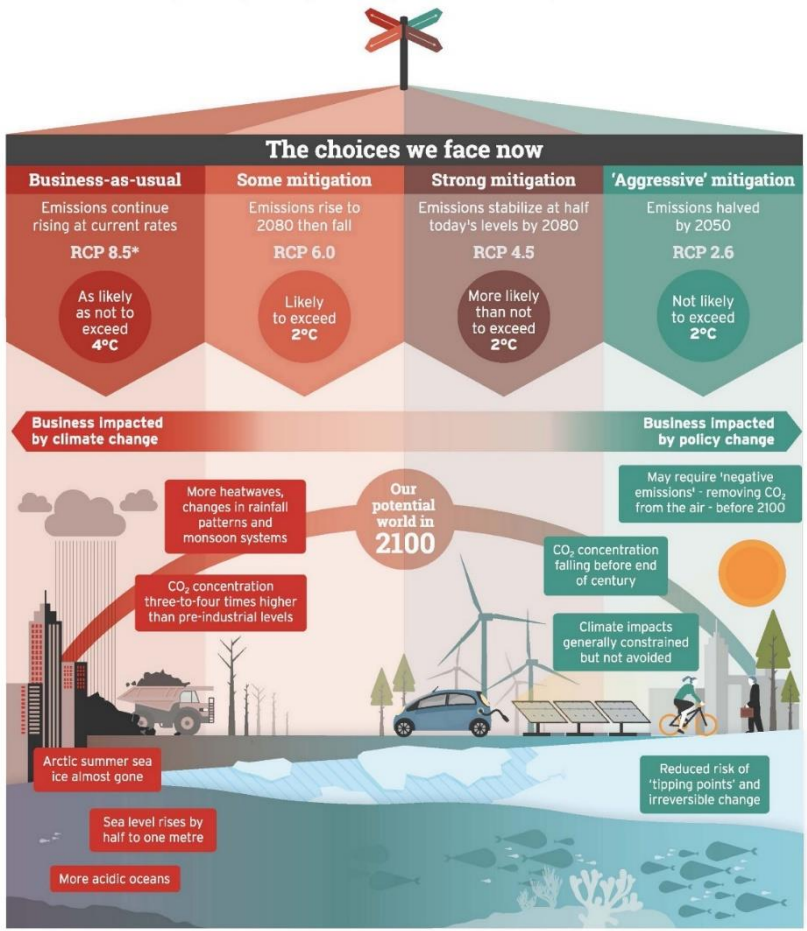
Understanding climate-related financial risks and opportunities

Climate change scenarios focus on two interdependent risks & opportunities:

Transition risk focuses on the impacts (opportunities & risks) experienced due to the transition to a low-carbon economy.

Physical risk focuses on changes (negative and positive) in the natural system attributable to global warming, i.e. sea level rise, frequency and severity of extreme weather events.

Source: IPCC 2018

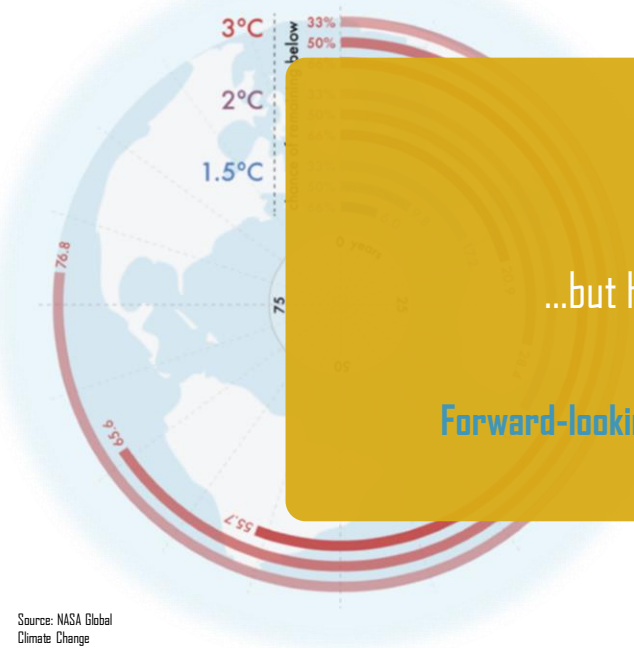


*The four RCP (Representative Concentration Pathway) scenarios each project a certain amount of carbon to be emitted by 2100, and as a result lead to a different amount of human-driven climate change. Climate change will continue after 2100 and elevated temperatures will remain for many centuries after human CO_2 emissions cease.

Why integrate climate and financial scenario analysis?

Carbon Countdown

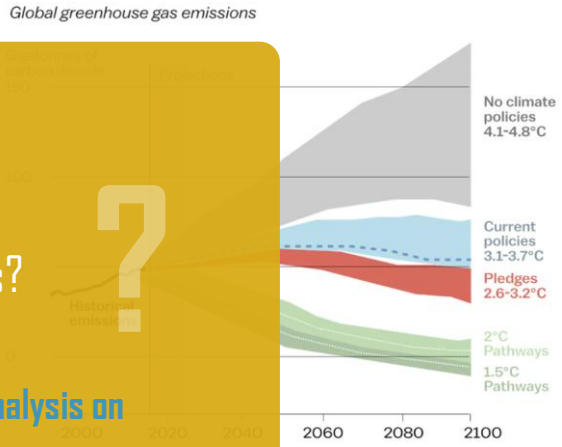
How many years of current emissions would use up the IPCC's carbón budgets for different levels of warming?



Source: NASA Global Climate Change

Scientific sense of urgency

Limiting global warming to a 1.5° pathway is a huge challenge!



Source: Carbon Tracker

A low-carbon, climate-resilient future...

Disruption ahead!!!

...but how are we impacted as investors?

Forward-looking climate-related financial impact analysis on investment portfolio (TCFD)

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Comparing climate scenario analysis with existing financial risk modelling

Some distinctive elements in climate scenario analysis	
Far-reaching in breadth and magnitude	The financial risk from physical and transition risk factors are relevant to multiple lines of business, sectors and geographies. Their full impact on the financial system may therefore be larger than for other types of risks, and is potentially non-linear, correlated and irreversible.
Uncertain and extended time horizons	The time horizons over which financial risks may be realised are uncertain, and their full impact may crystallise outside of many current business planning horizons (tragedy of the horizon). Using past data may not be a good predictor of future risks.
Foreseeable nature	While the exact outcome is uncertain, there is a high degree of certainty that financial risks from some combination of physical and transition factors will occur.
Dependency on short-term actions	The magnitude of future impact will, at least in part, be determined by the actions taken today. This includes actions by governments, financial market participants and a range of other actions.

Source: Bank of England (2018)

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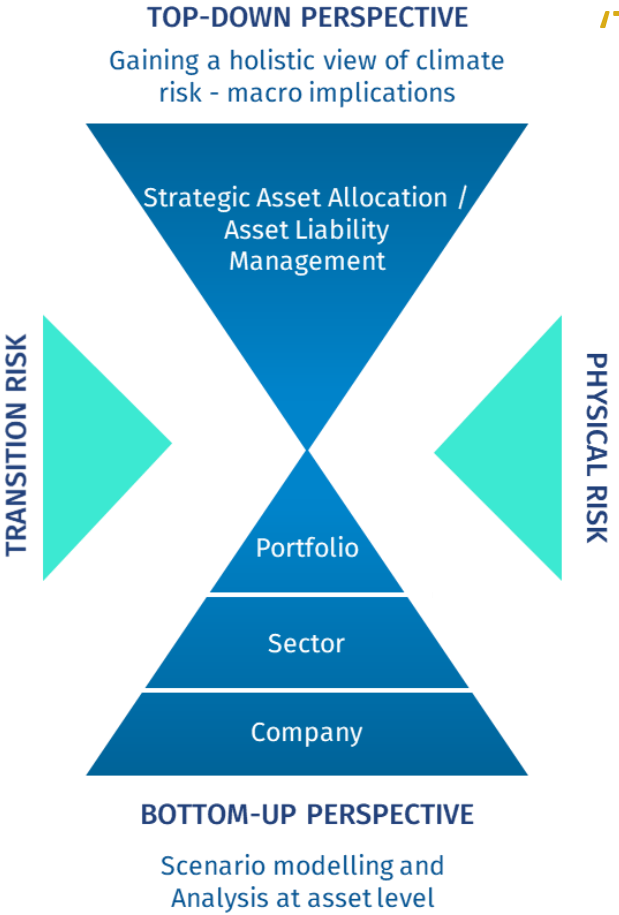
‘Top-down’ versus ‘bottom-up’ analysis



- Top-down (macro perspective) and bottom-up (holdings-specific) approaches to scenario analysis are complementary.
- They each enable different stages of the investment process to become ‘climate-informed’.
- Combination of both enables a consistent climate intelligent investment strategy

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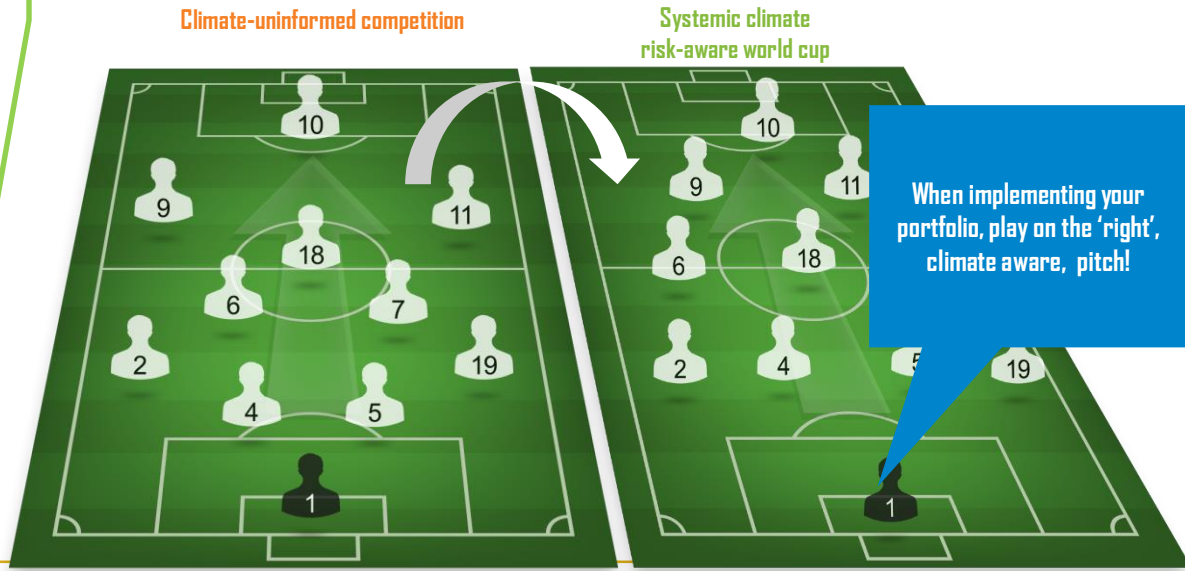
3. Quantification of climate scenarios

WHY: Implications of a quantified TOP-DOWN climate scenario approach

Climate risk adjustments at portfolio implementation level based on **bottom-up data** can help you 'improve your game' BUT...

Climate integration at the strategic/SAA level based on a top-down approach can help you **shift to play your game on the 'right' (climate-aware) pitch**!



HOW: Introducing Ortec Finance's climate scenario approach

... in partnership with... cambridge econometrics clarity from complexity

Developed in R&D project with 5 institutional investors...

OPTrust · FÖRSTA AP-FONDEN · a.s.r. de nederlandse verzekerings maatschappij voor alle verzekeringen · PME Pensioenfonds van de Metalektro · Philips Pensioenfonds

... and supported by leading academic institutions...

CICERO Center for International Climate Research · PIK · Potsdam Institute for Climate Impact Research · Grantham Research Institute on Climate Change and the Environment · IVM Institute for Environmental Studies · VU

Underlying climate science models, *as well as* ***Cambridge Econometric's macro-economic model*** *and the* ***Ortec Finance stochastic financial model*** *are* ***established*** *and well* ***respected****. What is unique and new in our solution is that we combine them.*

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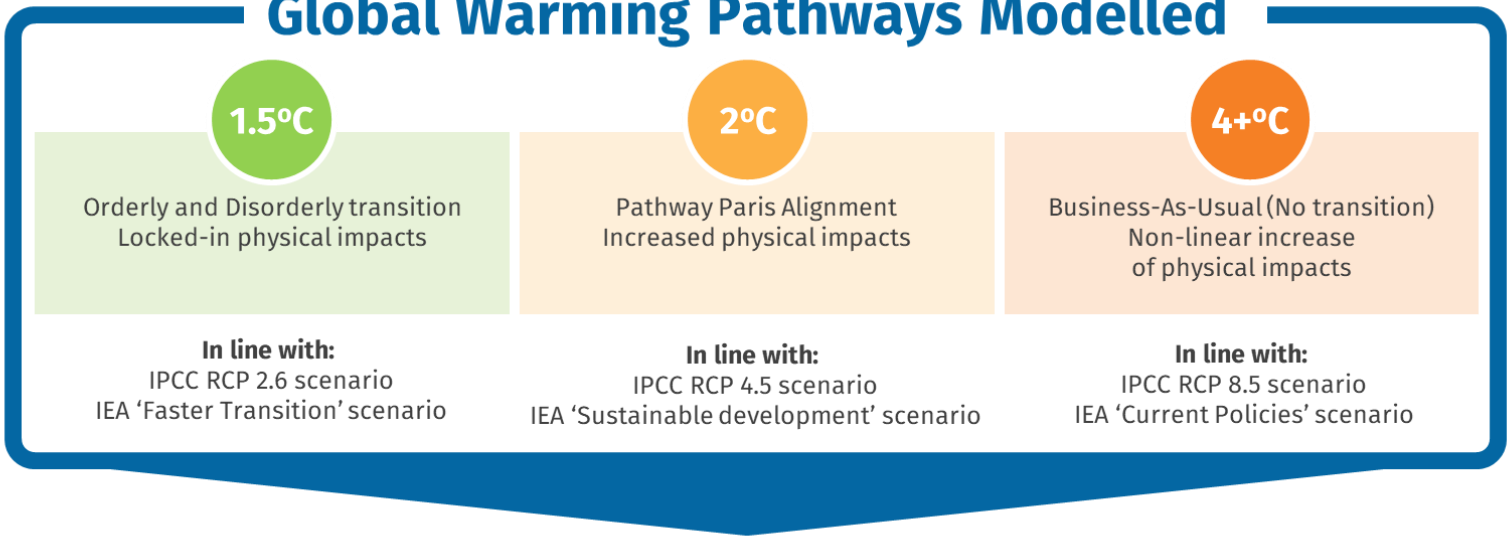
Global Warming Pathways Modelled



Annual climate-related transition & physical impacts, differentiated per country, up to 2100.

Risk-Return impacts are compared to a climate-uninformed baseline economic scenario set.

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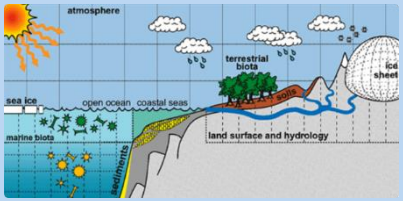
Integration logic per global warming pathway

Climate Science

1.5°C | 2°C | 4+°C

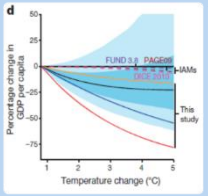


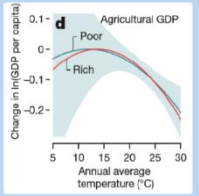
Climatology:
Temperature & carbon budget

consistent with GENIE
(Grid Enabled Integrated Earth System Model) [1]

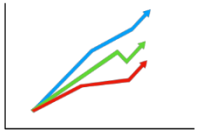
Systemic climate impact

based on Burke et al. (2015) Global non-linear effect of temperature on economic production [2]
- e.g. agriculture and worker productivity





Global carbon price



Transition Risk Assumptions

Policy

- Phase out fossil fuel subsidies
- Energy efficiency
- Renewable energy
- Carbon tax
- Electric vehicles

Technology

- Technology diffusion via FTT (= micro-model of technology choice and substitution, given economic/policy context)
- Low-carbon infrastructure and CCS investment
- Electricity storage advancement

TECHNOLOGY DIFFUSION

MACRO-Economic Model

STOCHASTIC Financial Model

Systemic Climate Risk – Aware Scenarios Sets

[1] Holden et al. (2018) Climate-carbon cycle uncertainties and the Paris Agreement. *Nature Climate Change* 8, 609-613.

[2] Burke, M., Hsiang, S.M. & Miguel, E. (2015). Global non-linear effect of temperature on economic production. *Nature* 527, 235-239.

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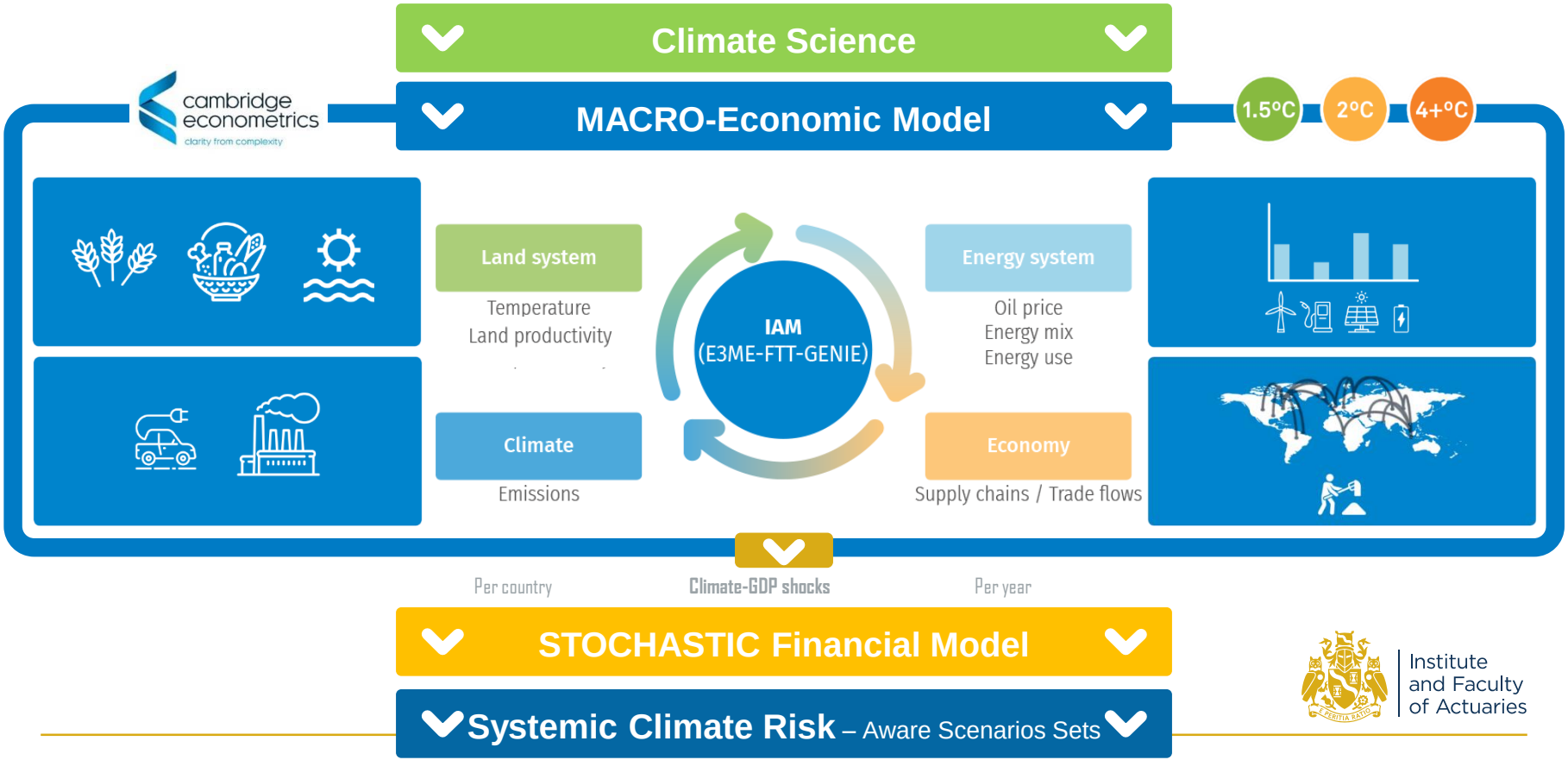
Integration logic per global warming pathway



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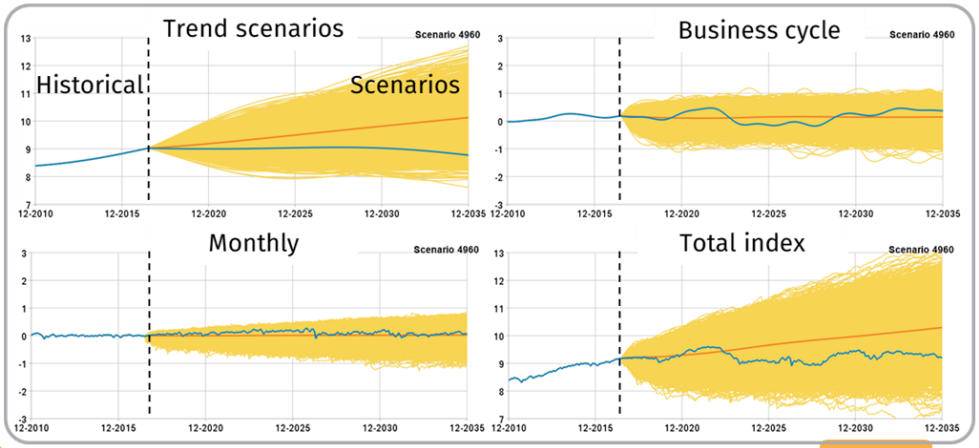
Integration logic per global warming pathway

Climate Science

MACRO-Economic Model

STOCHASTIC Financial Model

1.5°C | 2°C | 4+°C



Translates climate-GDP shocks over time to 600+ financial and economic variables via historical relations

Trend Model (Long Term Means)	Business Cycle Model (8 year steps)	Monthly model
Gradual physical impacts	Orderly transition impacts	Disorderly/extreme event shocks

Systemic Climate Risk – Aware Scenarios Sets

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New innovation: systemic climate risk-aware economic & financial scenarios set

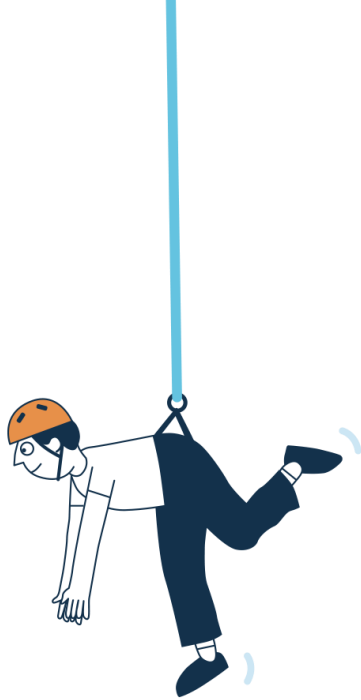
Climate Science

MACRO-Economic Model

STOCHASTIC Financial Model

Systemic Climate Risk – Aware Scenarios Sets

Climate-adjusted economic and financial outlooks up to 2100, differentiated per country.



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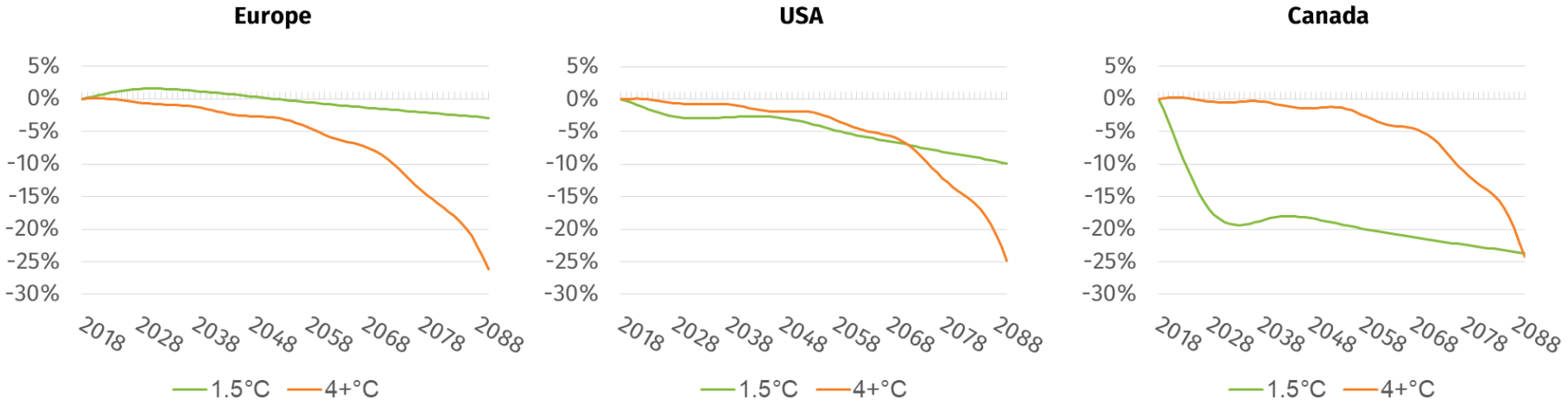
Risk drivers: GDP

Systemic Climate Risk – Aware Scenarios Sets

Cumulative GDP growth in a (orderly and disorderly transition) and a 4+°C climate change pathway (incl. extreme weather event) as compared to climate-uninformed market expectation



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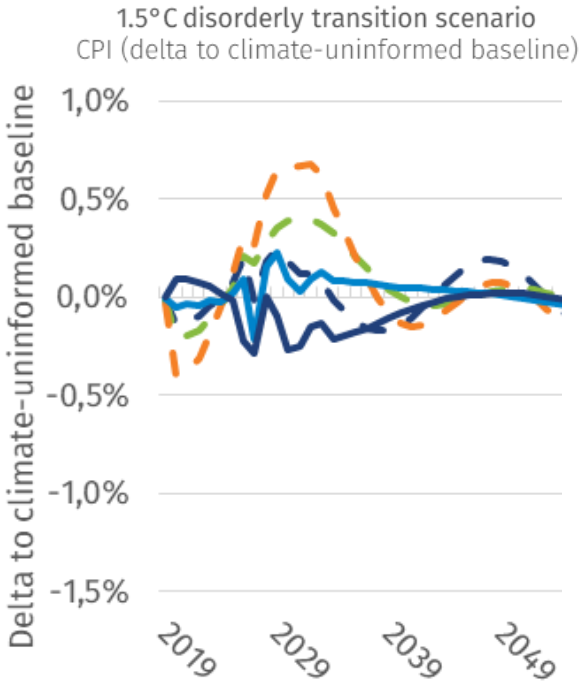
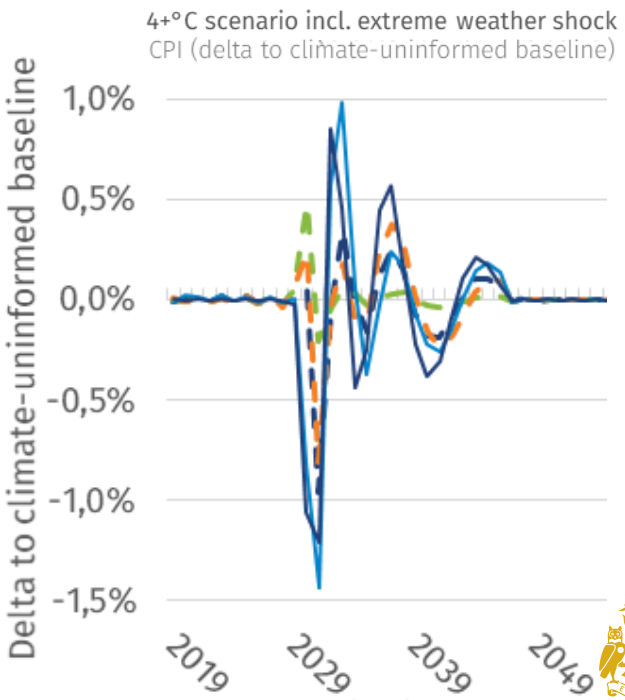
Risk drivers: CPI

Systemic Climate Risk – Aware Scenarios Sets





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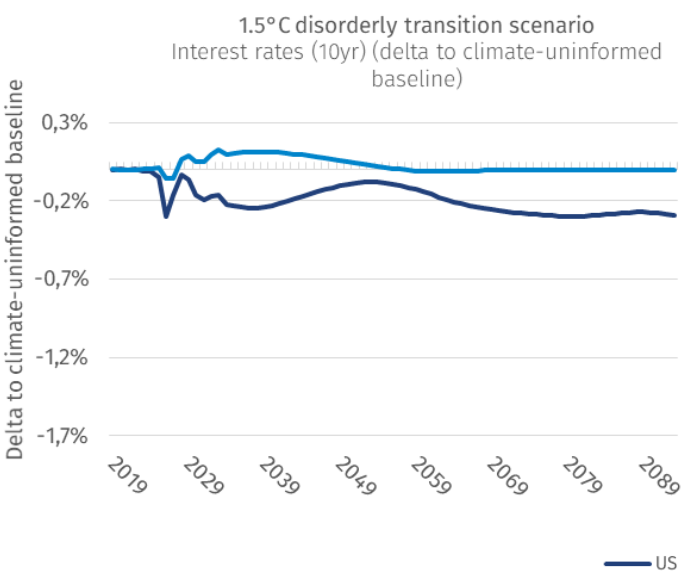
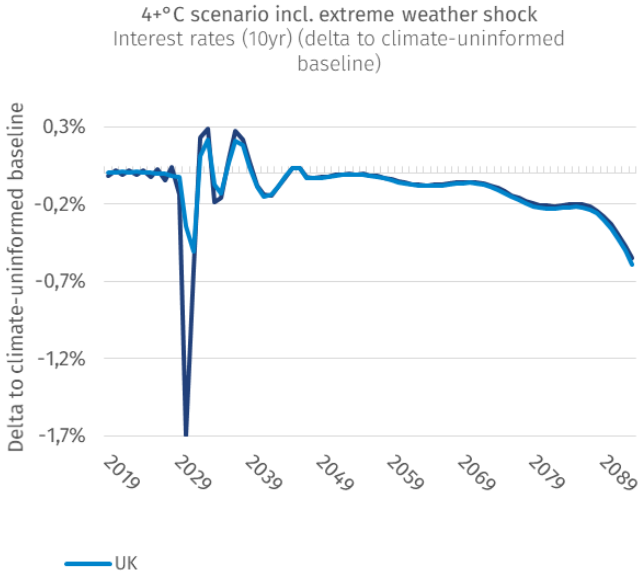
other high income
lower middle income
US
upper middle income
UK

Risk drivers: Interest rates

Systemic Climate Risk – Aware Scenarios Sets

Interest rates in a (orderly and disorderly transition) and a 4+°C climate change pathway (incl. extreme weather event) as compared to climate-uninformed market expectation





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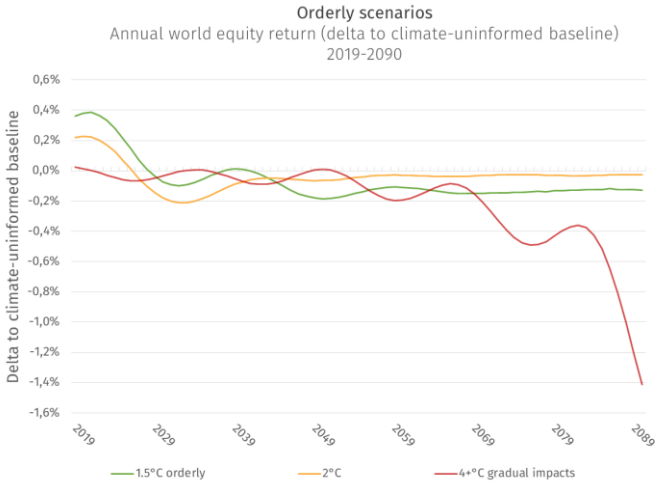
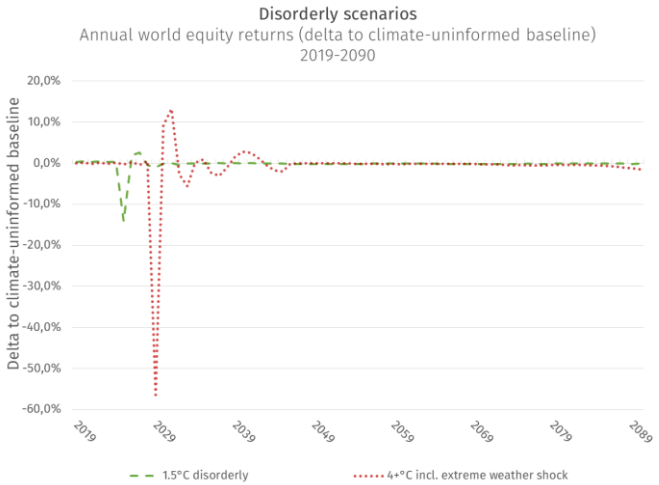
Results: Impact on world equities returns

Systemic Climate Risk – Aware Scenarios Sets

World equity returns in a 1.5°C (orderly and disorderly transition), 2°C and a 4+°C climate change pathway (slow onset and incl. extreme weather event) as compared to climate-uninformed market expectation





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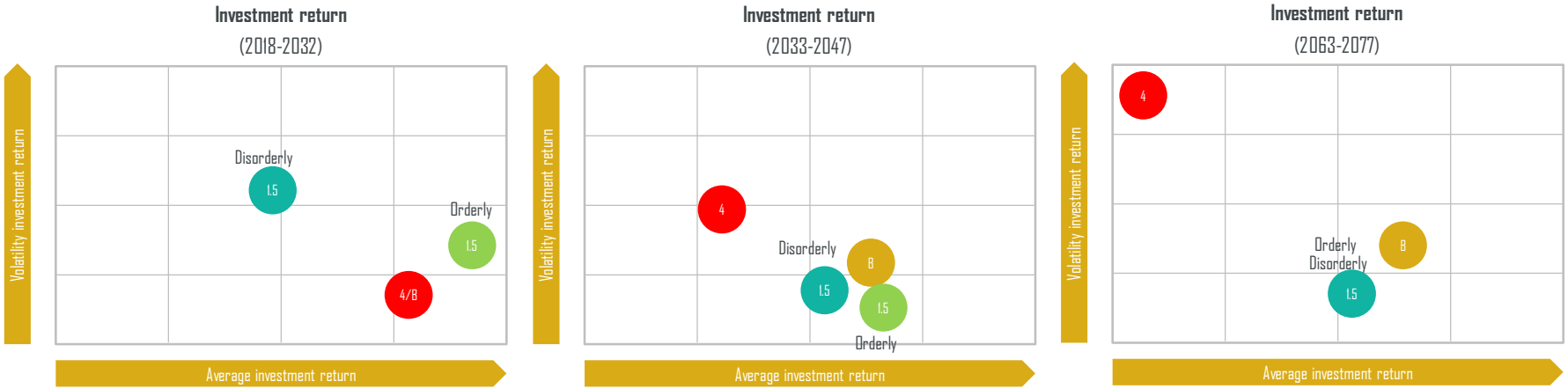
4. Scheme level impacts

Risk-Return INSIGHTS: from climate-uninformed to climate risk-aware

How robust is your policy framework for different climate paths?

Example: model-based risk-return projections



Note: these are results based on a fictive demo set-up, results will vary for each specific investor.

- Different climate pathways are expected to impact economic and financial risk drivers in their own way, per horizon and per region.
- Are expected returns for different climate paths still aligned with required return?

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Risk-Return Insights: from climate-uninformed to climate risk-aware

Impact of climate scenario on RRS compared to baseline

4+°C incl. extreme weather shock	Years 1-15		Years 15-30		Years 60-75	
(delta to climate-uninformed baseline)	Geometric Average return	CVaR 95	Geometric Average return	CVaR 95	Geometric Average return	CVaR 95
Risk and return statistics						
Total Assets	**-1,0%**	**-16,7%**	**0,0%**	**0,5%**	**-0,3%**	**-6,2%**
Fixed Income	**0,2%**	**3,2%**	**0,0%**	**0,6%**	**0,0%**	**1,1%**
Gilts	0,0%	-0,8%	0,0%	0,3%	0,2%	3,7%
Credits	0,6%	9,1%	0,2%	4,2%	-0,1%	-2,5%
Emerging Market Debt	-0,8%	-12,9%	-0,1%	-0,3%	-0,3%	-4,6%
Fixed Income Derivatives	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Cash	-0,1%	-0,7%	0,0%	-0,4%	-0,3%	-4,7%
Equity	**-4,2%**	**-40,9%**	**-0,1%**	**-1,2%**	**-0,9%**	**-9,0%**
Equity Developed Markets	-4,2%	-39,6%	-0,1%	-1,5%	-0,9%	-9,1%
Equity Emerging Markets	-4,2%	-29,7%	-0,1%	-0,9%	-0,9%	-8,3%
Property	**-3,1%**	**-30,4%**	**-0,1%**	**-1,6%**	**-1,0%**	**-11,3%**
Direct Real Estate UK	-2,7%	-26,4%	-0,1%	-1,7%	-0,7%	-7,8%
Indirect Non-listed Real Estate UK	-3,5%	-29,7%	-0,1%	-1,9%	-1,3%	-12,3%
Alternatives	**-2,1%**	**-31,4%**	**0,0%**	**-0,6%**	**-0,6%**	**-10,5%**
Hedge Funds	-0,9%	-12,5%	0,1%	2,2%	-0,2%	-2,6%
Infrastructure	-1,4%	-22,3%	0,0%	-0,1%	-0,6%	-10,2%
Commodities (GSCI)	0,0%	-1,2%	0,3%	3,9%	-0,4%	-3,9%
Private Equity	-3,9%	-28,5%	-0,1%	-1,0%	-0,9%	-7,8%

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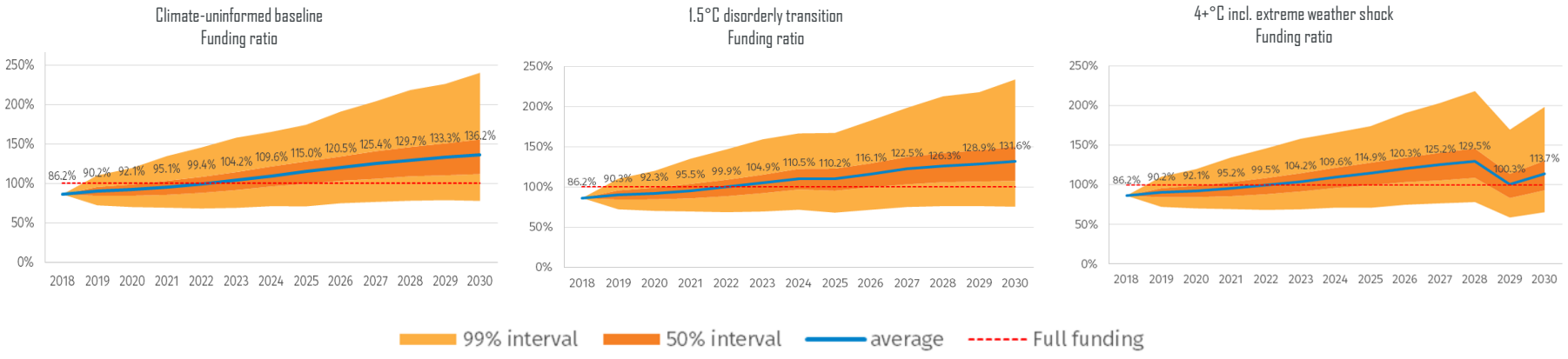
Note: The risk-return output is based on an example UK portfolio, and results will vary for each specific investor.

ALM INSIGHTS: Funding Ratio (stochastic view up to 2030)

How robust is an example UK portfolio for different climate pathways?



Note: The risk-return output is based on an example UK portfolio, and results will vary for each specific investor.

- The different climate pathways are expected to have varying impacts on the funding ratio of the UK example portfolio
  - The higher warming scenarios result in lower funding ratios over the observed time-horizon

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ALM INSIGHTS: Funding Ratio (differences across entire time horizon)

How robust is an example UK portfolio for different climate pathways?

Note: The risk-return output is based on an example NLportfolio, and results will vary for each specific investor.

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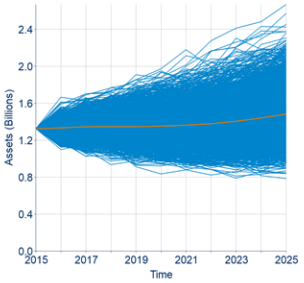
Key applications

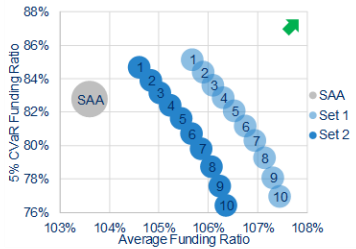
Quantified systemic climate risk-aware **stochastic economic scenarios sets & ALM/SAA analytics software**

For all types of portfolio analyses incl. exploring impacts on strategic asset allocation/ALM; running financial planning on a climate-integrated economic outlook, etc.



Optimizing Investment Strategies

Portfolios can be optimized under different climate scenarios and compared to the SAA



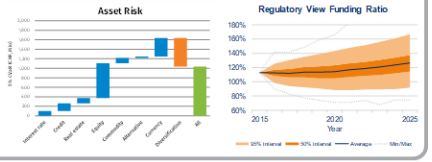
Strategic framework for fully consistent climate-intelligent investment strategy

Consistent climate risk framework from SAA/ALM decisions, to risk budget, to portfolio construction

Climate-aware Risk Factor Decomposition & Risk Monitoring

The asset risk can be decomposed to the underlying risk factors or asset categories.

Projected Funding Ratio or Asset values can be compared with the realizations.



Disclosure: Fulfilling **forward-looking scenario-based analysis** in line with **TCFD, UN PRI, etc.**

Quantified, systemic climate risk portfolio scan results fulfill requirements of pillar 2 'Strategy of the TCFD disclosure recommendations

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Questions

Comments

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