
UNIVERSITY OF CAMBRIDGE
INSTITUTE FOR SUSTAINABILITY LEADERSHIP
Unhedgeable Risk
How climate change sentiment impacts investment
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#RewireEconomy

CISL: A unique Cambridge institution

30 years of building leadership capacity to tackle global challenges

60 staff in Cambridge, Brussels, Cape Town

Patron:
HRH The Prince of Wales

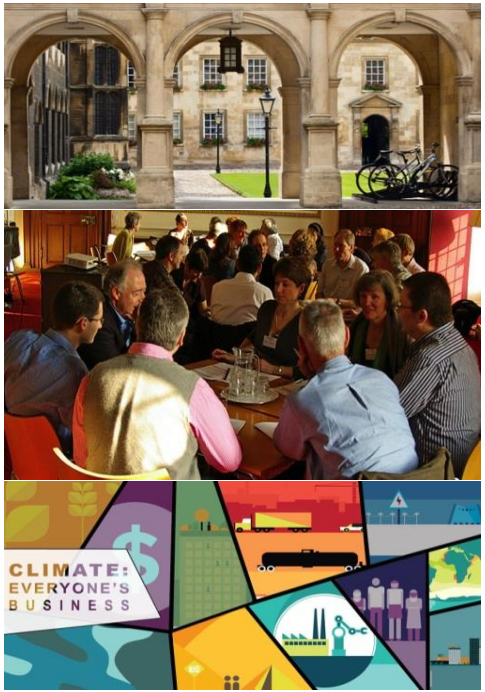
Global network of
7,000 senior executives

Business and policy engagement

- Sustainable finance (banking, insurance, **investment)**
- Natural capital (incl. carbon)
- Equality and wellbeing

Independent research

Executive and graduate education



Investment Leaders Group

First State Investments

HSBC Global Asset Management

NATIXIS

Nordea

PIMCO

Standard Life Investments

TIAA GLOBAL ASSET MANAGEMENT

ZURICH

Focus Mandates for sustainable investing
Metrics for investment impact
Understanding consumer demand

A question tackled by an interdisciplinary team

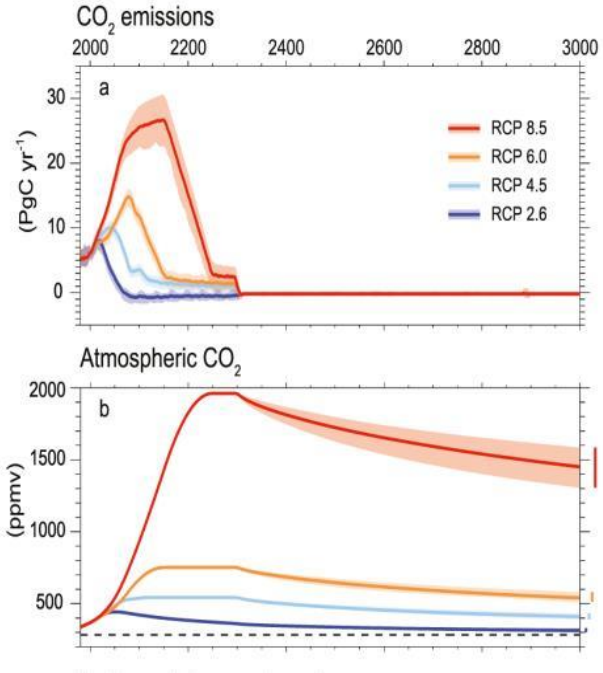
- Commissioned by CISL and the ILG

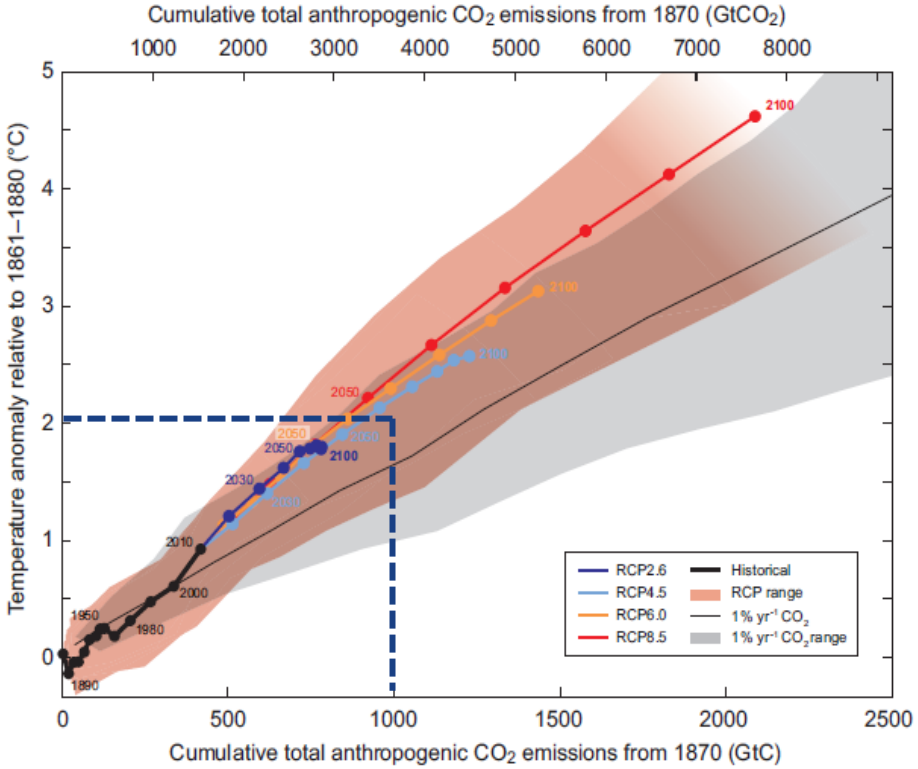
- Collaborative effort of three Cambridge research teams
  - Centre for Risk Studies (CRS)
  - Centre for Climate Change Mitigation Research (4CMR)
  - Cambridge Judge Business School (CJBS)

UNIVERSITY OF CAMBRIDGE Judge Business School | Centre for Risk Studies

4CMR Foreseeing Mitigation

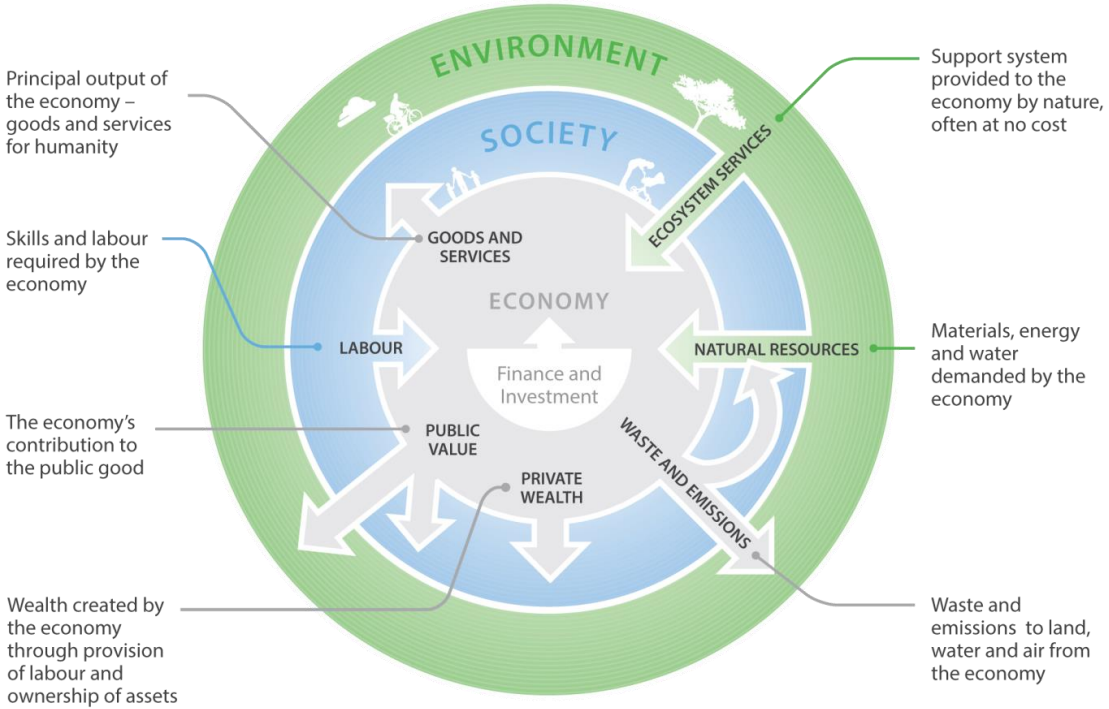
Cumulative emissions and the “tragedy of the horizon”





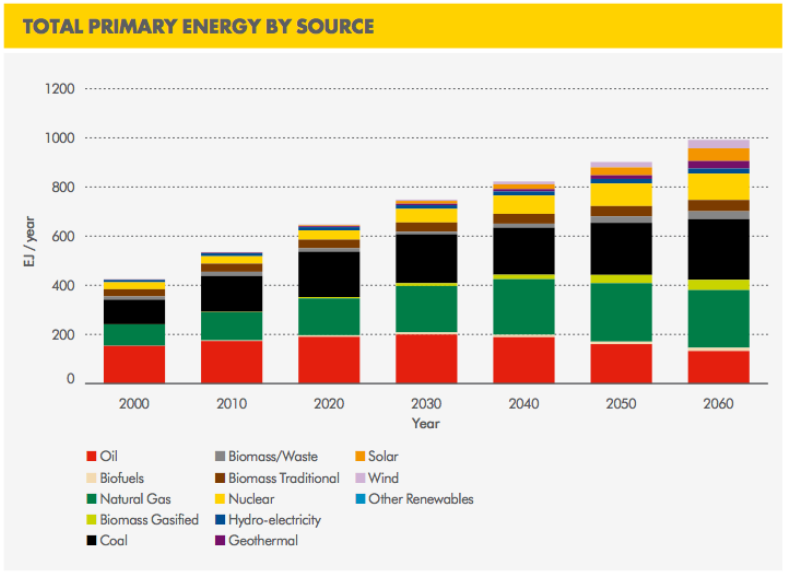
The nested model of finance and investment

Inflows and outflows from the economy



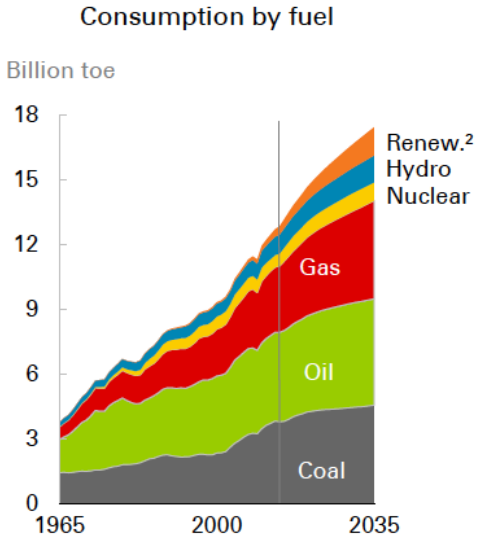
Unburnable carbon and the carbon bubble

Shell: Mountains



Shell Energy Scenarios: New Lenses
http://www.shell.com/global/future-energy/scenarios/new-lens-scenarios.html

BP: Best Knowledge



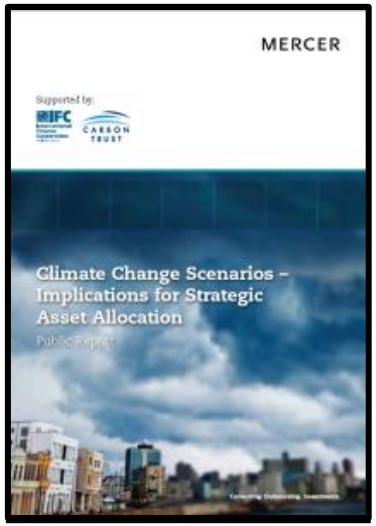
BP Energy Outlook 2035:
http://www.bp.com/content/dam/bp/pdf/Energy-economics/energy-outlook-2015/Energy_Outlook_2035_booklet.pdf

Meeting 2°C target requires 60% cut in fossil fuels by 2050

The analytical challenge

- Estimating economic damages is **problematic**
- Significant **uncertainties**
  - Future economic productivity
  - Climate sensitivity
  - Catastrophic climate change and tipping points
  - Human behaviour
- Sensitivities and assumptions
  - What is included / excluded in the analysis
  - Timing of climate policies

Recent reports on the financial impacts of climate change



June 2011

July 2015

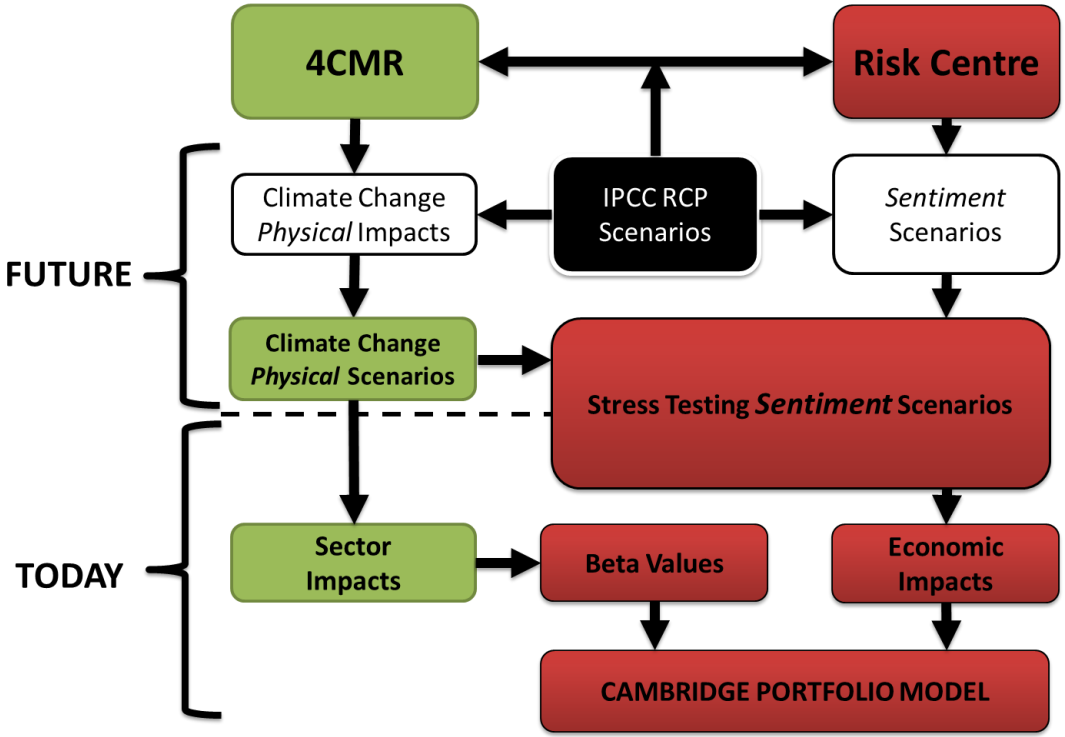
Aug 2015

1. Mercer, 2011. Climate Change Scenarios - Implications for Strategic Asset Allocation. http://www.mercer.com/services/investments/investment-opportunities/responsible-investment/investing-in-a-time-of-climate-change-report-2015.html

2. Mercer, 2015. Investing in a time of climate change (update). http://www.mercer.com.au/insights/focus/invest-in-climate-change.html

3. The Economist, 2015. The cost of inaction.

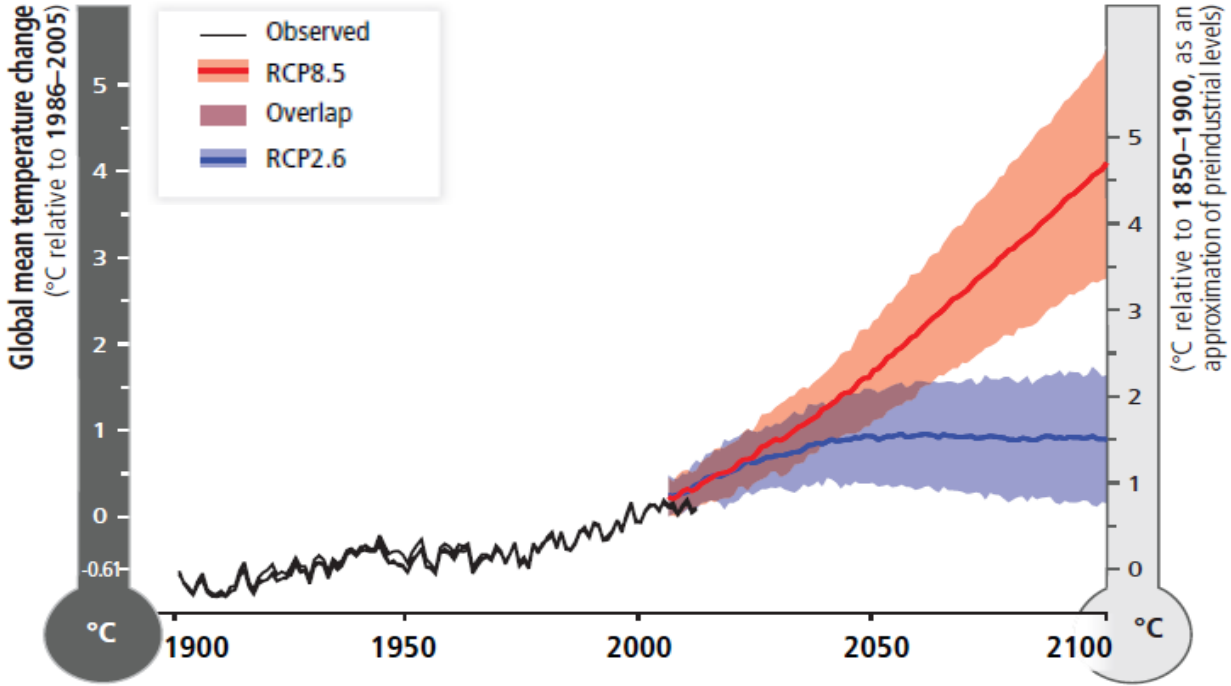
Structural methodology



Extreme events “plausible and highly unlikely”

- Scenarios are **not predictions**
- Scenarios are stress tests for risk management purposes
  - These are not forecasts of what is likely to happen
  - These are hypothetical: Illustrate a 1-in-100 year event in a particular threat class
  - Used for ‘what-if’ studies

Development of sentiment scenario



Defining the sentiment scenarios

Representative Concentration Pathways (RCPs)

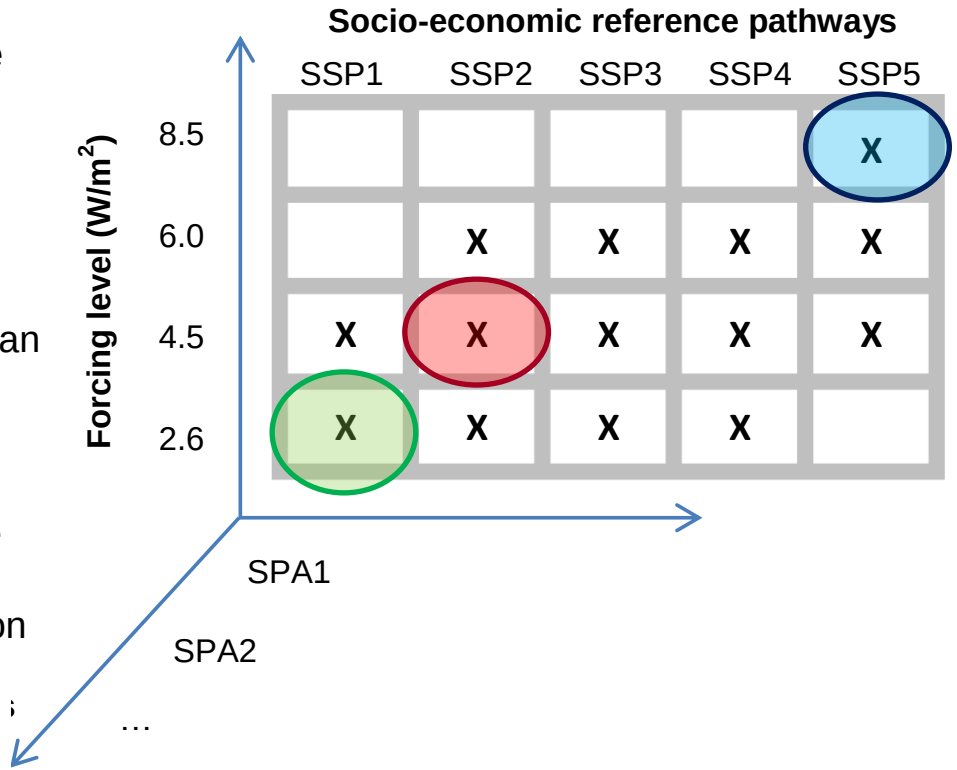
- Total radiative forcing from GHG causing climate change

Shared Socioeconomic Pathways (SSPs)

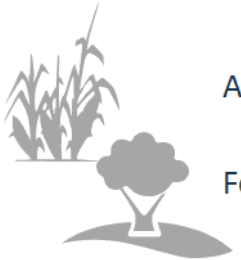
- Range of future socioeconomic, technology and emissions scenarios
- Reference scenarios upon which policy targets can be modeled

Shared Climate Policy Assumptions (SPAs)

- Climate change policy designs + how targets are achieved
- GHG emissions coverage, accession, cooperation



The process begins by defining the sectors to be considered



Agriculture

Forestry

land productivity change due to temperature and rainfall

Land transport

change in tonne-km transport for manufactured goods due to storm damage

Building assets

Production assets

(including energy generation)

percentage damage due to flooding (energy includes temperature)

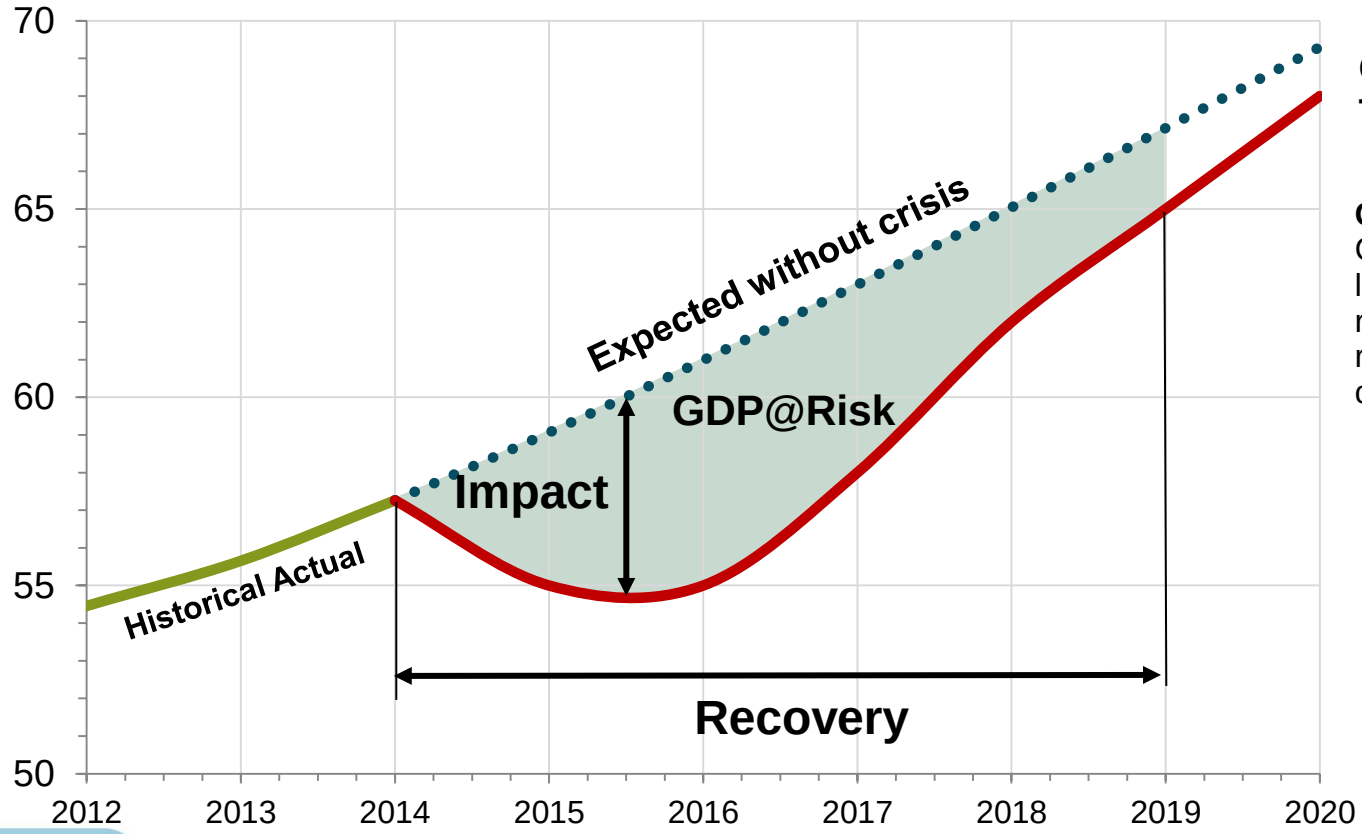
Damage functions are used to estimate impacts on sectors at different temperature change values

Agricultural productivity

Temperature change (C) relative to pre-industrial baseline

Region	0	0.5	1	2	3	4	5	6
North America	1	1.05	1	0.95	0.85	0.7	0.6	0.4
Central America	1	1.04	1.02	0.98	0.8	0.7	0.58	0.42
South America	1	1.03	1.01	0.97	0.79	0.69	0.57	0.41
Sub-Saharan Africa	1	1.06	1.01	0.96	0.86	0.71	0.61	0.41
Middle East	1	1.04	0.99	0.94	0.84	0.69	0.59	0.39
European Union	1	1.03	0.98	0.93	0.83	0.68	0.58	0.42
Southeast Asia	1	1.06	1.01	0.96	0.88	0.72	0.61	0.4
China	1	1.06	1.01	0.96	0.88	0.72	0.61	0.4
Russia	1	1.1	1.05	1	0.9	0.75	0.65	0.45
Australia and NZ	1	1.04	1.02	0.07	0.78	0.72	0.6	0.44

Estimating GDP@Risk



Crisis GDP Trajectory

GDP@Risk:
Cumulative first five year loss of global GDP, relative to expected, resulting from a catastrophe or crisis

Scenario assumptions

Scenario: Two Degrees

World making good progress towards sustainability w/ rapid improvement to cleantech development

Regulations: Coordinated level of global cooperation for mitigation: global $30/ton carbon tax imposed, increasing in future.

Market Reaction: Moderate shift in market sentiment due to uncertainties to future energy resources and structural change as energy consumption is reduced and divestment from fossil fuel takes place

Scenario: Baseline

Trends typical of recent decades continue with mild progress, if any, towards reducing resource and energy intensity

Regulations: Delays in global climate policy action with no carbon tax and fossil fuel demand remaining unchanged

Market Reaction: Negligible shift in market sentiments; expectations of future economic activities remain unchanged

Scenario: No Mitigation

Focus on rapid economic growth dependent on fossil fuel with little attention to climate change adaptation; no room for mitigation which lead to belief that global warming is accelerating past the point of no return

Regulations: Higher fixed investment for fossil fuel extraction and subsididies

Market Reaction: Drastic shift in market sentiments due to large uncertainties regarding climate outlook and future economic activities

Scenario assumptions

Scenario: Two Degrees

Regulatory assumptions:

- $100/tonne CO_2 of carbon tax to reflect the strength of climate policies aimed at reducing greenhouse gases (GHG) emissions
- Carbon budgets set at 20% on existing reserves
- 80% more investments in low-carbon technologies
- No further investment (or subsidies) for fossil fuel extractions

Scenario: Baseline

Regulatory assumptions:

- No carbon or oil tax
- World fossil fuel energy supply/production remains unchanged
- Fossil fuel-dominant energy investments remain unchanged
- No technological advances to renewable energy sources

Scenario: No Mitigation

Regulatory assumptions:

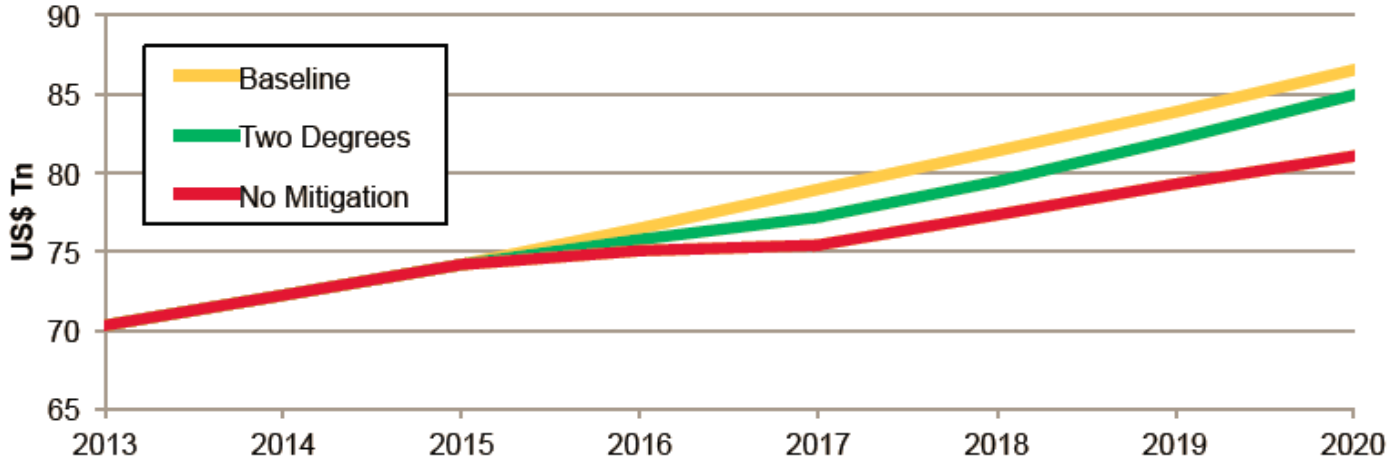
- No carbon or oil tax
- 50% increase in world fixed investment for energy extraction

Sentiment scenario summary table

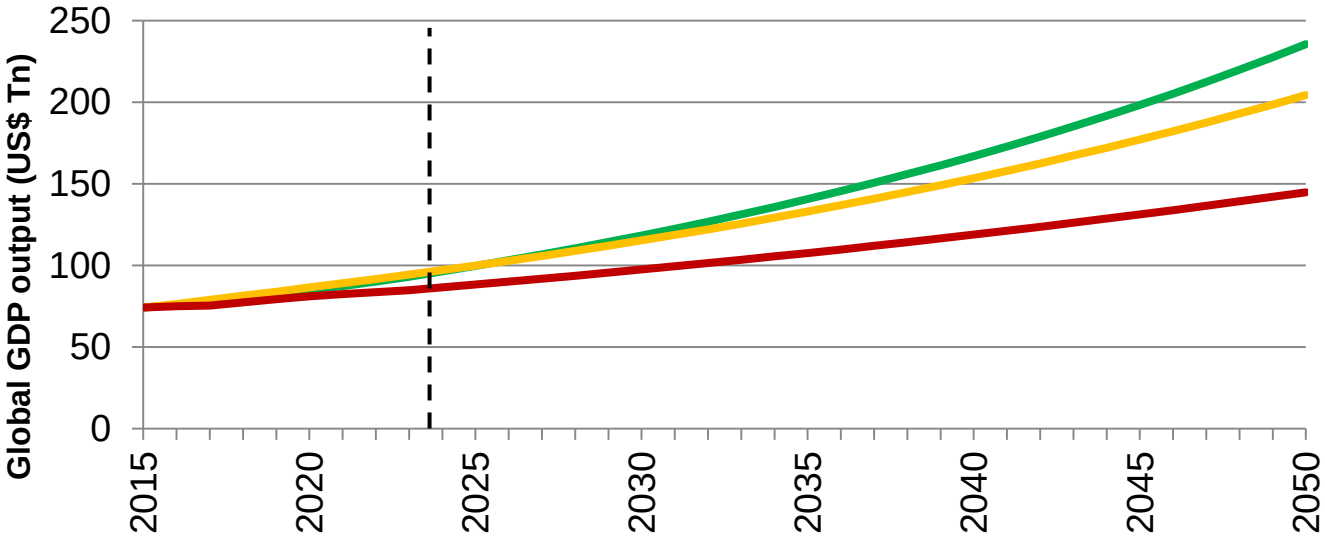
Matrix Axis	Parameters	Two Degrees	Baseline	No Mitigation
Climate impacts	Future temperature increase	Low	Moderate	High
	Extreme weather events	Low	Moderate	High
Socio-economic development	Population Growth	Low	Moderate	Low
	Resource consumption	Low	Moderate	High
	Fossil fuel demand	Low	Moderate	High
Environmental Policies	Fossil fuel price	High	Low	High
	Green technology	High	Moderate	Low
	Climate policies	High	Moderate	Low

Global macroeconomic impacts

Summary of Effects of Sentiment Scenarios			
	Baseline (Reference)	**Two Degrees**	**No Mitigation**
Macroeconomic Losses			
Min. GDP growth rate	3%	0.3%	-0.1%
Global recession duration	Nil	Nil	3 Qtrs
GDP@Risk (US$Tr)	-	**8.9**	**19.1**
GDP@Risk (%)	-	**2.2%**	**4.7%**



The long-term view



	Long Term Impact of Scenarios with Respect to Baseline to 2050 (GDP@Risk)		
Scenario	**No Discount Rate**	**3.5% Discount Rate**	**6% Discount Rate**
Two Degrees	6.5%	4.5%	3.2%
No Mitigation	-19%	-16%	-14%

Aggregate vs. sectoral analysis

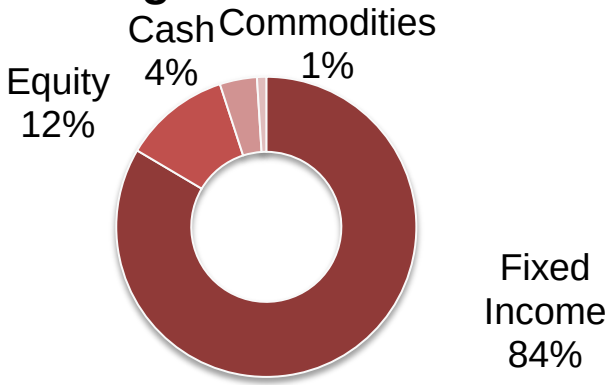
- Multiple portfolio structures considered
- Portfolio rebalancing to maintain correct proportions
- Sectoral impacts of particular relevance for equities
  - Uses physical impacts data for sectors and regions

Within model variation

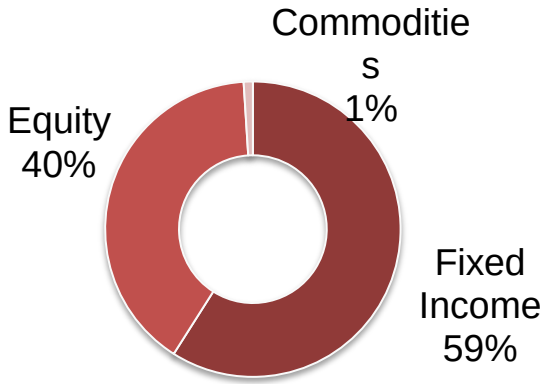
Climate impacts	Countries	Asset classes	Economic Sectors	
Heat wave	United States	Fixed income	Health Care/Pharma	Energy / Oil and Gas
Flooding	United Kingdom	- 10Y gov bonds	Technology (renewables)	Transport
Storms	Germany	- 2Y gov bonds	Construction	Real Estate
	Japan	Equities	Agriculture	Consumer Retail
	China	Corporate bonds	Consumer Services	Basic Materials
	Brazil	Commodities	Financials	Telecommunications
			Industrials	

Four portfolio structures

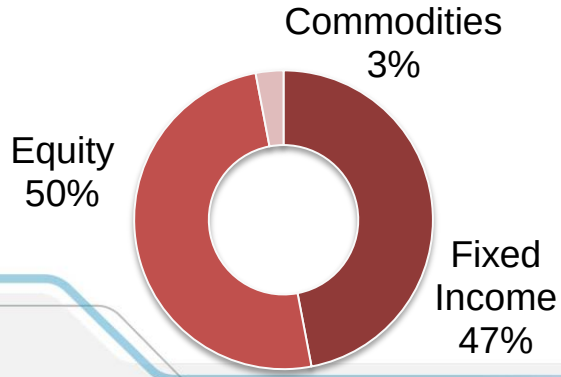
High Fixed Income



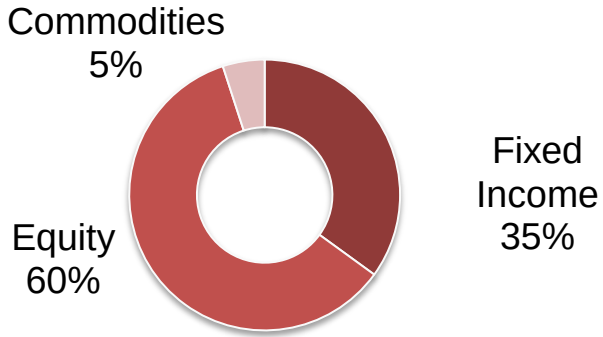
Conservative



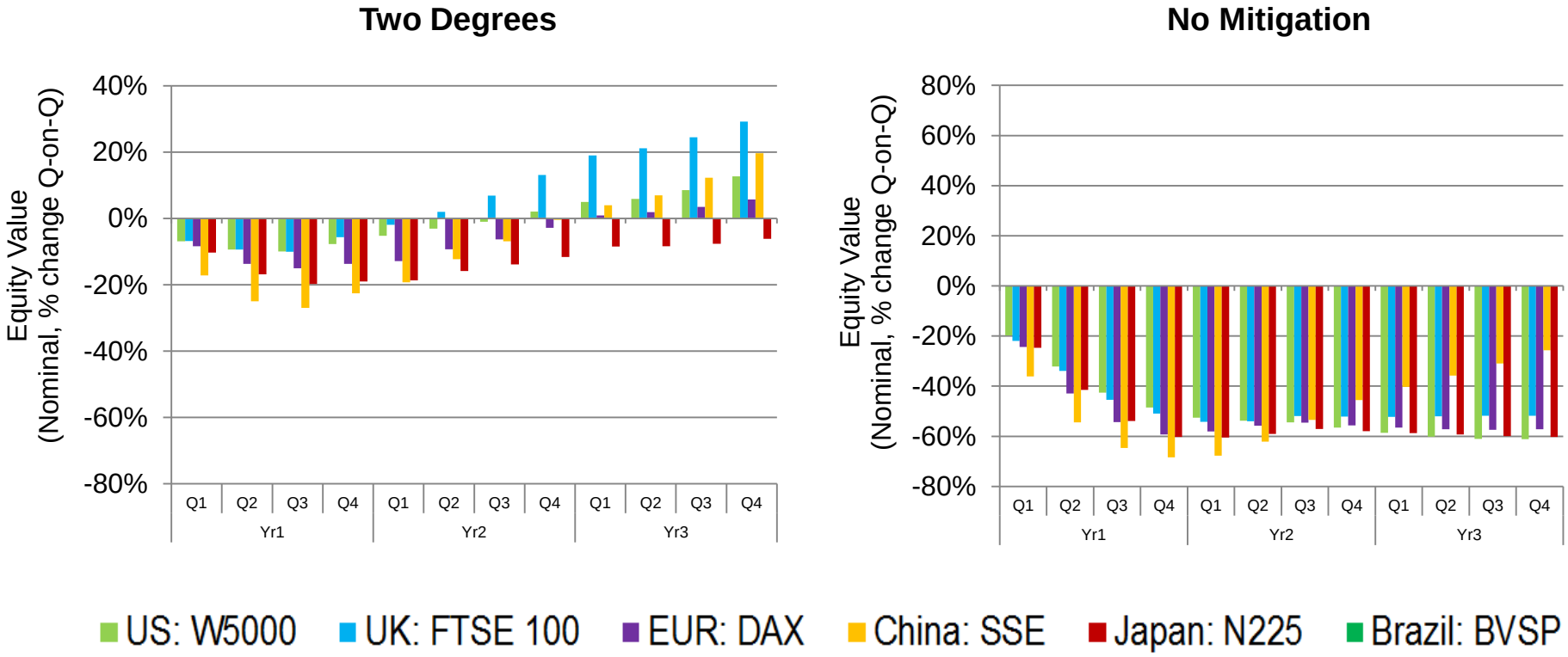
Balanced



Aggressive

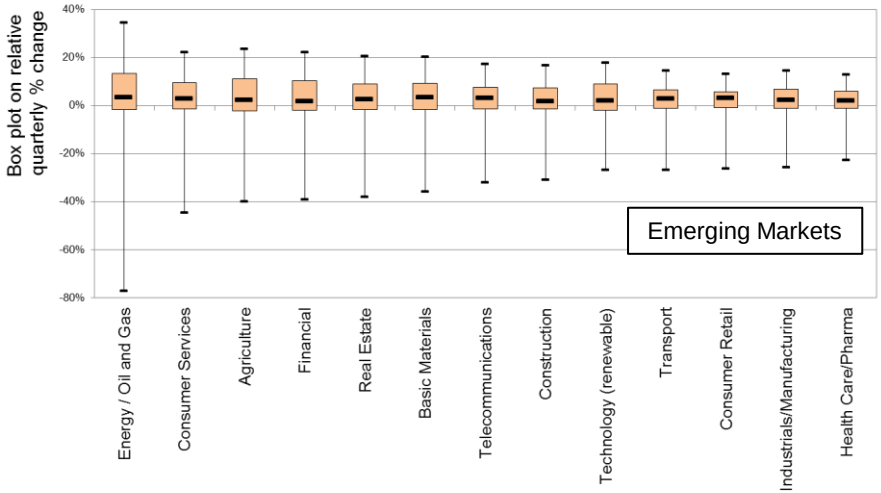


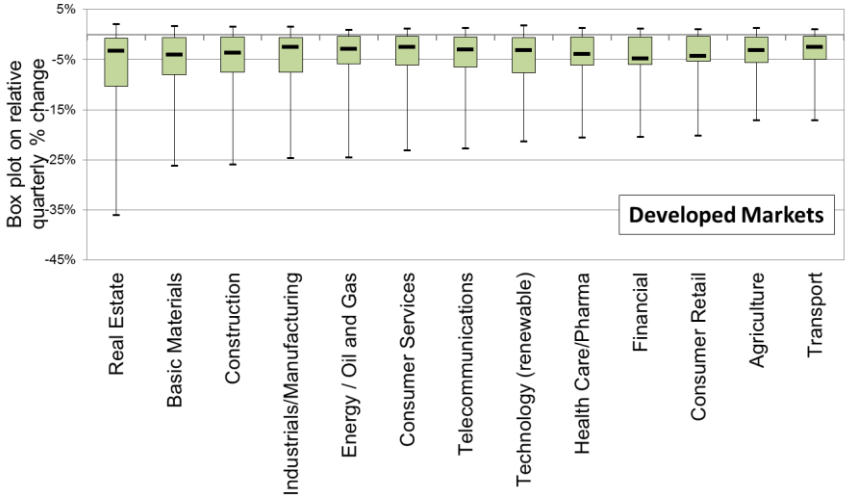
Impact on equity markets



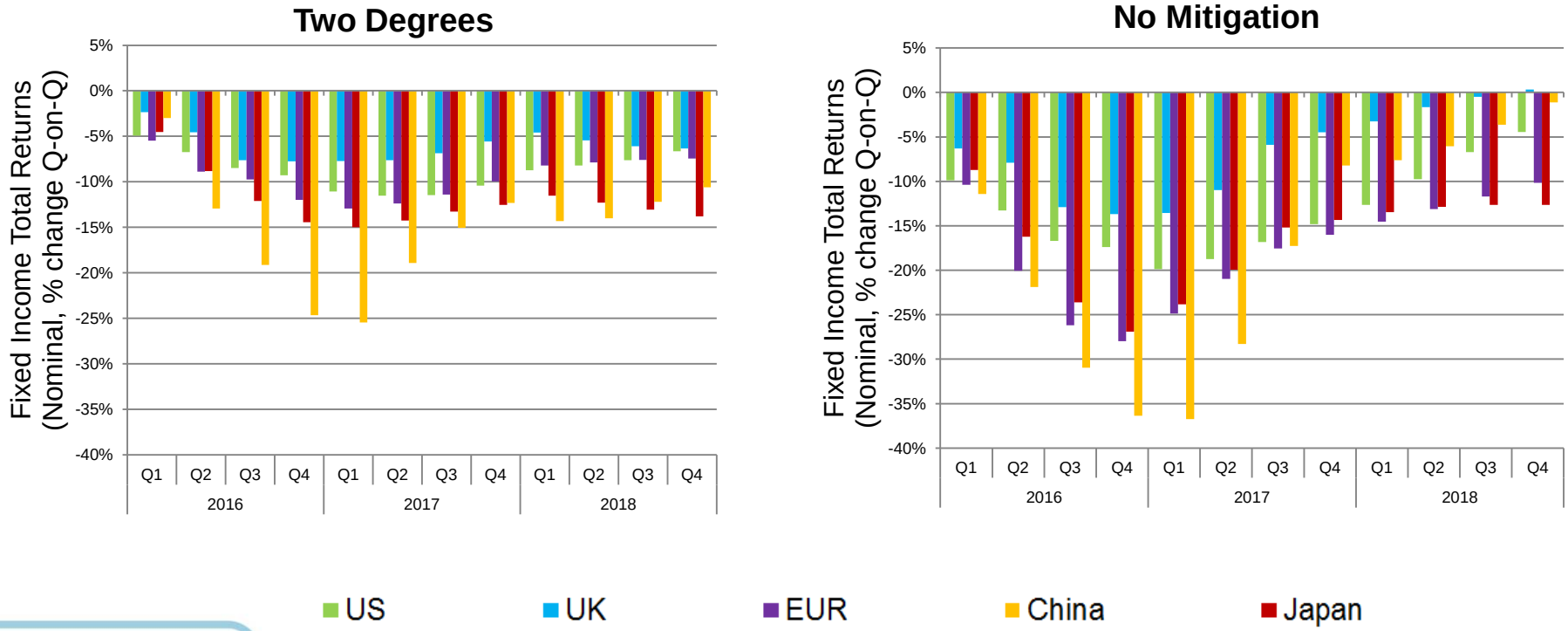
Impact by sector

Impact by sector, No Mitigation: emerging vs. developed markets





Impact on fixed income



“Unhedgeable Risk”

Summary of portfolio performance (short-term impact)

Portfolio Structure	Baseline	Two Degrees	No Mitigation
High Fixed Income	+0%	-10%	-23%
Conservative	+1%	-11%	-36%
Balanced	+1%	-11%	-40%
Aggressive	+1%	-11%	-45%

Summary of portfolio performance (long-term impact after 5 years)

Portfolio Structure	Baseline	Two Degrees	No Mitigation
High Fixed Income	+4%	-3%	-4%
Conservative	+12%	+9%	-26%
Balanced	+16%	+17%	-30%
Aggressive	+21%	+25%	-45%

Conclusions

- 49% of climate related sentiment risk is unsystematic and can be hedged through portfolio construction
- Even in the short run climate change is an aggregate risk driver that requires system-wide action to mitigate impacts
- Benefits of a sustainable economy lie in the reduction of risk in the short run and in superior returns in the long run

Recommendations for investors

- New tools for portfolio management – dynamic perspective
- Value of scenario stress tests for sustainability-related risks on investments
- Though climate policy is for governments to decide, investors have an interest in maintaining financial stability:
  - Collaboration toward “orderly transition” of financial markets
  - Role in transition to low-carbon economy reduction (2^{o}C portfolio)

Comparison with mercer study

Mercer study	ILG research
Similarities: ▪ Similar objective: elucidate the impact of climate change on returns across asset classes and industries, using a scenario-based approach ▪ Scenarios cover the next 35 years, and are built on similar components (emissions pathway and economic damages)	
Differences: ▪ Sensitivity of industries to climate change risk uses same approach as for assets ▪ Models are based largely on expert elicitation of physical impacts ▪ Models the average annual return impact over the years 2015-2050	▪ Stricter separation of physical impacts and macroeconomic developments ▪ Scenarios as input parameters ▪ Models the short-run impact through shifts in investor sentiment