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June Topical Issues

23 June 2021

Carbon Divestment & Investment

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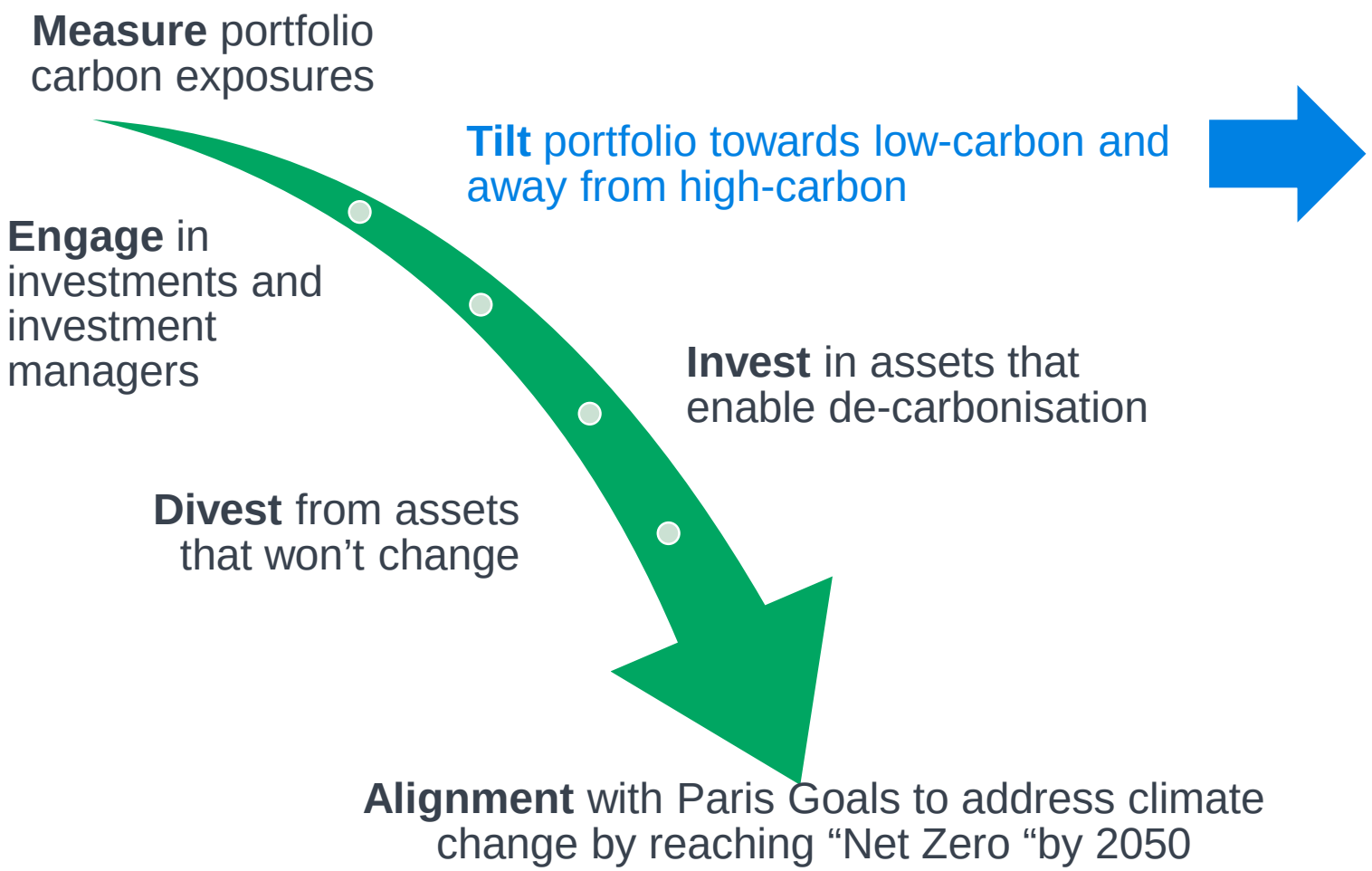
Agenda

1. Low Carbon Indices

2. Carbon Emissions Market

Low Carbon Indices – What are they?

"The Journey Towards Net Zero"



Passive Investing Tool

- Specialist benchmark index
- Construction based upon measures of carbon exposure – e.g. recent emissions; fossil fuel reserves etc.
- **By exclusion** → can exclude index constituents that are too carbon intensive
- **By weighting** → can overweight constituents with low carbon exposure; underweight constituents with high carbon exposure – i.e. apply a **"Tilt"**

Low Carbon Indices – An Example

UK equity benchmark:
FTSE 100

101 Large Cap Stocks

UK equity low-carbon index**:**
FTSE ESG Low Carbon Select

18 Stocks → Weighting Increased

41 Stocks → Weighting Decreased

42 Stocks Excluded

4 Smaller Cap Stocks

(Comparing exchange-traded fund holding data from 19 April 2021)

Scope 1&2 Carbon Emissions per £1 million invested

FTSE 100 = 181.1 CO2e tonnes

Exclusions = -85.8
Inclusions = +0.0
Re-weightings = -32.5

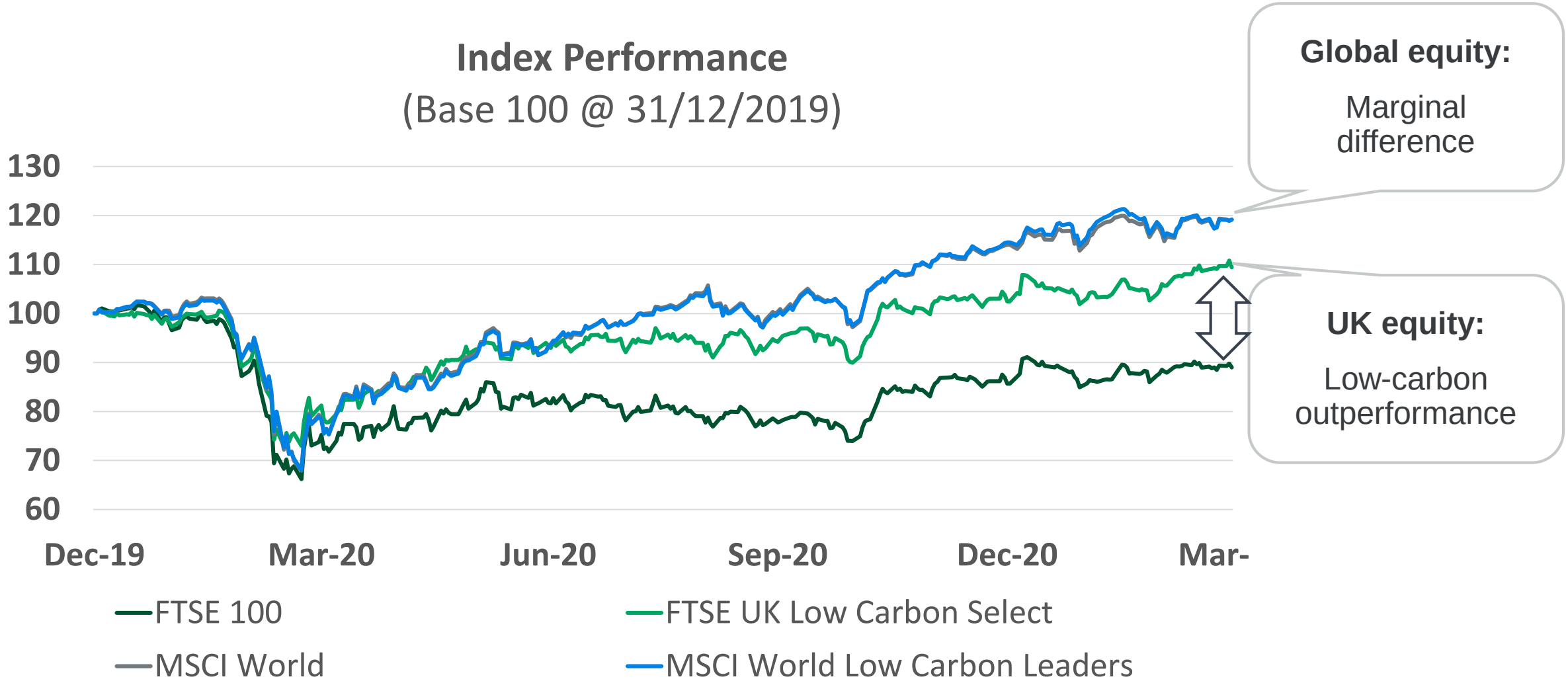
FTSE ESG Low Carbon = 62.7 CO2e tonnes

(analysis using carbon data from Arabesque)

(Index rules are not just focused on carbon emissions, but also other ESG factors)

Milliman **Data sources:** Bloomberg; Arabesque; Milliman analysis

Low Carbon Indices – Recent Performance



Data source: Bloomberg

Low Carbon Indices – Risk Management Compatibility

Correlation of Daily Returns (31/12/2017 – 31/12/2020)

	FTSE 100	MSCI World
FTSE UK Low Carbon Select	94.9%	
MSCI World Low Carbon Leaders		99.6%
UK Gilts	*-18.5%*	*-20.8%*
US Treasuries	*-34.5%*	*-39.9%*

(LONG) Underlying Fund

Low carbon exposure

(SHORT) Derivatives Hedge

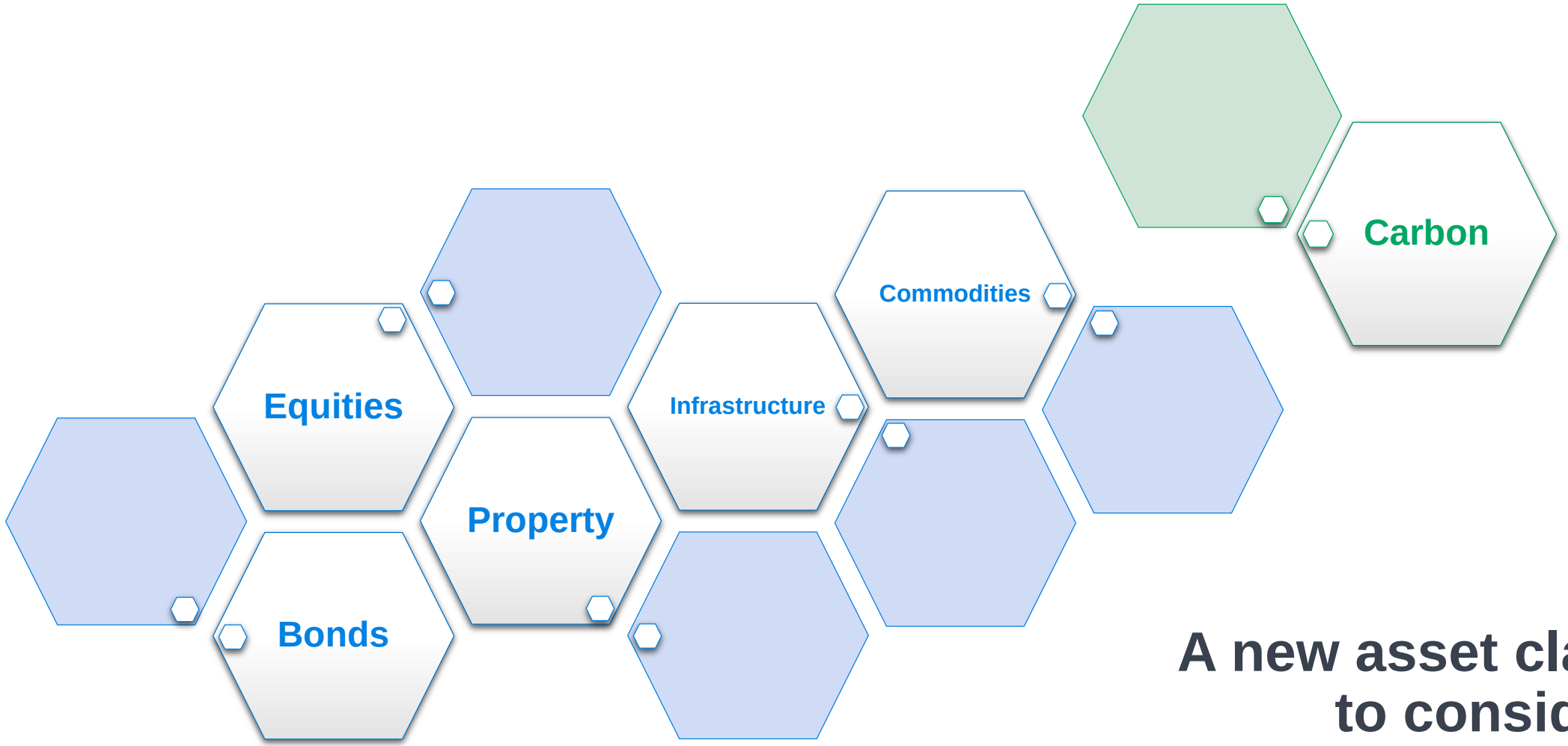
Liquid indices on traditional benchmarks with higher average carbon exposure

NET Position

Lower average carbon exposure

Milliman **Data sources:** Bloomberg; Milliman analysis

Carbon Emissions Contracts



A new asset class to consider?

Carbon Emissions Market Overview

"Reaching a fair carbon price"

Regulator sets cap on total annual CO2e emissions for in-scope businesses

In-scope businesses are **required to report** annual CO2e emissions

Each business has a fixed emissions allowance. They must **compare actual emissions to allowance**.

For excess actual emissions, either **purchase unused allowances on the Carbon Emissions Market**, or face a hefty fine

Over time businesses are incentivized to cut emissions, as regulatory cap is reduced each year and supply of allowances reduces too

Physical Emissions Allowances (2020 year-end price)

€44 bn. size	**~45%** of total emissions	**1.35 bn.** CO2e tonnes

Futures Market

Total size (2020 year-end price):

- **€28 bn.** size
- **0.86 bn.** CO2e tonnes

Daily volume (last 2020 full trading day):

- **€392 mn.** size
- **12.2 mn.** CO2e tonnes

*Assuming **6.7 CO2e** tonnes per person → a city roughly the size of Naples or Birmingham*

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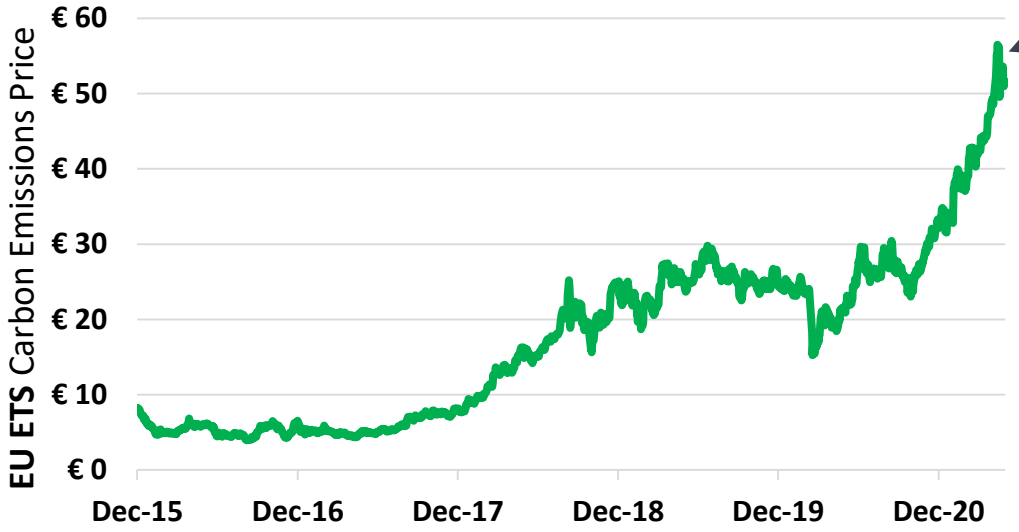
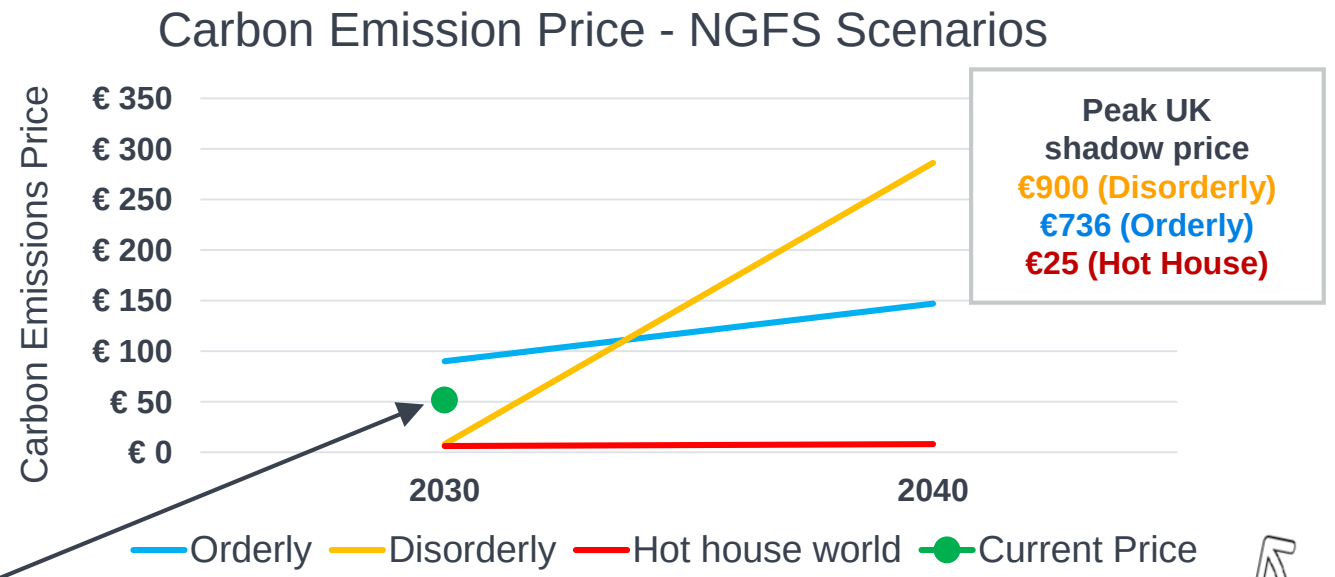
Data sources: Bloomberg; Milliman analysis; *1 Greenhouse gas emission statistics - carbon footprints: Statistical Office of the European Union*

Carbon Price – Historic vs Scenario

- Carbon emission prices have been increasing steadily since the 2015 Paris Climate Agreement.
- The dip in early 2020 can be explained by the COVID-19 induced economic downturn.
- Carbon prices then soar post-pandemic, reflecting market seeing momentum from the EU on climate change (e.g. the “green recovery package“)





- **Orderly –** Reducing emissions in a measured way
- **Disorderly –** Sudden and unanticipated response
- **Hot house world –** Increase in emissions while doing little to meet climate goals

Data sources:
Carbon price scenario lines from:
Network for Greening the Financial System (2020)
Peak UK shadow prices from:
BoE BES2021 Climate Change Scenarios – Key Elements

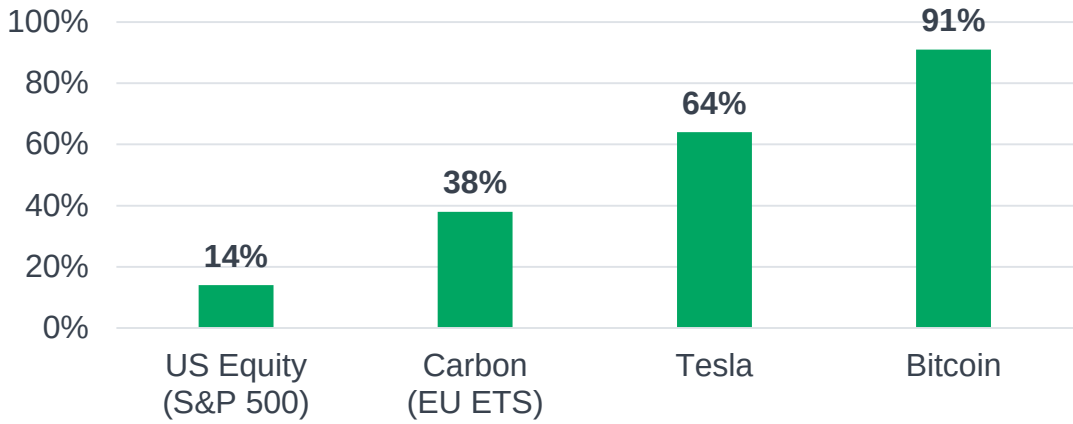
Milliman **Data sources:** Bloomberg; NGFS; Milliman analysis

Carbon Price – Risk and Return Characteristics

IMPLIED RETURN (ANNUALISED):
End-May 2021 EU ETS → NGFS scenario price

Return p.a.	2030	2040	2050 (Peak)
Orderly Transition	**6.7%**	**5.8%**	**9.7%**
Disorderly Transition	**-19.3%**	**9.6%**	**10.1%**

RISK: Realised Volatility in 2021



CORRELATION of WEEKLY RETURNS
(31/12/2017 - 31/12/2020)

	Global equity	UK equity	UK gilts	UK corps.	Gold	Carbon
Global equity (MSCI World)	*100%*					
UK equity (FTSE 100)	82%	*100%*				
UK government bonds (Barclays)	-10%	-6%	*100%*			
UK corporate bonds (Barclays)	47%	41%	65%	*100%*		
Gold	35%	26%	35%	43%	*100%*	
Carbon (EU ETS)	**37%**	**30%**	**-22%**	**18%**	**7%**	*100%*

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Data sources: Bloomberg; NGFS; Milliman analysis (realised volatility analysis is 1 Jan to 31 May 2021)

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Any Questions?

Modelling of Equity Release Mortgages

Michael Leitschkis
Amritpal Khangura

23 JUNE 2021

What we'll cover today

1. Refresher of key risks in play with ERM
2. Our recent success story and the important decisions we made
3. Broad themes emerging from ERM modelling work
4. ERM implications on analysis and reporting needs

Key ERM risks in play

Cash flow models

Voluntary Early Repayment

Voluntary Early Repayment rates significantly impact the ERM cash flow pattern, the valuation of NNEG etc.

Interest Rates

Impact upon ERM through various channels including discounting and deferment rate calculations.

Morbidity Risks

Morbidity risk also affects the ERM loan settlement timing.

Residential Property Volatility

Value of NNEG heavily dependent on future dynamics of residential property price.

Longevity Risks

Longevity risks are in play impacting the point at which the ERM loan is settled.

Our recent ERM modelling success story

and the key modelling decisions we made

QUESTIONS	RESPONSES
1 ERM required both asset and liability type logic. **Where should it be modelled?**	We implemented ERM in our **core single cash flow projection system**, within the asset module. Allowing ERM assets to be valued as **part of the existing end-to-end reporting process**.
2 **Where should we implement SPV calculations** and how do we connect loan level and SPV level?	We added SPV waterfall calculations in **the corporate module of our cash flow projection system**. Loan & SPV levels “glued” via dedicated structures.
3 SPV optimization is underpinned by a number of rating stresses. **How do to perform them in one job-step in parallel?**	**Parallel calculations of a double-digit number of rating stresses in the same projection** using advanced modelling capabilities.
4 Internal rating and reverse stress testing require thousands of scenarios. **How should these processes be designed?**	All **stress scenarios to be expressed consistently to the Internal Model** stress taxonomy. A Proxy Model curve evaluation can also help here.

Key conceptual challenges

NNEG Valuation

Several approaches possible:

- Closed form solution versus simulation approach?
- Real-world or risk-neutral paradigm or both?

Loan Securitisation

Maximise the Matching Adjustment benefit subject to side constraints.

- Which is the best optimisation strategy?
- Which side constraints to consider explicitly?

MA Under Stress

How should the model calculate impact on MA under stress?

How should the model perform EVT under stress?

Internal Ratings

Base: Best-estimate real-world assumptions

Stresses: Bespoke, not necessarily defined in line with “IM speak”.

Climate Change Risk

Climate change will come through several risks over our 60-year projection horizon.

Example: Flood risk impacts residential property projections.

Analysis and reporting needs

Portfolio Management

Analysis of how loans securitized into notes, under which scenarios can loans not match notes,

Actuarial Modelling System

Solvency II Reporting

Support creation of loss-functions, perform analysis of change, AvsE analysis, inter-quarter daily monitoring, TMTP calcs, MA, LP…

Capital Management

Ability to generate capital requirements associated with just ERM in isolation to other business.

Financial Accounting

Need for cashflow data at an individual loan, securitsed tranches and SPV level. IFRS reporting needs also coming to the fore.

ALM

Need to provide cash flow data at different securitization levels. credit rating information may also be requirement for downstream ALM purposes.

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Any Questions?

SFCRs: the 2020 results

UK and European Life Insurers

Neil Christy & William Smith

JUNE 2021

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Data Overview and Analysis

Source

- Data from Solvency II Wire Data
- http://www.solvencyiiwire.com
- Contains SFCR and QRT information in public disclosures

Database Coverage

- Group (over 250) and Solo (over 2000) QRTs/SFCRs
- Covering Life/Non-life/Health companies
- Companies from over 30 countries

Our Focus

- Focus on Life companies only
- Focus on nine large markets as measured by total TPs, grouping the remaining countries
- Around 650 companies included

Challenges

- Definition of a Life company
- Errors/missing data in QRTs
- Checking data for consistency

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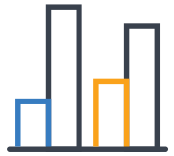
Milliman's previous SFCR reports can be found here

Standardised Sensitivities in the SFCRs

EIOPA has recommended including a set of standardised sensitivities in the SFCR

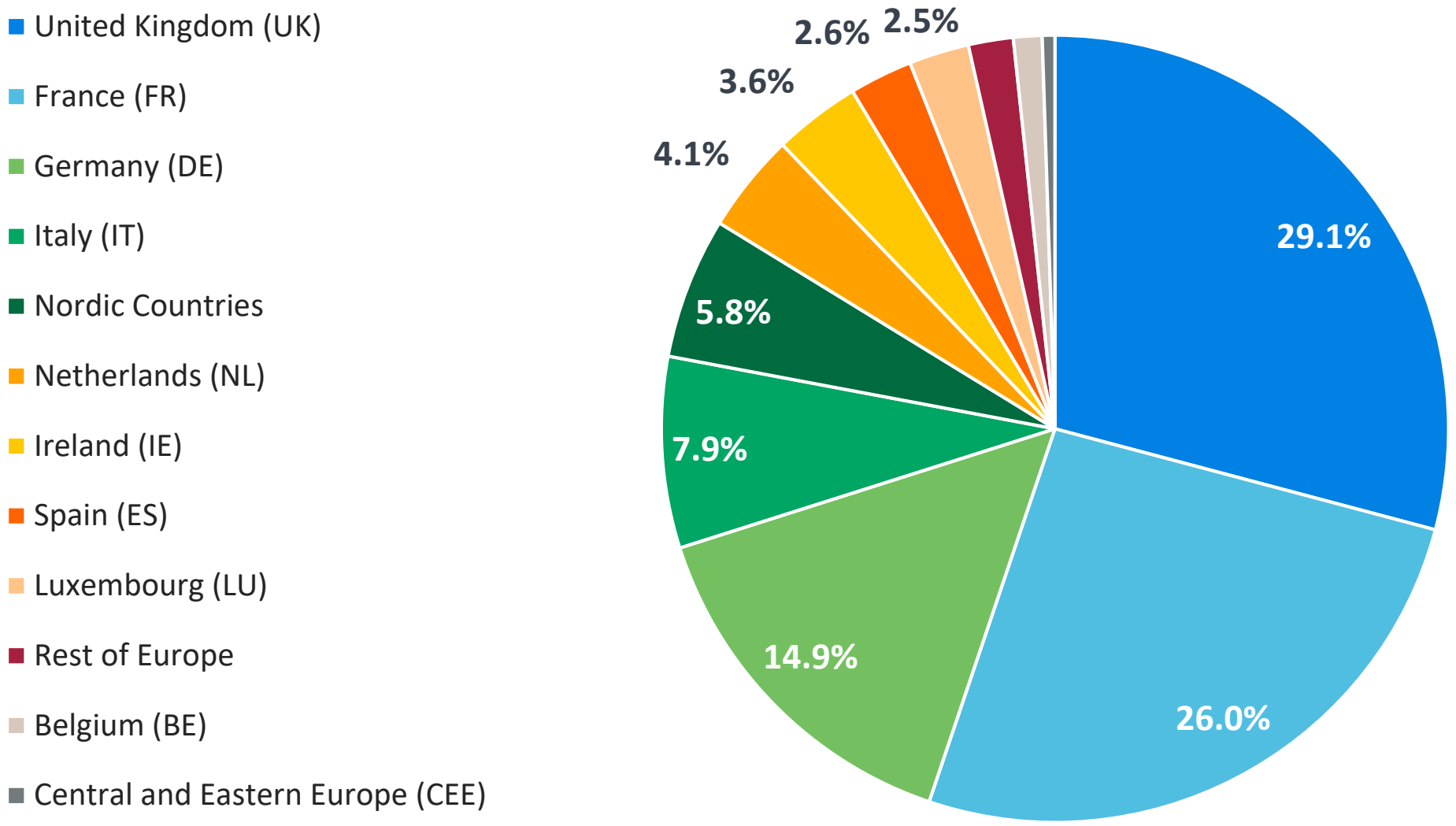


EIOPA recommendation

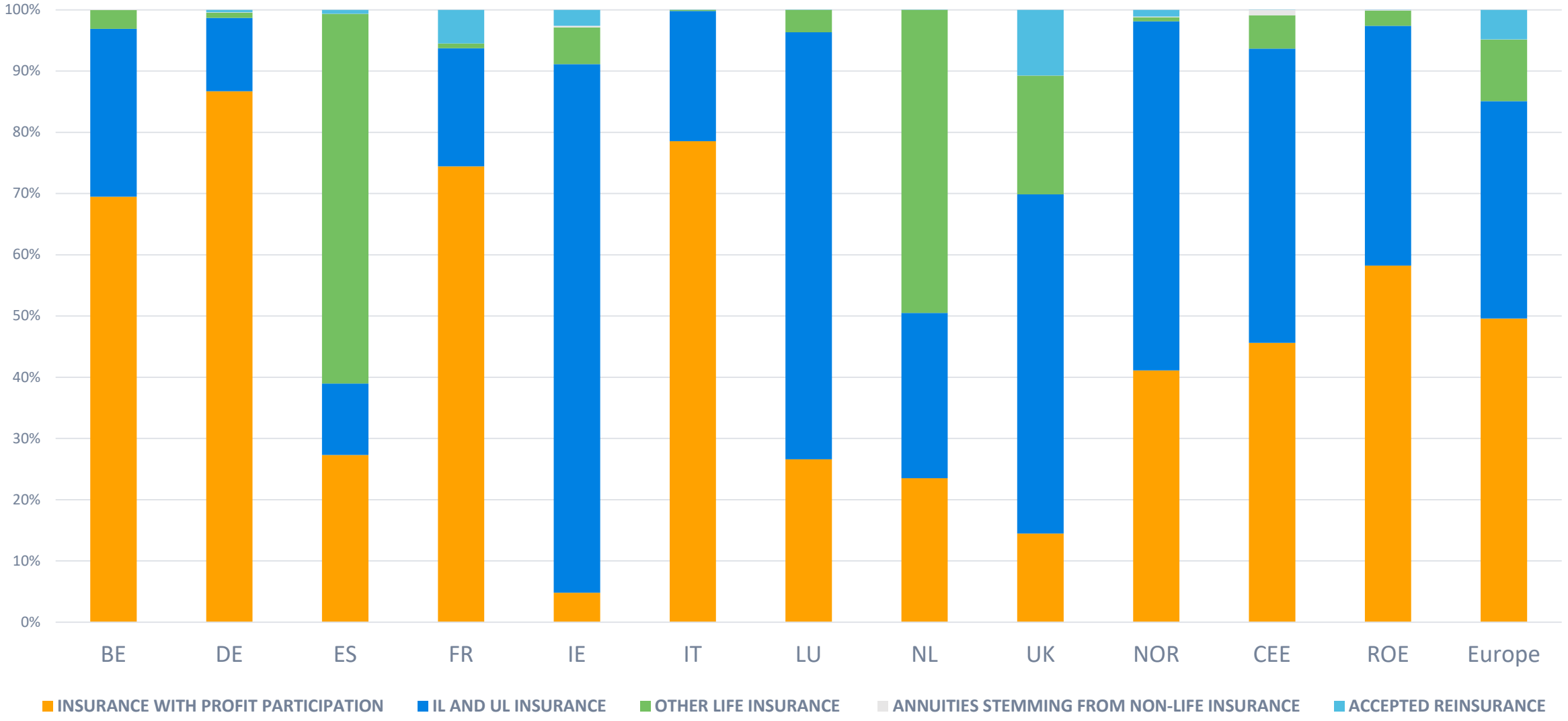
- Equity markets (+/- 25%)
- Risk free interest rates (+/- 50bps)
- Credit spreads on fixed income investments (+/-50bps)
- Property values (+/- 25%)

- Currently no requirements to include standardised sensitivities in the SFCR
- This would complement the current disclosures in the SFCR and allow further analysis
- Impact on amount of SCR, Own Funds and solvency coverage ratio would need to be included
- Firms can publish additional list of sensitivities that better reflect risk profile

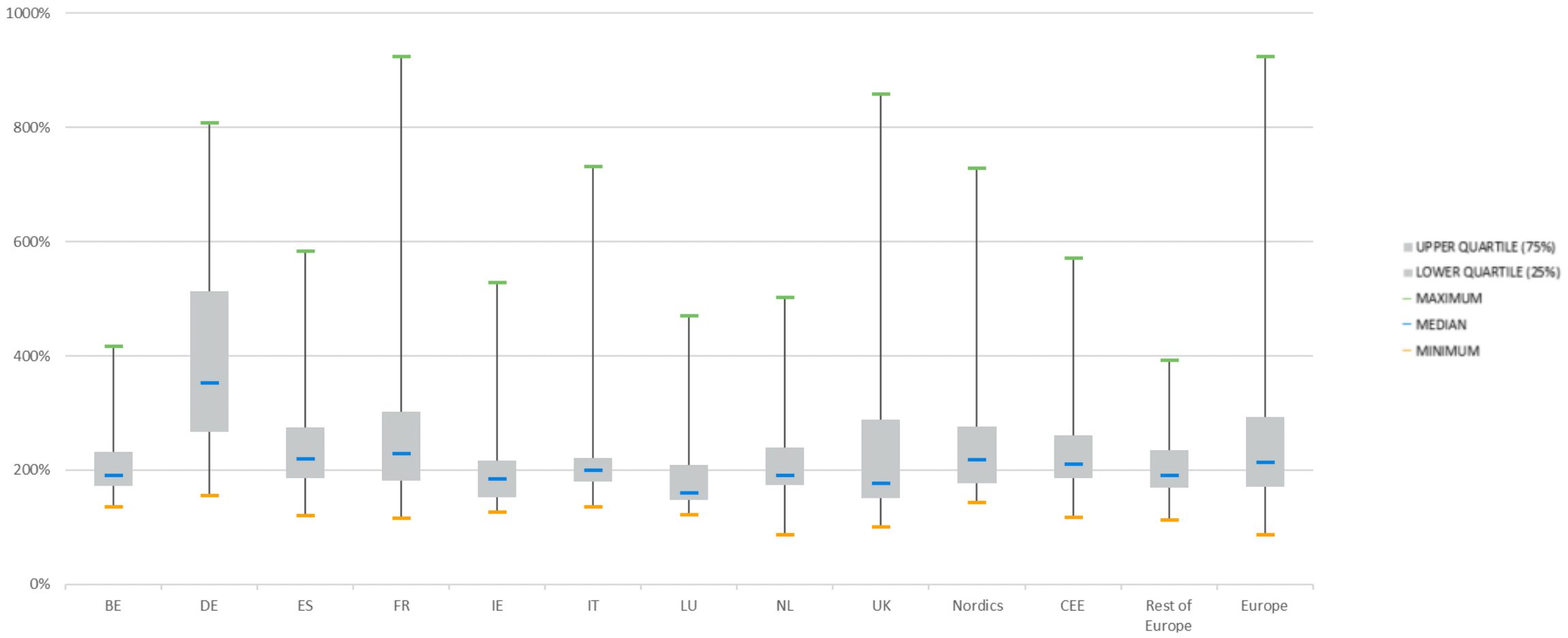
Split of Technical Provisions by Country



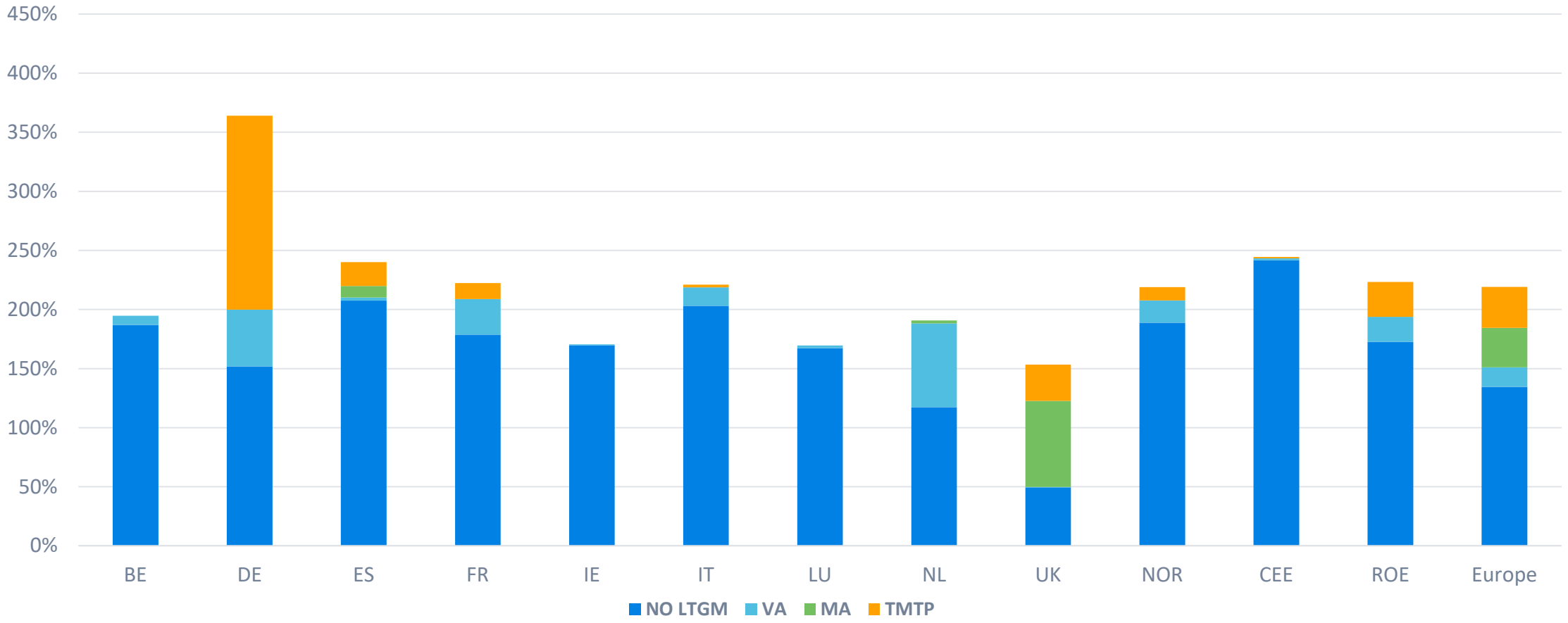
Technical Provisions by Line of Business



Solvency Coverage Ratio Distribution

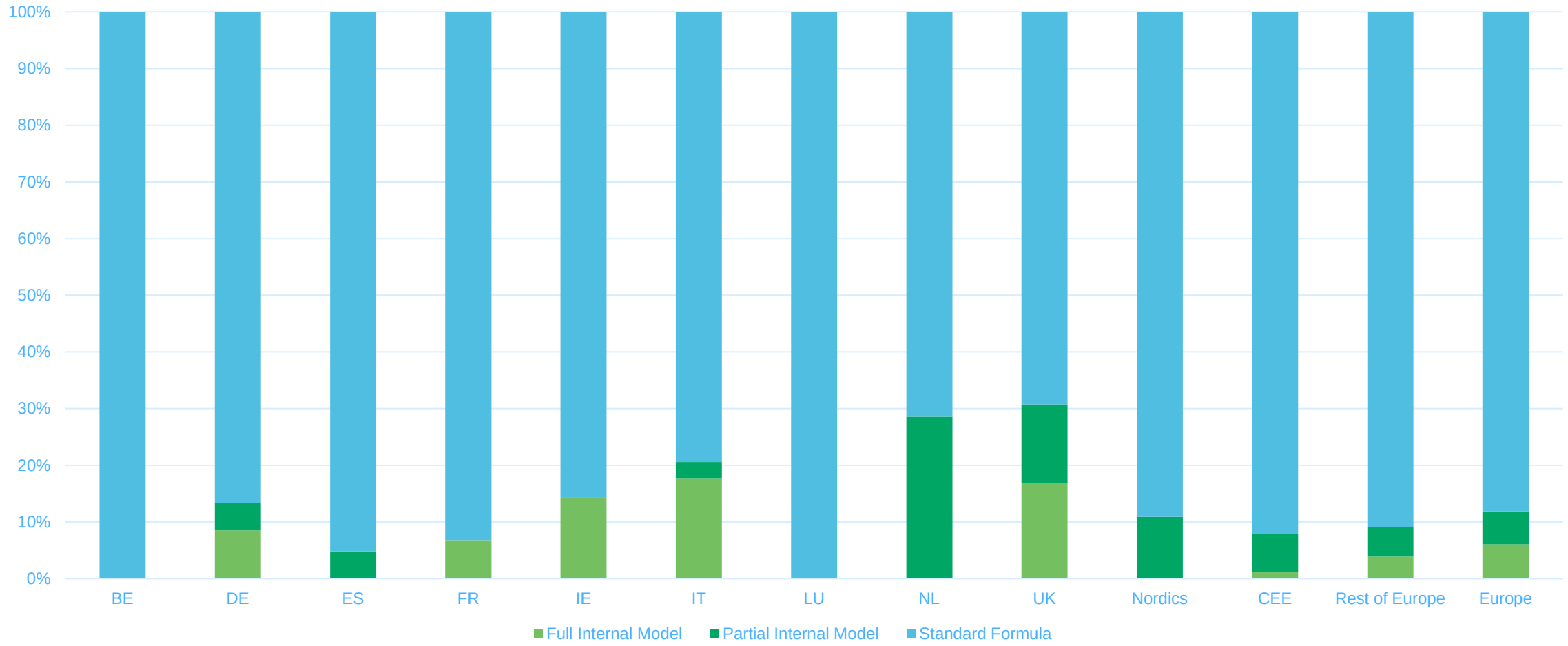


Solvency Coverage Ratio by LTGM



- The height of each bar are the Solvency Coverage Ratio of the consolidated market so is weighted towards the larger firms

Split of Calculation Method by Market



- In Belgium we are still missing some firms from our dataset. In previous years we have seen both FIM and PIM
- We have seen 9 firms move from PIM to FIM in AT, FR, DE and IT
- There has been 1 instance of PIM to SF and 1 of FIM to SF

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Any Questions?

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Operational Resilience

9 months to go…

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Regulatory Development

July 2018 → December 2019 → March 2021 → March 2022

- ✓ Identify IBS
- ✓ Set IT
- ✓ Identify vulnerabilities
- ~ Map resources
- ~ Scenario testing

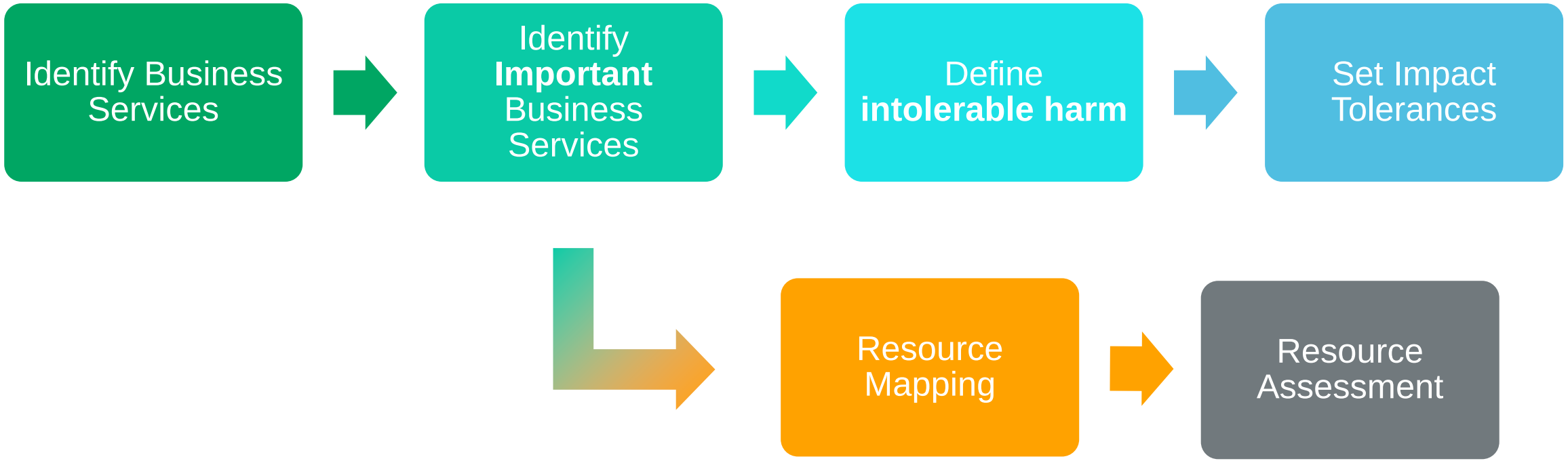
Links with:

- PRA Third-Party Risk Management PS - March 2021
- BCBS Principles for Operational Resilience - March 2021
- PRA Operational Continuity in Resolution PS - May 2021

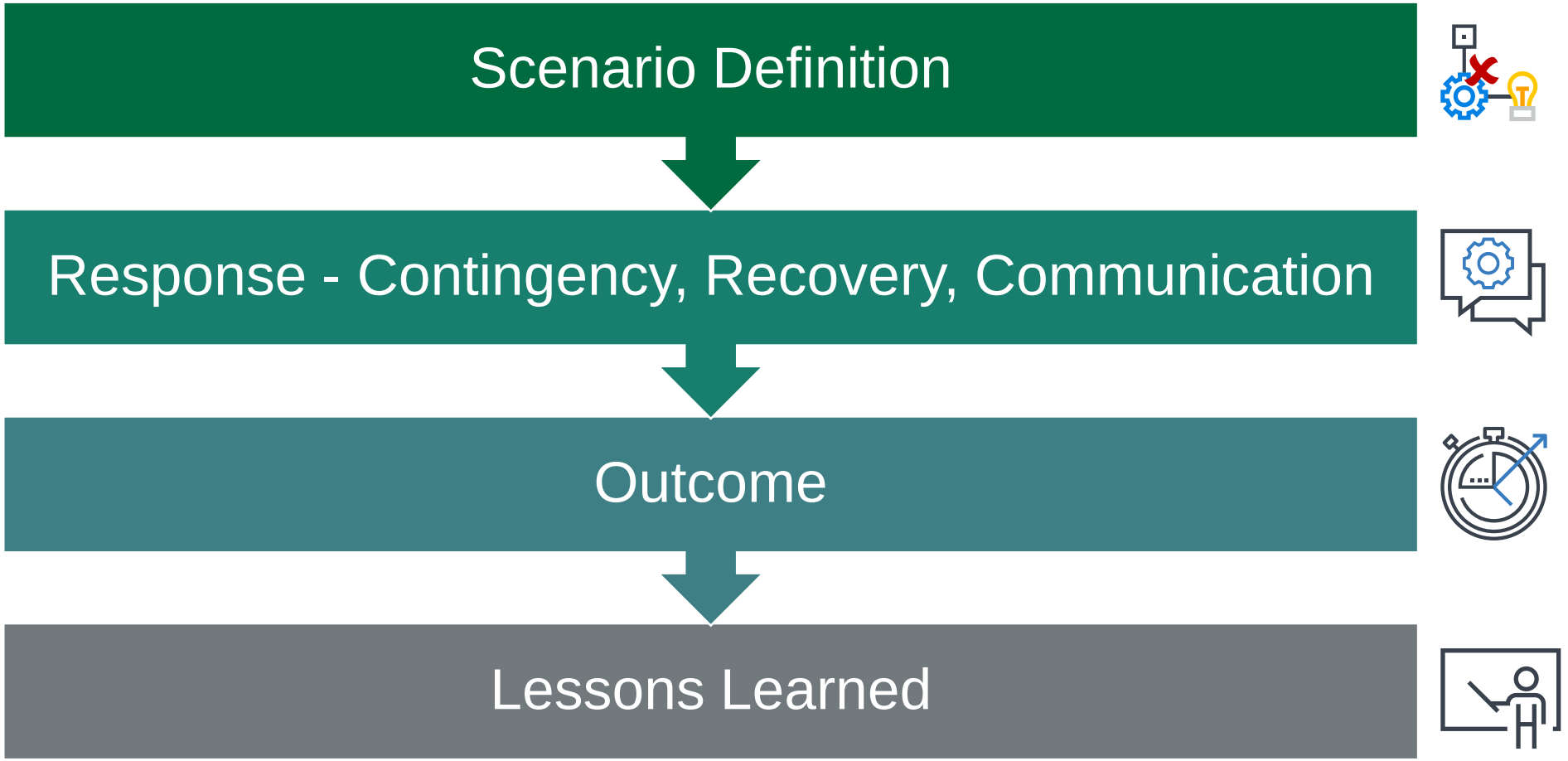
Policy vs. Consultations

- Key clarifications:
  - outcome-based regime ⇨ no templates or prescriptive guidance
  - scope of Important Businesses Services ⇨
    - third-party provided services in ✓
    - internal services out ✘
  - approach for dual-regulated firms ⇨ consider PRA and FCA objectives
  - calibration of Impact Tolerances ⇨ can be specified in terms of time and non-time based metrics
  - coverage of 4th-parties ⇨ identify and monitor, but out-of-scope of mapping and testing

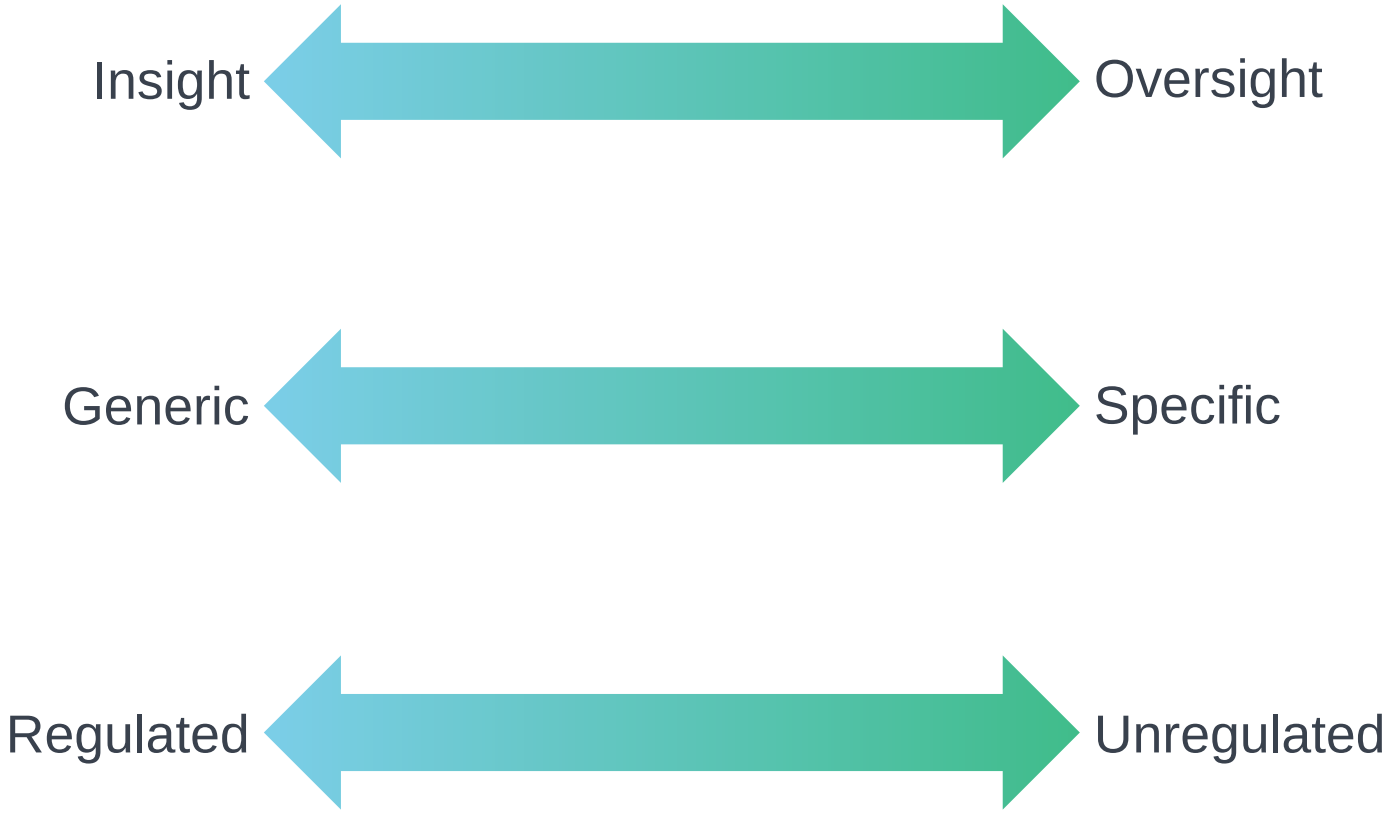
Important Business Services and Impact Tolerances



Scenario Testing



Third-Party Engagement



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Thank you

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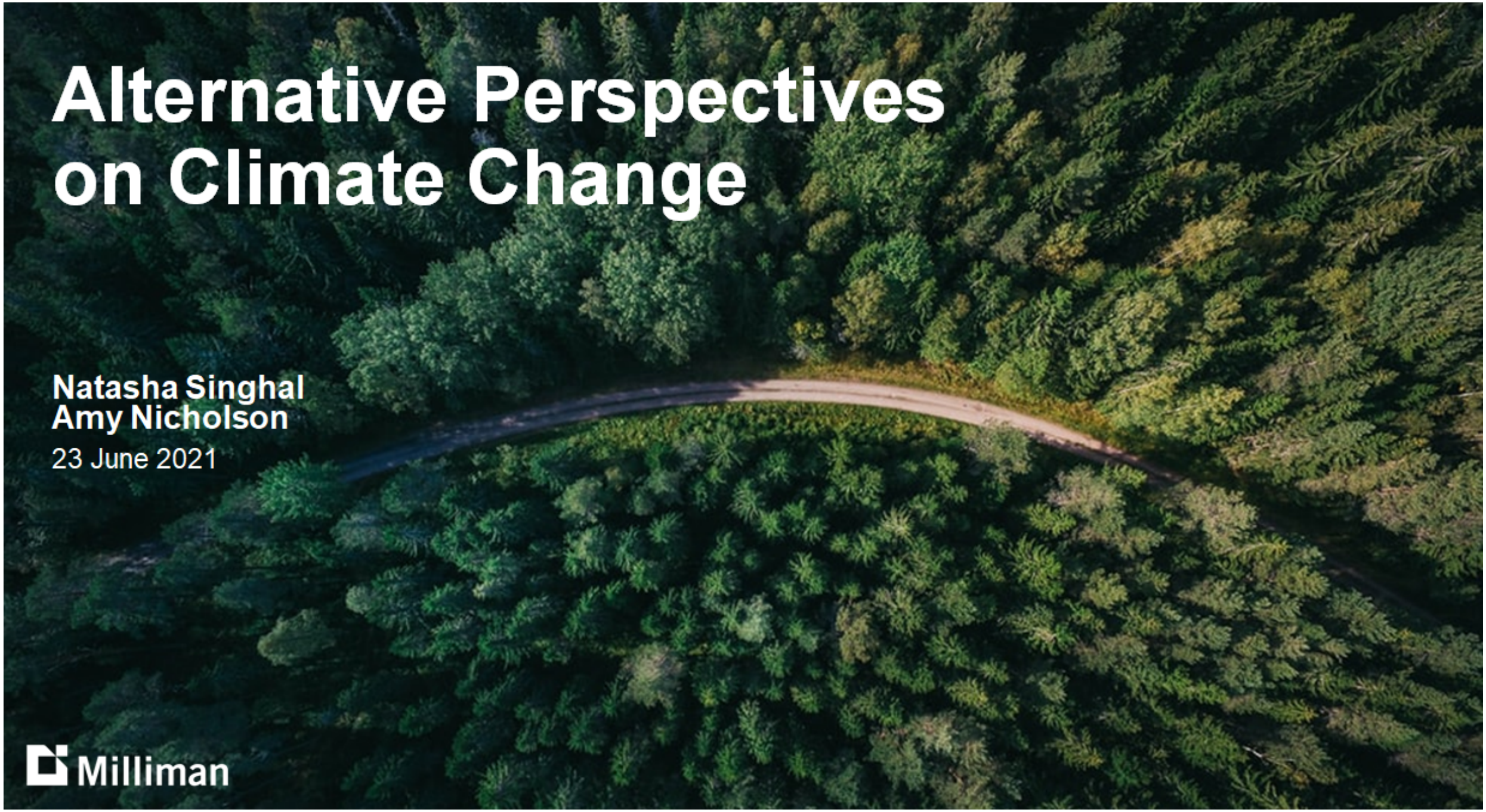

Alternative Perspectives on Climate Change

Natasha Singhal
Amy Nicholson

23 June 2021

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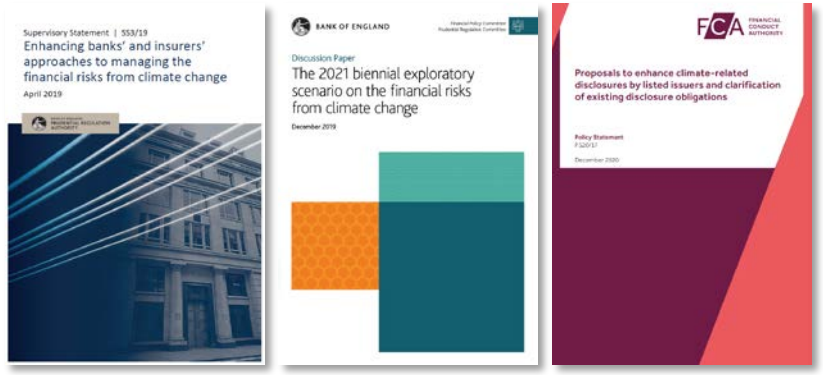
Agenda

1	Introduction
2	Liability risk: mortality and morbidity
3	Innovation

Introduction

Climate change: long-term liability risk and innovation

- Climate change has become a key area of regulatory focus



- Key focus for long-term insurers is the risk posed by climate change to asset values
  - Transition risk – corporate bonds, equities, gilts
  - Physical risk – property, ERMs

Liability risk
The risk posed by climate change to the liability side of the balance sheet should not be ignored:

- SS 3/19 requires firms to understand the financial impact of climate change on an insurer's ***entire business model*** using scenario analysis
- 2021 CBES requires firms to quantify the impact of scenarios on invested assets and ***insurance liabilities***, including BEL, RM and TMTP

Innovation

- TCFD requirements
  - Mandatory for insurers by 2022/2023
  - Covers disclosure of both climate-related risks and ***opportunities***
- CFRF Guide
  - Chapter dedicated to innovation

Liability risk: mortality and morbidity

Key liability risks: mortality and morbidity

- The relationship between climate – driven events and various health conditions is key to map the impact of climate change liabilities.
- How physical climate events impact mortality and morbidity rates depend on:
  - what the climate event is
  - where it happens
  - how prepared the country/countries are for the event
- Increased frequency of climate events may increase the frequency of sickness, accidents and the expected rate of acute illnesses.
- The impact of such events may be estimated based on your distribution of risk by factors.

Examples of health conditions that are exacerbated by certain climate events, which could impact an insurers liability experience

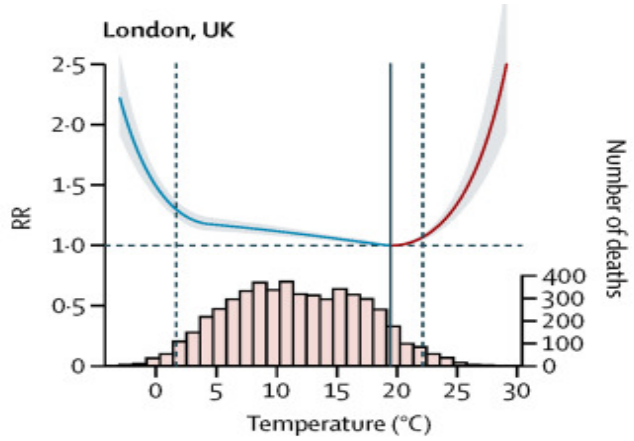
Health Condition	Climate – related risk driver
Heart disease	Exacerbated significantly by warmer or colder weather. Research indicates dramatic changes may increase heart attack rates.
Respiratory conditions	High temperature can raise the levels of ozone and other pollutants leading to an increase in respiratory conditions.
Cancer conditions	Exposure to increased heat, or reduced air quality, may increase the rate of some cancers.
Infectious diseases	Higher levels of waterborne disease spread through flood risk; malaria zones spreading to places which have become hotter.
Diagnostic services	Frequency of chronic conditions (asthma) due to air quality.
Mental Health	Impact of natural disasters on a policyholders environment may cause additional stress.

Climate-related impact: Mortality

Mortality rates are higher at more extreme temperatures

Study: Effect of temperature on mortality rates in London.

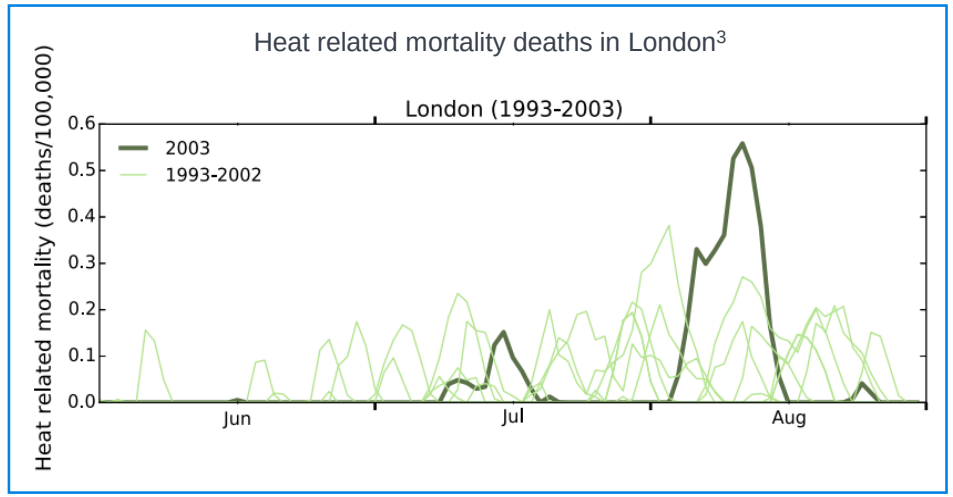
Overall cumulative exposure-response associations for London, UK[1]



- Mortality risk increase rapidly when temperatures are above or below certain temperature points, with minimal change in mortality rates within that range.

Past event: 2003 heatwave, where temperatures were 8% above expected average values, has been expected to have led to approx. 2100 excess deaths in England[2].

Heat related mortality deaths in London[3]



- Key takeaway: Temperature changes unlikely to increase mortality rates materially over the short term, however acute climate events such as heatwaves may increase insurers exposure to excess deaths in the short term.

[1]*Source : Mortality risk attributable to high and low ambient temperature : A multicounty observational study*

[2]*Arbuthnott & Hajat, 2017*

[3]*Mitchell, D. et al. (2016) Attributing human mortality during extreme heatwaves to anthropogenic climate change*

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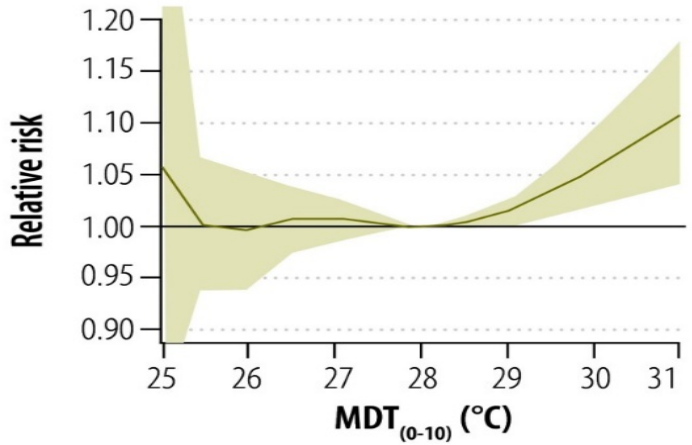
Climate-related impact: Morbidity

Expected impact on morbidity risk will vary by health condition

- Two ways in which climate events will impact morbidity liabilities:
  - Increased severity of claims through worsening health conditions due to climate.
  - Increased frequency of claims through higher numbers of policyholders impacted due to climate.
- Climate events have greater impacts on chronic conditions, generally exacerbating them and causing acute flare-ups.

Study: Patterns in temperature related hospital admission rates for respiratory, infectious and cardiovascular diseases

Relative risk of hospitalisation as a function of mean daily temperature lagged by 0 to 10 days ($MDT_{(0–10)}$) within Hong Kong[1]



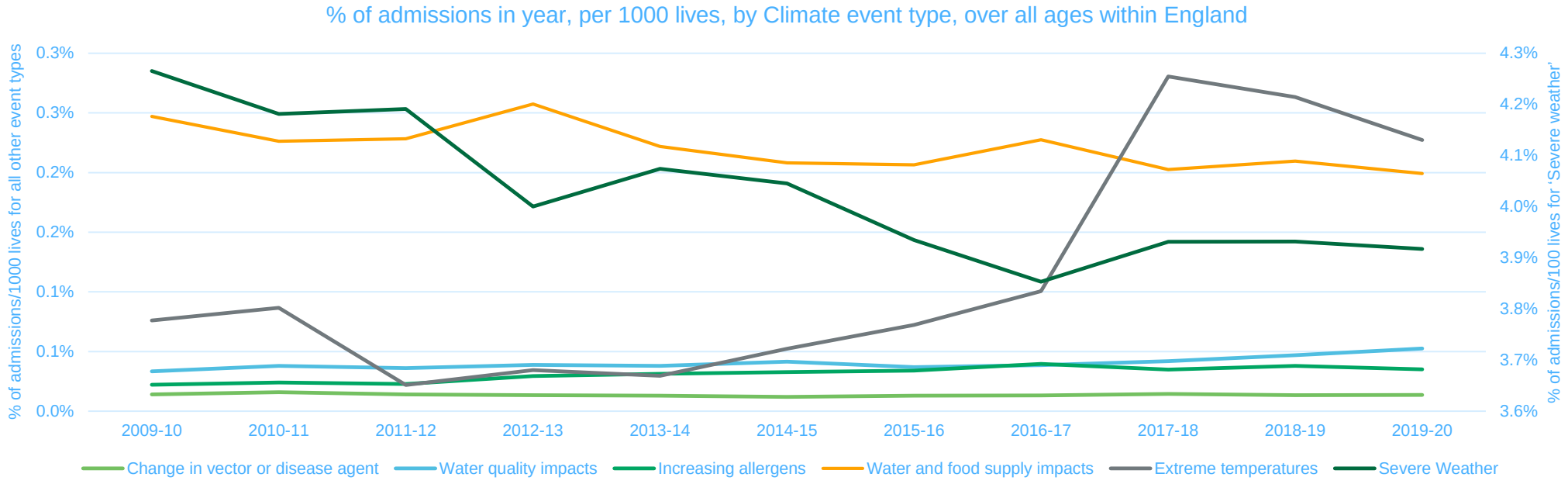
- During a hot season, hospital admissions increased by 4.5% for every 1°C increase above 29°C
- During a cold season, hospital admissions increased by 1.4% for every decrease of 1°C within the range of 28.2 to 26.9°C

[1]*Source : Hospital admissions as a function of temperature, other weather phenomena and pollution levels in an urban setting in China.*

Morbidity research analysis

Using ‘Climate’ flags we have analysed trends in hospital admissions in England that may be climate related

- Milliman have created a ‘climate change’ flag to apply to ICD 10[1] diagnostic codes. This mapping provides a grouping based on the type of climate change event, and includes the following categories:
  - Change in vector or disease agent
  - Increasing allergens
  - Water quality impacts
  - Water and food supply impacts
  - Extreme temperatures
  - Severe Weather
- We have used this mapping to look at the trend in hospital admissions over the last 10 years within England, by type of climate change event:



[1]*ICD codes: international Statistical Classification of Diseases and Related Health Problems (ICD) codes are used globally to record medical services provided for the purposes of payment, health management and clinical analysis.*

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Measuring risk exposure in liabilities

To assess exposure to an increase in mortality and morbidity, ideal metrics are those that assess the current and future profile of a book of business

- Useful metrics can be based on information that is currently available.
- Below are examples of some metrics that can be used for life and health insurance:

Composition of book by age

Distributing the book in certain age bands will highlight the exposure to increased climate-related mortality and morbidity.

Composition of book by geography

Distributing the book by territory or state indicates the proportion of policyholders in areas more at risk to extreme weather events.

Composition of book by occupation

Certain industries would be affected more by climate change than others e.g. agriculture, tourism and sports.

Hazards may increase income replacement claims or lapses due to premiums becoming unaffordable.

Composition of book by product type

Annuities and pure endowment products could experience higher mortality rates due to climate change.

Identifying and monitoring high-risk individuals

Policyholders with health conditions, particularly comorbidities, will be at higher risks from extreme temperature fluctuations.

Potential approach to monitoring and testing liability risk

Temperature change is a key liability risk factor: below we outline one approach insurers may use to monitor and test the impact of this risk factor

Identify climate-related risk exposures

- Increase in mortality and morbidity from extreme temperatures and storm related accidents.

Metrics to measure risk

- Identified to assess the profile of the current and future book of business.
- Relevant metrics may be composition of book by age, extreme ages more at risk; geography i.e. vulnerable areas; occupation.

Risk scenarios

- For temperature change, the relevant risk scenario is where there is minimal transition and therefore high physical impacts are experienced.
- The metric of interest is the increase in mortality/morbidity rates under various temperature projections.

Testing and monitoring

- Stress and scenario testing can be performed to estimate the impact on metrics at future time points under different scenarios.
- Assessment of the metrics under different scenarios should be monitored over time to identify the manifestation of risk.

Innovation

Why consider innovation

As the financial industry adapts and integrates climate change into risk management processes, in order to consider climate change holistically, innovation will become a more relevant consideration for all insurers.

CFRF Guide innovation chapter: enabling a step-change in institutional capital to meet the Paris Agreement.

Climate change presents various innovation opportunities for insurers:

- Tailoring traditional life and pension products
- Opportunity to act as a key contributor to green investment
- Retail products also provide opportunity for innovation

CFRF CLIMATE FINANCIAL RISK FORUM

Current barriers to innovation

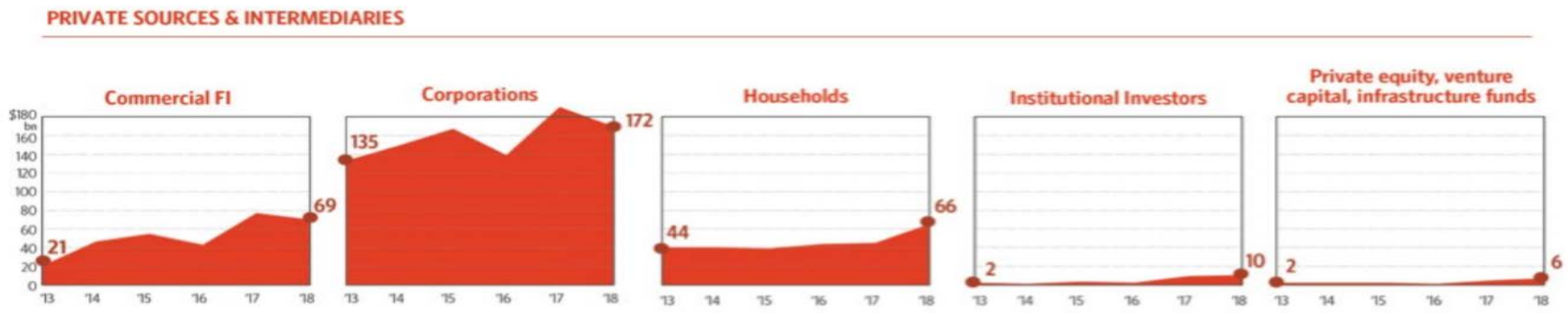
Capital flow allocation

- Significant investment is required to fund the transition to a low carbon economy
- In 2018:
  - Private finance accounted for ~$323 billion of climate finance, the bulk from corporations ($172 billion)
  - Sustainable investing was over $30 trillion, an increase of 34% from 2016
- However, there is around $1 trillion of investment per year less than needed in climate finance

Source: CFRF Guide

Data development

- There is a wide range of data currently available to help inform climate risk assessments and decisions, however there is still room for development in:
  - Transparency
  - Compatibility
  - Scope
  - Granularity



Source: Climate Policy Initiative

Product and investment innovation

Tailoring investment products

Tailoring traditional life and pension products towards ESG

- Unit-linked, with-profits, pensions

Green investments

Opportunity for insurers to act as a key contributor to green investment

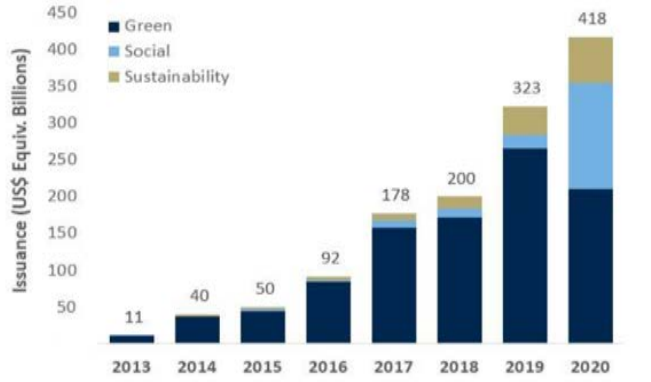
- Increased stewardship
- Growing green bond market

Product Design

Retail products

- More direct examples come from the non-life sector, e.g. car and home insurance products which incentivise green choices
- Green lifetime mortgages
- Opportunity for further innovation in this area

Growth in the green bond market



Source: RBC Capital Markets Sustainable Debt Newsletter, November 2020. 2020 data as of 12/03/2020.

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Any Questions?

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Thank you

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SFCRs: the 2020 results

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Operational Resilience

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Alternative Perspectives on Climate Change

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