GLOBAL INSURANCE MARKET REPORT

SEPT 21

GIMAR SPECIAL TOPIC EDITION

THE IMPACT OF CLIMATE CHANGE ON THE FINANCIAL STABILITY OF THE INSURANCE SECTOR






IAIS
INTERNATIONAL ASSOCIATION OF INSURANCE SUPERVISORS

ABOUT THE IAIS

The International Association of Insurance Supervisors (IAIS) is a voluntary membership organisation of insurance supervisors and regulators from more than 200 jurisdictions. The mission of the IAIS is to promote effective and globally consistent supervision of the insurance industry in order to develop and maintain fair, safe and stable insurance markets for the benefit and protection of policyholders and to contribute to global financial stability.

Established in 1994, the IAIS is the international standard setting body responsible for developing principles, standards and other supporting material for the supervision of the insurance sector and assisting in their implementation. The IAIS also provides a forum for Members to share their experiences and understanding of insurance supervision and insurance markets.

The IAIS coordinates its work with other international financial policymakers and associations of supervisors or regulators, and assists in shaping financial systems globally. In particular, the IAIS is a member of the Financial Stability Board (FSB), member of the Standards Advisory Council of the International Accounting Standards Board (IASB), and partner in the Access to Insurance Initiative (A2ii). In recognition of its collective expertise, the IAIS is also routinely called upon by the G20 leaders and other international standard setting bodies for input on insurance issues as well as on issues related to the regulation and supervision of the global financial sector.

ABOUT THIS REPORT

This is the 2021 special topic edition of the Global Insurance Market Report (GIMAR). The regular GIMAR presents the outcomes of the IAIS' Global Monitoring Exercise (GME), which is the IAIS' framework for monitoring risks and trends in the global insurance sector and assessing the possible build-up of systemic risk. The special topic edition of the GIMAR delves deeper into relevant topics stemming from each year's GME.

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ACRONYMS AND ABBREVIATIONS

BIS	Bank of International Settlements
COP26	26th United Nations Climate Change Conference of the Parties
CDS	Credit default swap
CPRS	Climate policy relevant sectors
EIOPA	European Insurance and Occupational Pensions Authority
ESG	Environmental, social and governance
FSB	Financial Stability Board
GA	General account
GHG	Greenhouse gas
GIMAR	Global Insurance Market Report
GME	Global Monitoring Exercise
IAIS	International Association of Insurance Supervisors
IPCC	Intergovernmental Panel on Climate Change
NACE	Statistical classification of economic activities in the European Community
ND-GAIN	Notre Dame Global Adaptation Initiative
NGFS	Network of Central Banks and Supervisors for Greening the Financial System
SIF	Sustainable Insurance Forum
TCDC	Targeted climate data collection
TCFD	Task Force on Climate-related Financial Disclosures
WRI	World Risk Index

EXECUTIVE SUMMARY

This International Association of Insurance Supervisors (IAIS) Global Insurance Market Report (GIMAR) special topic edition provides the first quantitative global study on the impact of climate change on the insurance sector. The report focuses exclusively on insurers' assets, although insurers are exposed to the consequences of climate change on both sides of their balance sheets as they underwrite risks that could be affected by climate change as well as invest in assets that could be affected by climate change.

Drawing on unique quantitative and qualitative data gathered from 32 IAIS Members covering 75% of the global insurance market, analysis was carried out to better understand insurers' asset-side exposures to, as well as supervisors' views on, climate-related risks. In addition, scenarios were developed to assess climate change impact on a forward-looking basis. The data was gathered through the arrangements put in place as part of the IAIS Holistic Framework for the Assessment and Mitigation of Systemic Risk in the Insurance Sector, in particular the Global Monitoring Exercise.

The analysis of climate-related risks poses conceptual and methodological challenges, including a lack of understanding about the uncertain process of climate change and its non-linear effects, the forces influencing it and how these relate to financial sectors, and the lack of a globally consistent framework for measuring climate risk-related financial information. The report engages with these debates, highlighting the challenges encountered, the paths followed to address them and the resulting limitations emerging from the choices made.

Our quantitative data analysis on insurers' asset-side exposures to climate risks shows that more than 35% of insurers' investment assets (including equities and corporate debt, loans and mortgages, sovereign bonds and real estate) could be considered "climate-relevant", ie exposed to climate risks. Within the equities, corporate debt, and loans and mortgages asset classes, the majority of climate-relevant exposures relate to counterparties in the housing and energy-intensive sectors. However, the report also highlights significant regional differences in terms of balance sheet asset composition and exposures to climate-relevant sectors.

DRAWING ON UNIQUE QUANTITATIVE AND QUALITATIVE DATA GATHERED FROM 32 IAIS MEMBERS COVERING 75% OF THE GLOBAL INSURANCE MARKET, ANALYSIS WAS CARRIED OUT TO BETTER UNDERSTAND INSURERS' ASSET SIDE EXPOSURES TO, AS WELL AS SUPERVISORS' VIEWS ON, CLIMATE-RELATED RISKS.

Scenario analysis was carried out using the representative scenarios developed by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) to explore the potential impact on the insurance sector of alternative policy approaches to climate change. A scenario with climate change policies pursuing an orderly transition towards internationally agreed climate targets appears to have only limited impacts on insurers' solvency positions. A scenario

SCENARIO ANALYSIS WAS CARRIED OUT USING THE REPRESENTATIVE SCENARIOS DEVELOPED BY THE NETWORK OF CENTRAL BANKS AND SUPERVISORS FOR GREENING THE FINANCIAL SYSTEM (NGFS) TO EXPLORE THE POTENTIAL IMPACT ON THE INSURANCE SECTOR OF ALTERNATIVE POLICY APPROACHES TO CLIMATE CHANGE.

with policies that reflect a disorderly transition towards meeting targets or that do not meet the climate targets has more significant effects on the insurance sector. For example, under an orderly transition scenario, results show a drop in insurers' available capital of around 7% to 8% of their required capital; that drop increases to over 14% under a disorderly transition scenario, and to almost 50% under a "too little, too late" scenario. Despite the significant losses shown in the four scenarios analysed, the insurance sector as a whole appears to be able to absorb these investments losses, in light of the high pre-stress capital levels. However, these outcomes also partly depend on the scope of the data collected, which cover 53% of the targeted climate data collection (TCDC) sample total assets (general account only). For instance, for the analysis of both climate-relevant exposures and stress scenarios, assets out of scope are not taken into account although they may contain some climate-relevant assets; therefore, the results may not fully reflect the actual impact of the different scenarios.

Over the past few years, a number of private and public initiatives aimed primarily at expanding and strengthening consistent cross-border and cross-sectoral reporting of climate-related risks disclosures have been developed or implemented. At a global level, the Financial Stability Board's (FSB's) Task Force on Climate-related Financial Disclosures (TCFD) Framework continues to gather support. However, companies' disclosure of the potential financial impact of climate change on their businesses, strategies and financial planning remains low (TCFD, 2020).

With specific reference to the insurance sector, in May 2021 the IAIS and the Sustainable Insurance Forum (SIF) published *Application Paper on the Supervision of Climate-related Risks in the Insurance Sector*, which provides guidance for supervisors in integrating climate-related risks into their supervision.

AS A NEXT STEP, AND BUILDING ON THE LESSONS LEARNED FROM THIS ANALYSIS, THE IAIS WILL CONTINUE TO IMPROVE DATA AVAILABILITY AND ANALYTICAL TOOLS FOR MONITORING FINANCIAL STABILITY RISKS AS WELL AS TO SUPPORT THE DEVELOPMENT AND SHARING OF GOOD SUPERVISORY PRACTICES AMONG IAIS MEMBERS.

As a next step, and building on the lessons learned from this analysis, the IAIS will continue to improve data availability and analytical tools for monitoring financial stability risks as well as to support the development and sharing of good supervisory practices among IAIS Members.

1. INTRODUCTION

This is the 2021 special topic edition of the GIMAR. While the regular GIMAR reports on the outcomes of the IAIS' Global Monitoring Exercise (GME),[1] this special topic edition delves more deeply into the potential impact of climate change on the financial stability of the insurance sector, focusing on the insurer's investments.

This report contributes to the IAIS' strategic work on climate risk, which is a key theme of the IAIS Strategic Plan 2020–2024. Scientists are already observing changes in the Earth's climate in every region and across the whole climate system, according to the latest Intergovernmental Panel on Climate Change (IPCC) Report, released in August 2021. Climate change will lead to more extreme and frequent weather-related events, increasing the physical risks to which insurers are exposed and affecting insurers' assets and investments, and the insurability of policyholder property and operations. Insurers' assets and investments are also impacted by the necessary transition to a net-zero emissions economy,[2] especially if the transition is disorderly.

This report is the first global attempt to provide insight into the possible impact of climate change on the insurance sector's investment portfolio across regions and jurisdictions. The effects of climate change on the investment portfolio vary substantially and may depend on the locations and economic environments of entities, sectors and economies. Based on a unique data collection among 32 IAIS Members (representing around 75% of the global insurance market), this report analyses the size of the insurance sector's investment exposures to economic sectors and jurisdictions that are more likely to be negatively impacted by climate change. The analysis is complemented by an exploratory scenario analysis exercise assessing the possible magnitude of risks stemming from these exposures. Finally, the report also includes a qualitative description of possible risks to financial stability as well as an overview of mitigating steps taken by the insurance industry and supervisors.

The analysis provided in this report should be viewed as a step in the IAIS' work on assessing and responding to climate-related risks in the insurance sector. It is a first attempt to gauge the climate-related risks of the insurance sector's investment portfolio, to be refined as methodologies develop and more data become available. Undertaking this analysis has been an important learning experience for the IAIS and its Members, and also helps inform the need for further work. The conclusions in this report provide a partial and indicative insight into the climate-related risks of the insurance sector. It is partial as it focuses on investments only and does not examine the impact on liabilities (underwriting) – which is expected to be significant, especially for the non-life insurance sector. It is indicative given the limitations on data availability, the top-down nature of the analysis and the relative infancy of available analytical tools. Finally, the report does not provide a full global picture on the assessment of risks, but instead provides insights across different regions. By publishing this report, the IAIS hopes to encourage further work on this area.

1.1 CLIMATE CHANGE AS A FINANCIAL RISK

Climate change is an overarching global threat. It affects human, societal, environmental and economic systems through rising temperatures, rising sea levels, and an increasing frequency and severity of natural catastrophes and extreme weather-related events. Climate change, as well as the global response to the threats posed by climate change (eg the reduction of greenhouse gas (GHG) emissions and adaptation programmes), may have wide-ranging impacts on the structure and functioning of the global economy and financial system.

As such, climate change is a source of financial risk.[3] It may have an impact on the resilience of individual financial institutions, including insurers, as well as on financial stability through physical risks and transition risks.[4] Physical risk refers to increased damage and losses from physical phenomena associated with climate-related trends (eg changing weather patterns or rising sea levels) and events (eg natural disasters or extreme weather). Transition risk refers to disruptions and shifts associated with the transition to a low-carbon economy, which may affect the value of assets or the costs of doing business.

Important interdependencies may exist between physical and transition risks. For instance, if the transition is slow at first, this may increase the probability that physical risks will materialise. In turn, sharp increases in economic losses from weather-related events may trigger more abrupt policy responses, leading to higher transition risks. In the least favourable scenario, extreme climate-induced damage as a result of long delays in the transition will eventually force a sudden and radical change in the economy.

1.2 SCOPE AND CONTEXT

The scope of the analysis is how insurers' investments may be negatively affected by physical and/or transition risks. It thereby focuses on the insurers' assets. The analysis does not assess the potential impact of climate change on insurer liabilities (underwriting), although their relevance is briefly described in a qualitative manner in Section 2. It also does not assess insurers' exposures to assets that are deemed to contribute to a sustainable transition (sometimes called "green" investments).

The report builds on existing IAIS work on climate risk. In early 2017, the IAIS published a qualitative analysis of the impact of climate change on insurance as part of its 2016 GIMAR. In mid-2018, the IAIS and the Sustainable Insurance Forum (SIF) published Issues Paper on *Climate Change Risks to the Insurance Sector.* As the first analysis of climate change risk by an international standard setting body, this paper provided an overview of how climate change affects the insurance sector and its relevance for insurance supervision. Since then, the IAIS and SIF also published an Issues Paper on disclosures and, most recently, an Application Paper providing guidance to supervisors on embedding climate-related risks into the day-to-day supervision. See also section 5. This GIMAR special edition complements existing IAIS work by presenting a quantitative analysis based on unique supervisory information provided by IAIS Members, including quantitative information and supervisory assessments of the risks.[5]

The report draws on, and complements, existing work by other international organisations as well as by IAIS Members. In recent years, several international organisations have highlighted the importance of climate change for central banks and supervisors, including the need for coordinated action to better assess and respond to climate-related risks. This includes publications by the Bank for International Settlements (BIS, 2020), the FSB and the Network of Central Banks and Supervisors for Greening the Financial System (NGFS). In addition, several IAIS Members have undertaken, or are undertaking, analyses similar to this report. However, these analyses focus largely on assessing risks within their own jurisdictions. The IAIS' analysis leverages the experience from Members' existing efforts and complements it by providing a cross-jurisdictional picture for the first time.

1.3 STRUCTURE

The remainder of this report is structured as follows:

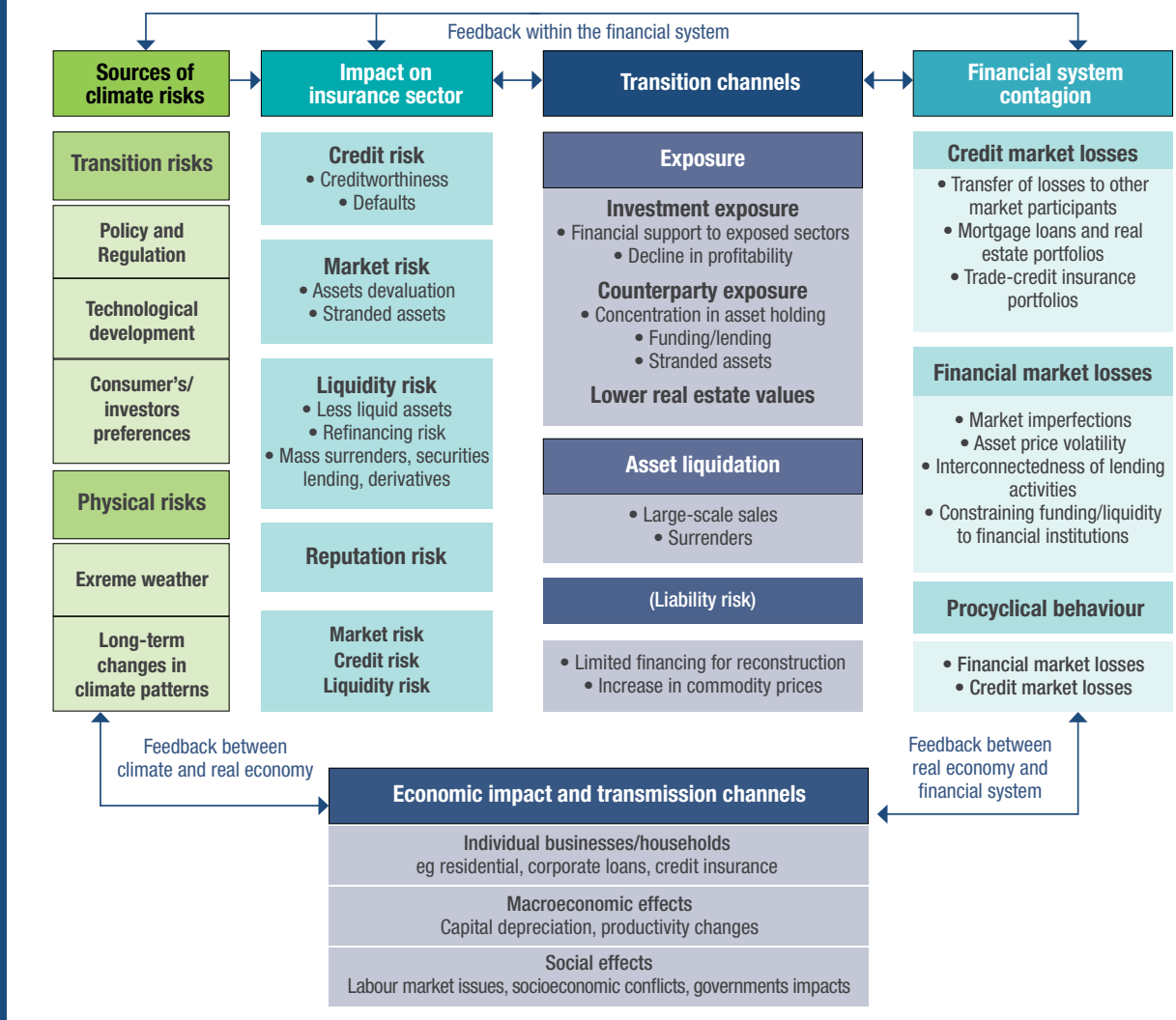
- Section 2 describes how the insurance sector may be affected by climate-related risks and provides insight into the potential financial stability transmission channels
- Section 3 discusses the approach taken in assessing the insurance sector's investment exposures to climate-related risks and presents the outcome of the data collection
- Section 4 presents an exploratory scenario analysis as a forward-looking perspective on the risks
- Section 5 discusses initiatives and measures taken by the private and public sectors in addressing climate-related risks in the insurance sector (with a focus on risks to insurers' assets)
- Section 6 presents the conclusions and work planned for the future.

2. CLIMATE CHANGE AND FINANCIAL STABILITY RISKS

Figure 1 illustrates a generic chain of events.[6] It presents a conceptual framework from the perspective of an insurer's balance sheet and outlines the sources, transmission channels, potential spillovers and feedback loops for climate risks to materialise.

The framework shows how a potential systemic impact could be created, without expressing the probability that this chain of events will occur and abstracting from regulatory mechanisms and interventions that could dampen or interrupt the chain of events.

Figure 1: Impact of climate change on insurer's assets and spillover effects



Insurers are exposed to climate change both as underwriters and investors and could be affected by a variety of climate risks. The transmission channels represent how adverse climate-risk events could spread beyond the insurance sector and impact the wider financial system. Initial impacts on the financial system could also trigger reactions with other players within the financial system (including insurers) trying to mitigate the impact of the events on their balance sheet. These reactions could generate feedback loops within the financial system and, ultimately, through macroeconomic and social effects, the real economy. Not all climate risk-related events generate a significant impact or turn into systemic risks if they materialise but, through the channels described above, insurers could contribute to the generation or amplification of systemic risk induced by climate risk events.

Though the potential financial stability impact of climate-related risks can be considered from different perspectives, the figure above focuses on the effect of both physical and transition risks, emphasising the latter, ie extensive policy, technology and market changes in favour of a low-carbon economy on the asset side of the insurers' balance sheet.

Much of this section is based on the work of the FSB report (2020),[7] which provides more information.

2.1 FINANCIAL IMPACT OF CLIMATE CHANGE ON INSURERS' ASSETS

Existing literature already investigates channels by which climate-related shocks might be transmitted through and amplified by the financial system (see FSB (2020)). The manifestation both of physical risks and of a disorderly transition towards a low-carbon economy could affect insurers' asset portfolios, although the timing of such impacts is uncertain and may differ. Transition risks affecting financial stability could appear in the near term, particularly if policies towards a net-zero emissions economy are accelerated. By contrast, physical risks are unlikely to lead to financial stability concerns in the short or medium term.

Focusing on insurers' assets, financial risks may materialise in different risk dimensions with potential financial stability consequences. There are also important second-round and spillover effects within the financial system that may amplify the effect of climate-related risks.[8] Examples of a possible split along four risk dimensions and related spillover effects are provided below.[9]

Credit risk: Sectors exposed to climate-related risks may suffer losses when they are unable to effectively manage transition risk. Climate-related risks can thus induce, through direct or indirect exposure, a deterioration in borrowers' capacity to generate sufficient income, as it might lead to higher probabilities of default in:

- carbon intensive industries (stranded assets);
- investments in technologies that turn out to be less promising than expected or superseded by new technologies.

This would affect the creditworthiness of these borrowers, and ultimately affect bond prices or cause yield shocks. Moreover, the potential depreciation of assets used for collateral (eg lower value of real estate due to policy changes) can also contribute to higher credit risk.

In terms of physical risk, an example would be if the destruction of a production site due to an extreme weather-related event increases the probability of default of the company operating the site.

Market risk: Under a disorderly transition scenario, financial assets concentrated in certain sectors of the real economy and/or certain regions could be subject to a change in investors' perception of profitability, leading to a propensity for reducing the value of these assets. As outlined by the FSB (2020), such changes need not, in themselves, pose risks to financial stability. However, such movements may be amplified by an unanticipated and sudden disorderly transition, which could have a destabilising effect on the financial system through a sharp fall in asset prices (eg stranded assets, significant decrease in the value of real estate, carbon intensive and/or GHG intensive sectors). Following a regulatory shock aimed at sectors whose technology relies on carbon emissions, large-scale sales may ensue through several channels of transmission. First, investors may have trouble gauging the fundamental value of such assets, which itself depends on future regulatory actions that are not yet known. In a world of increasing physical risk events and lagging technology within those sectors, many investors may deem such assets as undesirable to hold. Further, coupled with more

Table 1: Climate-related risks and insurance investment portfolio

Asset class	Relevance of climate-related risk	
	Physical risk	Transition risk
Sovereign bond	Depends on the intrinsic exposure of a jurisdiction to physical risk events (for instance, the debt of jurisdictions most exposed to a rise in sea levels may suffer in case of a global warming quicker than anticipated).	Through the need for additional fiscal spending on adaptation programmes, or via impacts on governments where the economy is heavily reliant on fossil fuels.
Corporate bond	Depends on the location or sector, eg exposure to agriculture may suffer from decreasing yields, for instance when extreme weather-related events become more common and damage crops.	Borrowers, bonds and/or counterparties that fail to properly address transition risk may suffer losses due to deteriorating creditworthiness.
Equity	Depends on the location or sector, eg exposures to corporates that have facilities in flood areas may suffer from equity price shocks after major flooding.	An impairment of financial asset values due to the low-carbon transition, for instance stranded assets, may decrease the value of carbon/GHG intensive sectors.
Loans/ mortgages	Depends on the location. For example, lien assets located in areas more prone to flood risk or other weather-related events.	Loans to debtors may be impaired if the debtors fail to address climate change issues.
Real estate	Depends on the location. For example, buildings located in areas more prone to flood risks may experience suspension of business activities and increased credit losses, eg of corresponding mortgages and lower market values.[10]	Buildings with low energy efficiency may be prone to transition risks, for instance if new regulation forced all properties to meet certain higher sustainability standards, leading either to stranded assets or significant investments to meet the higher standard.

stringent disclosure standards with respect to a portfolio's carbon footprint, investors may fear a reputational cost associated with holding such instruments. These are two examples of how market risk can intensify and lead to a significant drop in the value of climate-relevant assets beyond what has already been priced in.

Liquidity risk: A lack of reliable and comparable information on climate-sensitive exposures could create uncertainty and cause procyclical market dynamics, including large-scale sales of carbon-intensive assets, and hence reduce liquidity in these markets. As such, assets could become less liquid due to, for instance, climate-related increased credit or market risk, thereby triggering potential procyclical investment behaviour by insurers and negatively affecting insurers' ability to liquidate the assets when needed.

Reputational risk: Negative publicity may be triggered by an insurer's underwriting, or investing in, sectors perceived as contributing to climate change, or that do not take into account climate-change consequences and do not take mitigation or adaptation measures. This is exemplified by social movements calling for divestment from fossil fuels and the cessation of the underwriting of coal-fired power infrastructure.

When looking at an insurer's investment mix, each type of asset class may in theory be affected by transition and/or physical risks. The following table provides an overview and examples of the materialisation of these risks for five main asset classes on an insurer's balance sheet.

2.2 FINANCIAL STABILITY TRANSMISSION CHANNELS AND AMPLIFICATION MECHANISMS OF CLIMATE CHANGE

As noted by the FSB (2020), a gradual and well-anticipated transition to a low-carbon economy has a relatively contained impact on asset prices and is less likely to have material implications for financial stability. A rapid or disorderly transition could occur, however, due to sudden and

unanticipated changes in public policy, technology developments or the preferences of investors or consumers. This may affect the balance sheet or generate a decline in financial earnings – with potential implications for the solvency position – of companies whose business models are not based on low carbon emissions or in favour of climate adaptation or mitigation. In this case, a direct consequence may be the write-down of assets held by insurers investing in such companies, potentially leading to large-scale sales of assets.[11]

Under these circumstances, the financial system as a whole (including insurers, banks, investment funds and hedge funds) may demonstrate procyclical behaviour. This would enhance market imperfections and could have a destabilising effect on the financial system.

Climate-related risks may have an impact on insurers' investments portfolio via three main identified transmission channels: exposure channel, asset liquidation channel and legal liability risk channel. The analysis focuses on the first two. It thereby explains the channels through which climate-related risks might impact the financial system, without including any conclusive statements on the likelihood that these risks will materialise.

2.2.1 Exposure channel

The exposure channel is related to direct and indirect interlinkages between insurers and other parts of the financial system, and the real economy.

Investment exposure

As the value of insurers' assets (cf table 1) runs the risk of a sharp downward shock, expected returns on investments become hazardous for investors (including insurers) who may face potential financial (market) losses. As noted by the FSB (2020), the breadth of climate-related risks might reduce the degree to which market participants are able to properly price and manage their investments, which is likely to lead to increases in risk premia across a wide range of assets. An unanticipated shift in asset prices may challenge market participants' ability to diversify their exposure to climate-related risks.

Counterparty exposure

This phenomenon may be enhanced by the interconnectedness of lending activities between insurers and other financial institutions. Insurers are exposed to the banking and investment funds sectors through several exposed classes (mainly investments in bonds and equity). When financial institutions are hit by a shock, they can easily transmit it to the insurance sector through a sharp decline in the institutions' creditworthiness. A reduction in (re)financing within the financial system could in time amplify climate-related shocks to the real economy.

Various insurers are also part of financial conglomerates (including credit institutions, investments funds, hedge funds and payment institutions), where a decline in the financial soundness and solvency position of one institution may affect the whole conglomerate. Further, the failure of a systemic financial group or the failure of several non-systemic financial institutions may lead to contagion in the broader financial system through interlinkages. As seen in previous financial crises, such as in 2008, such disruption of the whole financial market can trigger a market crash and a domino effect that impacts the global real economy.

Market and credit risks can also be concentrated in certain geographies and sectors of the real economy. Among insurers' investments portfolios, mortgage loans and real estate portfolios are, in some geographies, particularly exposed to climate-related risks, increasing their default risk. Credit insurers will also need to monitor increasing risk of default on trade-credit insurance portfolios, in light of climate-related risks. Transition risk emerging from a large systemic default of corporates[12] may mean trade-credit insurers are unable to honour their insurance liabilities (increase in market risks and credit risks).

2.2.2 Asset liquidation channel

Asset liquidation refers to the sudden sale of assets on a large scale by one large insurer or a sufficient number of smaller insurers, which could trigger a decrease in asset prices and significantly disrupt trading or funding in key financial markets or cause significant losses or funding problems for other firms with similar holdings. Such behaviour may have a more significant impact on smaller, less liquid markets or in a stressed environment.

Climate-related shocks have the potential to lead the insurance industry to large-scale shifts in its portfolios. Market movements from investors' procyclical behaviour (including insurers and other financial institutions) may amplify changes in asset prices. As noted by the FSB (2020), this effect may be particularly widespread where there are substantial commonalities between investors' portfolios or concentrations of exposures through certain financial products (such as derivatives). It could also be amplified by changes in collateral values. Liquidity mismatches can also be seen in securities lending activities when collateral is invested by the insurers in less liquid assets. Furthermore, policyholders in need of cash (eg following damages resulting from a weather-related event) may be triggered to surrender their life savings in insurance. If such behaviour were to occur, insurers may be forced into procyclical behaviour to obtain the necessary liquidity to meet policyholders' payouts.

A procyclical phenomenon,[13] pushing the market to simultaneous and large-scale sales of assets, may trigger increased market volatility and raise the likelihood of further losses and failures of actors within the financial system. As a result, liquidity risks may emerge if insurers are not able to sell the stranded assets quickly enough to prevent or minimise losses.

2.2.3 Legal liability risk channel

In addition to a reputational risk (through financial support for carbon-intensive sectors), insurers may also be exposed to counterparty risk from their business relations with companies subject to climate-related legal liabilities. This might also have implications for the financial system.

This risk is not further developed as it is less relevant to the analysis in this report.

2.3 FINAL CONSIDERATIONS

Insurers are dually exposed to the consequences of climate change, as they underwrite risks and invest in assets that could be affected by climate change. While climate risk analysis related to insurers' investments often focuses on transition risks only, potential physical risks should not be neglected. The manifestation of physical risks – particularly prompted by a self-reinforcing acceleration in climate change and its economic effects – could also lead to a sharp fall in asset prices and increase in uncertainty (see FSB (2020)).

A variety of mechanisms within the financial system could amplify the effects of credit, liquidity and counterparty risks arising from climate-related shocks. Interactions within the financial system and with the real economy may also increase risks to financial stability.

As noted by the FSB (2020), a widespread reappraisal of the creditworthiness of large portions of the real economy might reduce the willingness of firms to provide financial services, reducing access to (or raising the cost of) bank lending, corporate finance and insurance. By depressing macroeconomic prospects, this could result in further losses for the financial system, which in turn could lead to another reduction in finance.

Ultimately, as the financial sector provides financial support to the real economy and taking into account the strong interconnectedness of the financial system, physical and transition risks may generate 'feedback effects' within the financial system and between the financial system and the real economy[14]. In particular, and directly in connection with insurers' activities, these effects may be expected at a macroeconomic level and at the level of individual businesses and households (ie loan mortgages and homeowner's insurance).

3. ASSESSMENT OF CLIMATE-RELATED RISKS TO INSURERS' INVESTMENTS

In this report, the analysis of risks stemming from insurers' investment exposures to climate change follows a two-step approach. The first step, in this section, consists of assessing the size and nature of the climate-relevant exposures and their materiality on insurers' balance sheets. This analysis aims to provide an initial indication of the relevance of climate-related risks to the insurance sector's investment portfolio. The second step is to analyse the potential losses for the insurance sector stemming from different forward-looking scenarios (see section 4).

3.1 METHODOLOGY FOR DERIVING CLIMATE RISK EXPOSURES

The analysis starts by identifying insurers' exposures to climate-relevant assets: this means classifying sectors and jurisdictions into different categories depending on their sensitivity to climate-related risks. Insurers' investments are then mapped to those categories.

The analysis covers the asset classes most relevant for insurers, namely equity, sovereign bond, corporate bond, real estate, and loans and mortgages. To select those assets, the IAIS considered:

- The materiality of those asset classes in the insurers' balance sheets
- Their relevance for climate risk, ie the extent to which physical and/or transition risks can impact the performance of those assets
- The availability of data, ie the extent to which it is possible to distinguish between climate-relevant and other assets within these asset classes (existence of a taxonomy).

On aggregate, insurers' investment assets are typically composed as follows (from most to least material):[15]

- Sovereign debt
- Corporate debt
- Equity
- Loans and mortgages
- Real estate
- Other: cash, securitisations and more.

Table 1 in section 2 shows relevance for climate-related risks analysis.

To consider data availability and taxonomy issues, existing initiatives on classifying climate-relevant investments, notably from the academic literature and supervisory authorities,[16] were reviewed. Different approaches were taken for equity, corporate debt, and loans and mortgages, compared to sovereign bonds and real estate, as explained further in sections 3.1.1 and 3.1.2. The first set is based on a categorisation of economic sectors, whereas the second set is based on a geographic approach.

3.1.1 Equity, corporate bonds, and loans and mortgages

The choice of climate-relevant sectors is based on climate policy relevant sectors (CPRS), a classification of economic activities to assess transition risk, which was developed in Battiston et al. (2017)[17] and refined over the years.

CPRS follow the statistical classification of economic activities in the European Community (NACE Rev2, 4-digit level)[18]. As described on the CPRS project webpage of the University of Zürich,[19] the CPRS "…provide a standardised and actionable classification of activities where revenues could be affected positively or negatively in a disorderly transition to a low carbon economy, based on their energy technology (eg based on fossil fuel or renewable energy)". As noted in FSB (2021), this approach has the advantage of usability and compatibility with existing economic and financial datasets (many of which are also at sector level). For this reason, "the CPRS classification is regarded as a reference for climate-related financial risk assessment and has been used by several international financial institutions to assess investors' exposure to climate transition risk". For example:

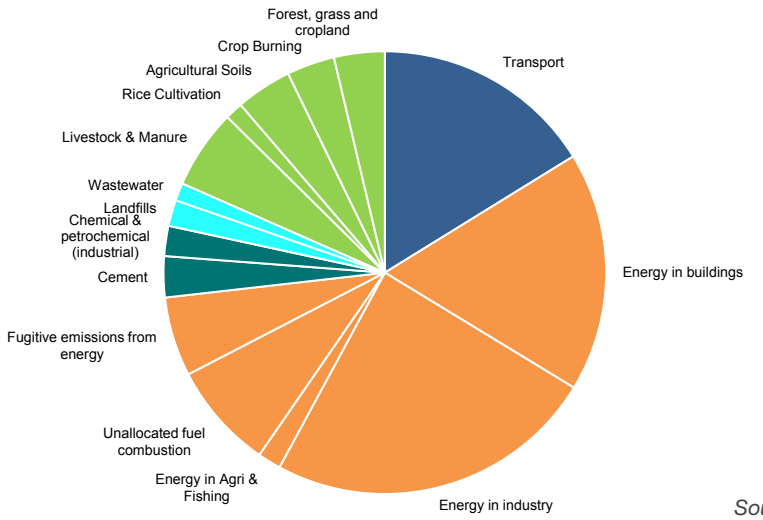
- The classification was used by the European Insurance and Occupation Pension Authority (EIOPA) in its 2018 Financial Stability Report to assess the climate risk exposure of the European insurance sector.
- The European Central Bank used this classification in its 2019 Financial Stability Review to assess the exposure of euro area investors to economic activities that are considered climate policy relevant.
- The European Commission's Joint Research Centre used it to assess the transition risk exposure of the sectors included in the European Commission's green taxonomy (Alessi et al., 2019).
- The Austrian National Bank analysed banks' exposure to transition risk using this classification in its Financial Stability Report 2020.

CPRS considers the economic and financial risk stemming from the (mis)alignment of firms' and sectors' climate and decarbonisation targets. CPRS includes six economic sectors: fossil fuels, utilities (electricity), energy-intensive activities, buildings, transportation and agriculture, which are identified by considering:

- their direct and indirect contribution to GHG emissions (see Graph 1)
- their relevance for climate policy implementation (ie their cost sensitivity to climate policy change, such as the European Union carbon leakage directive 2003/87/EC[20])
- their role in the energy value chain.

Table 2 provides more detail on the mapping of those 6 sectors with NACE codes, as well as the main reasons why these sectors have been identified as climate-relevant.

Graph 1: Greenhouse gas emissions by economic sectors



	Energy	57%
	Transport	16%
	Industrial processes	5%
	Waste	3%
	Agriculture, forestry and land use	18%

Source: Climate Watch, World Resources Institute

Table 2: Description of CPRS

CPRS: definition and classification			
CPRS	Role in GHG emissions	Transition risk	NACE (4-digit codes)
Fossil fuels	Production of primary energy based on fossil fuel; indirectly responsible for GHG emissions from fossil fuels	Revenues primarily from fossil fuels (eg extraction, refinement); diversification/ use of different resources not possible	Exraction of coal, gas and oil (eg 05.20), manufacturing related to the refinement of coal, gas and oil (eg 19.10) electricity and gas (eg 35.21), retail sales of automotive fuels (eg 47.30)
Utilities	Production of secondary energy, responsible for GHG emissions relative to type of fuel used	Revenues from generation, transmission or distribution of electricity; diversification possible (eg solar, wind)	Electricity production (eg 35.11)
Energy-intensive	Activities with intensive energy use as input	Affected by price changes of energy restrictions on use of GHG-intensive sources	Mining and quarrying (eg 07.10), various manufacturing secors (eg 11.01, 13.10, 23.51) based on the European Union carbon leakage list
Transportation	Provision of and support for transportation services	Fossil-fuel intensive, but no strict dependence on GHG emissions, diversification possible	Manufacturing of motor vehicles, ships and trains (eg 29.10), construction of roadways (eg 42.11), sale of vehicles (eg 45.32), transportation (eg 49.10)
Buildings	Provision of building services from construcion to renting	Energy-intensive, but diversification possible	Residential and commercial construction (eg 41.10), accommodation (eg 55.10), real estate (eg 68.20)
Agriculture	Agriculture, forestry and related services	Energy-intensive, but diversification possible	Agriculture, forestry and fishery (eg 1.10)

Source: Austrian banks' exposure to climate-related transition risk (2020)

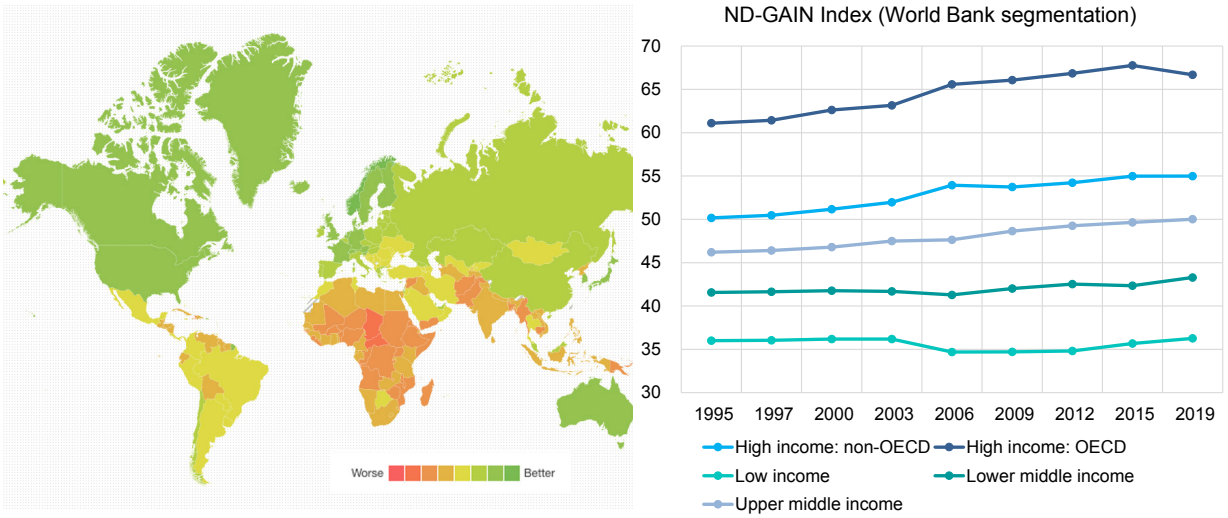
3.1.2 Sovereign bonds and real estate

As noted above, with respect to sovereign bonds and real estate exposures, this analysis focuses on the geographic location of the asset. For the purpose of this global study, analysis is performed at the country level.[21]

Sovereign bonds

To assess climate-related risks in sovereign bond exposures, the ranking system developed by the University of Notre Dame, Notre Dame Global Adaptation Initiative (ND-GAIN), was used. ND-GAIN is based on a jurisdiction's vulnerability to climate change in combination with its readiness to improve resilience.[22] It aims to help governments, businesses and communities better prioritise investments for a more efficient response to the immediate global challenges ahead. ND-GAIN is a widely referenced source in other studies and has also been used by rating agencies.[23] The ND-GAIN index is based on 45 underlying indicators, of which 36 variables contribute to the vulnerability score and nine variables constitute the readiness score. Vulnerability refers to "a country's exposure, sensitivity and capacity to adapt to the impacts of climate change" and include indicators of six life-supporting sectors (food, water, health, ecosystem services, human habitat and infrastructure). Readiness assesses "a country's capacity to apply economic investments and convert them to adaptation actions" and covers three areas (economic, governance and social readiness). The ND-GAIN index uses a score between 0 and 100, where 0 corresponds to "most vulnerable, least ready" and 100 corresponds to the "least vulnerable, most ready".

Graph 2: ND-GAIN Country index



Source: ND-GAIN (2021); World Bank Income segmentation.

As such, for the combined ND-GAIN index, a higher score reflects lower climate risk.

The index is available for more than 180 countries and spans almost 25 years. The most recent index uses data up until 2019 and was published in July 2021. Over time, the ND-GAIN index has remained relatively stable, although there were slight improvements particularly in the European and Asian regions. The range of global scores shows a correlation between the ND-GAIN index and income levels, with low-income countries being most vulnerable, and least adapted, to climate-related risks (see Graph 2).

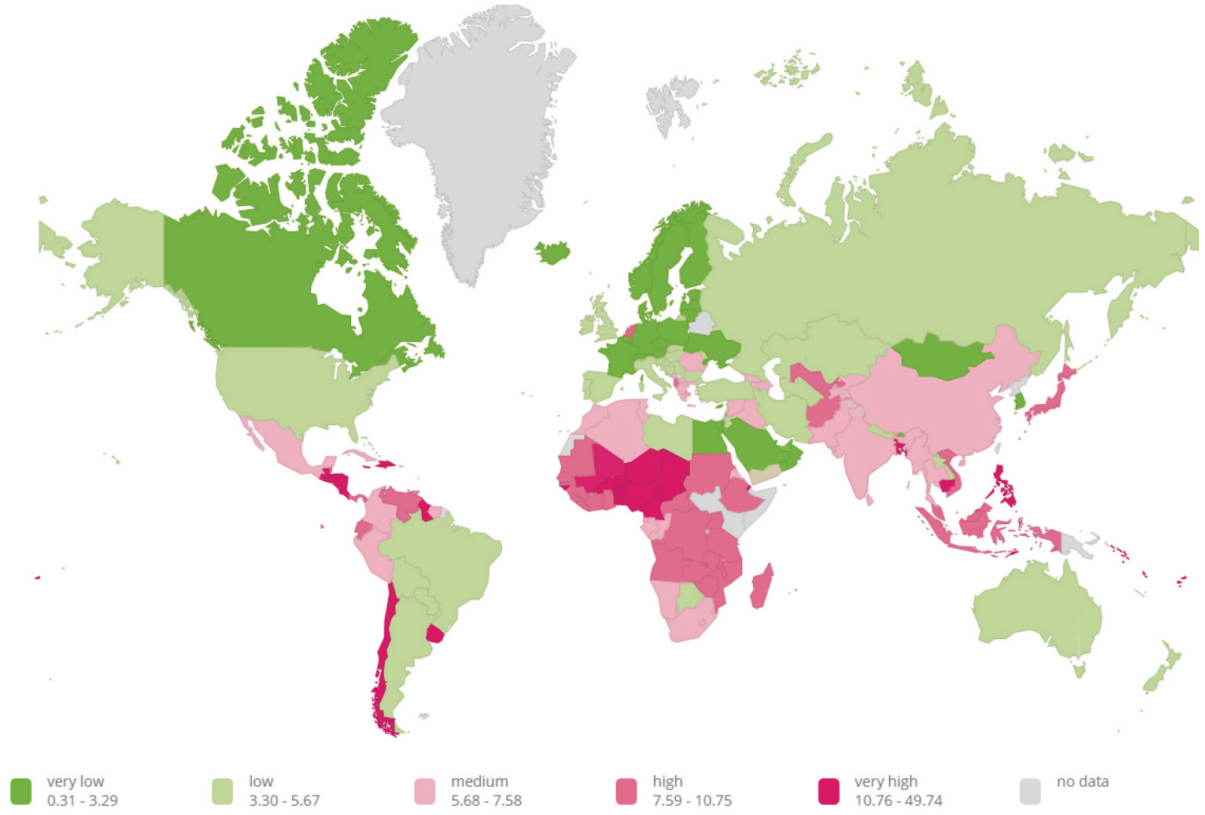
Real estate

ND-GAIN was also used as a proxy for climate-related real estate risks in the geographic location, focusing only on the vulnerability element. The ND-GAIN readiness element focuses on the readiness of the sovereign (ie the government), which is an imperfect indicator for the risk associated with real estate within each country. In contrast with the combined index used for sovereign bonds, the ND-GAIN vulnerability sub-index is constructed such that a higher score implies a higher risk.

For the scenario analysis, the analysis is augmented with the World Risk Index (WRI), a proxy for physical risk. The WRI measures countries' probability of natural disasters. The monitored natural disasters include earthquakes, volcanic eruptions, storms, floods, droughts and sea level rise for 173 countries worldwide. The WRI is annually calculated by the United Nations University – Institute for Environment and Human Security and disclosed in its annual World Risk Reports. However, this indicator is not a perfect proxy for physical risk, as it mostly provides a retrospective view on the frequency of natural disasters, and it includes non-climate-relevant disasters such as volcano eruptions.

The energy efficiency labels of buildings would be another relevant indicator to assess transition risks for real estate.[24] It is plausible that the transition to net-zero emissions could include a policy measure imposing a minimum energy efficiency requirement for existing housing stock.[25] If the necessary structural adjustments are not made to meet the new standards, due to a lack of resources for the additional investment, inability to find a construction firm or because people are not willing to make the investment, the value of energy-inefficient buildings could be severely affected. This could have a significant impact on real estate markets and collateral values. However, due to limited data availability, this indicator is not included in this report.

Map 1: World Risk Index



Source: WRI (2021)

3.2 LIMITATIONS

As the IAIS' first global, quantitative exercise on this topic, this study has some limitations and the results in this report should be interpreted with due care. This report should be seen as a first attempt to gauge the climate-related risks of the insurance sector investment portfolio, to be refined as methodologies develop and higher-quality data become available.

When interpreting the outcomes of the exposure analysis, it is important to remember that a fundamental assumption of the report is that climate risk is not yet fully accounted for in asset prices. This is important as markets that already price in climate risk may be less sensitive to abrupt price shifts in the future, for instance following severe weather-related events or a sudden transition to a less carbon-intensive economy. Although there is some evidence that prices in some corporate debt and equity markets have begun to reflect transition risk, effective market pricing is hampered by a lack of consistent methodologies, standardised metrics and comparable disclosures around climate risk. See Basel Committee on Banking Supervision (2021a) for a summary of existing empirical work on this issue.

Also, the classification of assets based on economic sectors and geographic locations relies on a rather high aggregation level. This is important because:

- Climate-relevant sectors, and firms within these sectors, will not all be equally affected in the transition. Within each sector, and between sectors, some assets may be negatively affected while others may experience a limited (or even positive) impact. The sectoral approach also abstracts differences in the intensity of emissions between firms within a given sector. Another challenge is that a firm may operate in different sectors, such that any asset issued by that firm could potentially be classified both as

climate-policy relevant by some investors and not relevant by other investors[26]

- Within a country, physical risk impacts may vary greatly between regions, municipalities or even between different postal codes, depending on for instance the proximity to the coast or the level of elevation. This is particularly relevant to the real estate analysis, as the ND-GAIN and WRI methods rely on country-wide rankings rather than the climate quality of a single building.

Specific limitations and assumptions relating to the classification of equity, corporate bonds, and loans and mortgages in climate-relevant sectors are described in subsection 3.4.1.1.

3.3 DATA COLLECTION AND COVERAGE

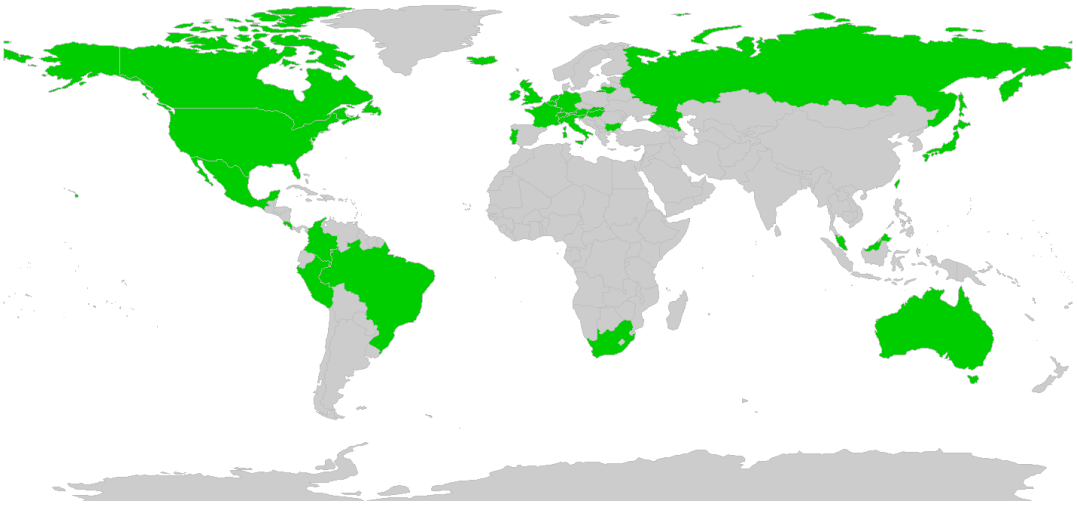
To support this report, the IAIS collected quantitative and qualitative information from IAIS Members. This TCDC is similar to the sector-wide monitoring data collection of the regular GME, as it covers data at a sector-wide level (aggregated data from legal entities within a jurisdiction) and has both a quantitative and a qualitative component. The quantitative information is based on year-end 2019; the qualitative information represents the situation as of March 2021. The analysis focuses solely on the insurance sector investments in the general account (GA); unit-linked or separate accounts are excluded.

The data collection outcomes in this report should be interpreted with some caution, since this is the first time data was collected at the global level to assess climate-related risks in insurance investment portfolios and given the best effort nature of the data collection. At the same time, a specific data dictionary was developed to ensure the consistency of data as much as possible, including across regions.

A total of 32 IAIS Members, representing around 75% of the global insurance market in terms of gross written premiums, provided data. They are highlighted in green on the following world map.[27] A few jurisdictions shared qualitative information only. While the quantitative information was directly available in some jurisdictions, other Members had difficulties in collecting this information if relying solely on existing supervisory reporting. As such, a few Members relied on an ad-hoc data collection among a subset within their insurance sector to provide the requested information.

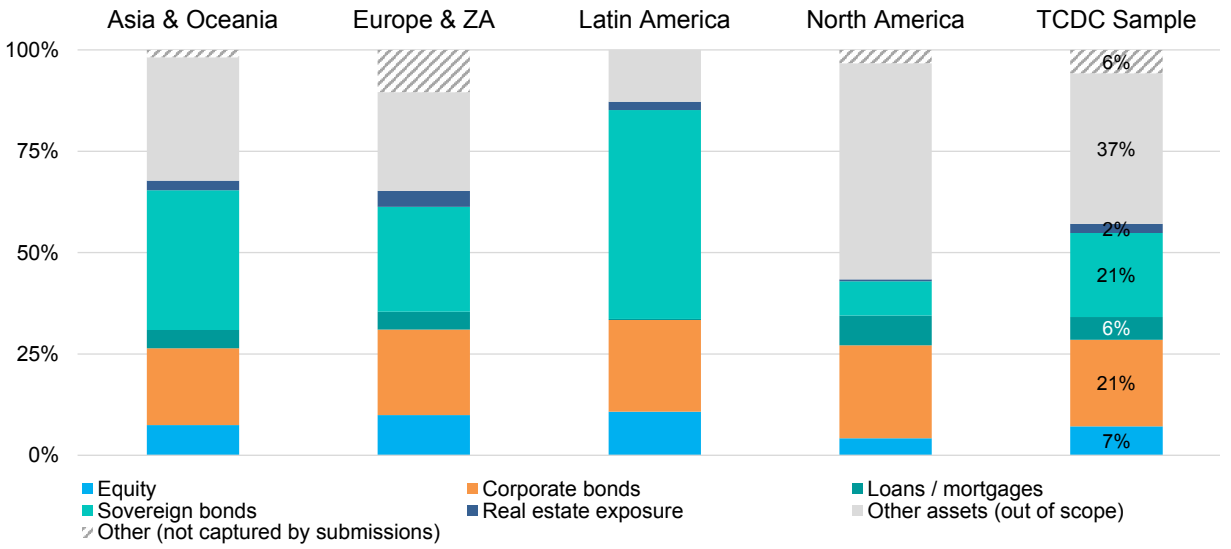
There is also good coverage in terms of the insurance sector's asset mix (see Graph 3). For most jurisdictions, the total insurance sector was covered – with some exceptions as denoted with the striped grey bars in the graph. On average, the five asset classes under analysis account for more than half of reported total assets, with relatively better coverage in Europe, South Africa and Latin America. Assets not covered include items such

Map 2: Jurisdictions that participated in the data collection



Source: IAIS data collection

Graph 3: Composition of assets (general accounts only)



Source: IAIS data collection

as reinsurance recoverables, deferred tax assets, cash and securitisations.

3.4 QUANTITATIVE FINDINGS ON CLIMATE RELEVANT EXPOSURES

One of the main objectives of this report is to determine the proportions of different types of climate-relevant assets held by the insurance sector. The exposures presented in this section are based on the data collected, complemented when necessary by other data and/or assumptions, as specified in the corresponding subsections. Those exposures inform the scenario analysis developed in Section 4.

Graph 4 presents the asset mix for the full TCDC sample, as well as the asset mix by region. The overall mix by asset class is complemented by a split of equity, corporate bonds, and loans and mortgages in climate-relevant sectors, providing a comprehensive overview of the asset mix by region.[28]

Subsections 3.4.1 to 3.4.3 provide a more detailed view of each asset class separately, as well as the relevant assumptions made. Since these assumptions have a direct impact on the overall results presented in Graph 4, that graph should be considered in conjunction with the figures and explanations provided thereafter.

3.4.1 Equity, corporate bonds, and loans and mortgages

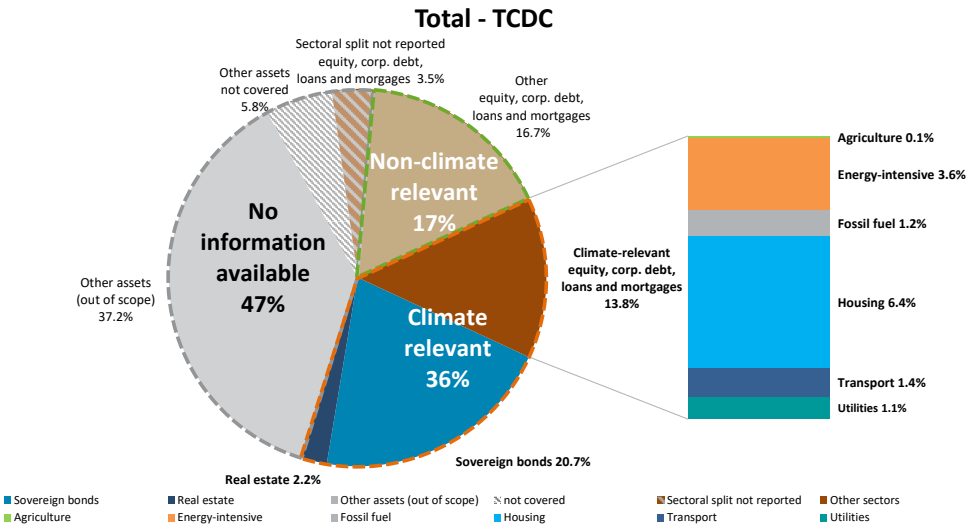
3.4.1.1 Mapping to climate-relevant sectors

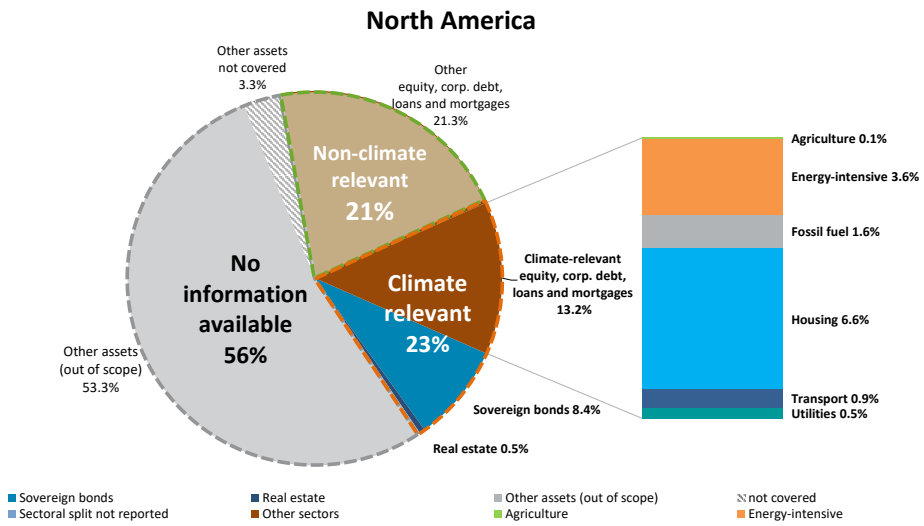
Consistency of reported data

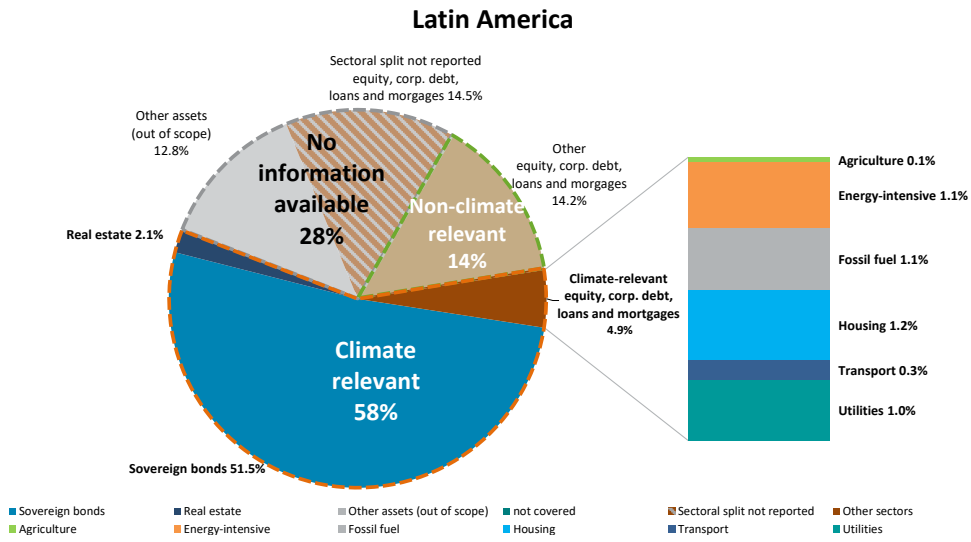
The mapping used to identify climate-relevant assets is quite dependent on the region of the respondent. In particular, almost all respondents from Europe and South Africa used the mapping based on NACE codes,[29] except for two respondents using a mix of standards or their own jurisdictional classification. Most respondents used one of the three mappings provided by the IAIS for the purpose of collecting data.[30] A few of them, however, referred to the Global Industry Classification Standard, or used either a combination of classifications or their own national classification.

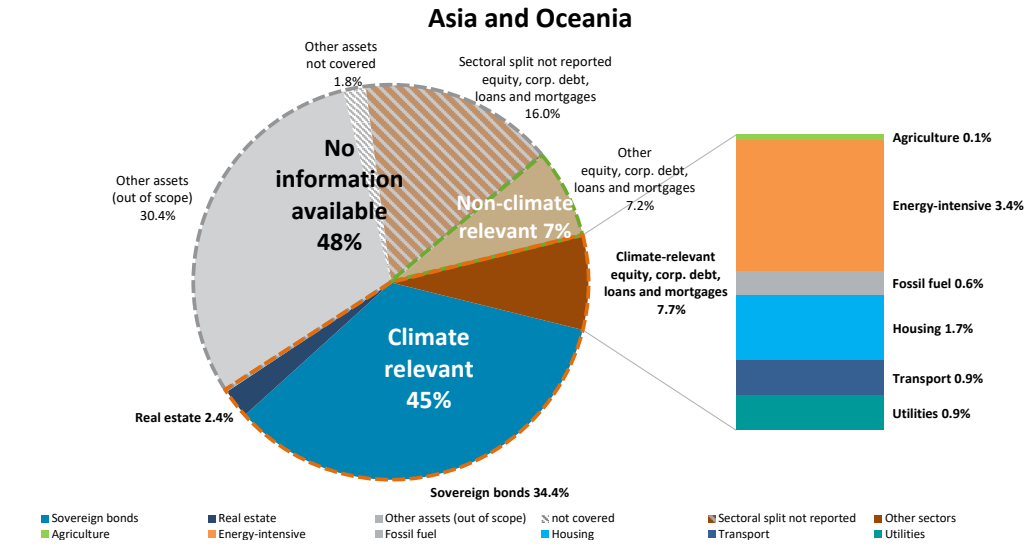
The three mappings provided by the IAIS were developed with a view of cross-consistency for the identification of climate-relevant assets. Therefore, the use of any of those three mappings should not generate major discrepancies in the reporting. However, the use of other mappings could be a source of heterogeneity. As an illustration, one of the respondents using the Global Industry Classification Standard provided details on the allocation of the standard's codes to the six climate-relevant sectors. Those details show a limited alignment with the three mappings

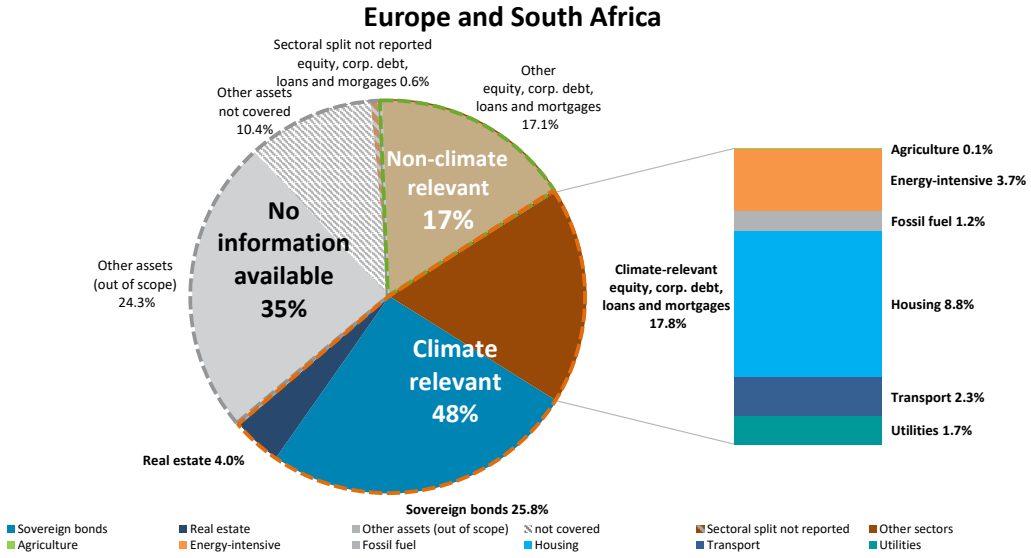
Graph 4: Split by asset class and climate relevance, at global and regional levels











Source: IAIS data collections

provided for the data collection, thereby restricting the comparability of results across jurisdictions.

Treatment of exposures to the utility sector

One weakness of the CPRS classification is that the climate-relevant utility sector includes all electricity-generation activities, regardless of the energy source used. This lack of granularity results in renewable-energy assets being unduly considered climate-relevant.

In an attempt to remedy this weakness, a haircut was applied on a jurisdictional basis to all amounts reported in that sector. The size of the haircut was determined with reference to the proportion of renewable power generation in the region of each jurisdiction, as published in the regional factsheets of the International Renewable Energy Agency (IRENA).[31]

At a global level, applying this haircut decreased the total exposure to utilities by 27% (ranging from 20% to 65% depending on the jurisdiction). This may be a

rather crude measure, as it relies on the assumption that insurance sectors' investment mix in the utility sector matches the energy mix within that region whereas insurers may have invested more or less in renewable energy classes. In addition, the energy strategies of different jurisdictions may vary within an IRENA region.

Treatment of loans and mortgages exposures to the housing sector

In some jurisdictions, a lack of sectoral information for loans and mortgages led to an underestimation, sometimes material, of exposures to the housing sector. In jurisdictions where the amount of mortgages was known, based on other sources, it was used as a floor to determine the exposure to the housing sector to get to a more relevant result.

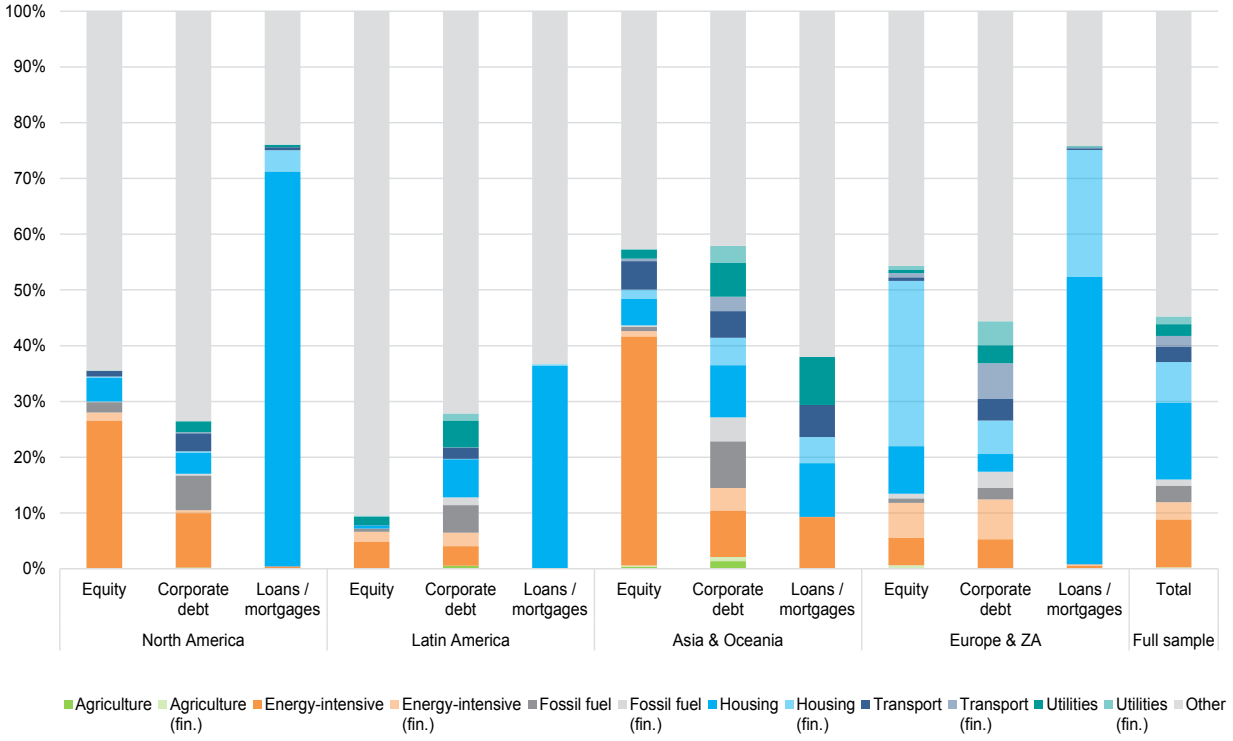
Treatment of exposures to the financial sector

When analysing the data, a significant limitation was identified relating to the treatment of assets that belong to the financial sector. Those assets, which for some jurisdictions represent a very high proportion of their total reported assets, include participation in other insurance companies or banks (which may be part of the same group), and holdings of investment funds, which are not looked through.

Since the financial sector has not been explicitly classified as climate-relevant, the absence of look-through of investment funds and participations in financial entities that are part of the same group may result in a significant underestimation of the actual proportion of climate-relevant assets. To approximate the exposures that would result from a look-through approach, it was assumed that entities or funds classified in the financial sector include climate-relevant assets in a similar proportion to that of assets directly held by insurers. The results presented in section 3.4.1.2 (Graph 5) are based on that assumption, and therefore include a portion of assets that belong to the financial sector in the different climate-relevant sectors.[32]

The IAIS acknowledges the uncertainty over the amount of financial sector assets classified as climate-relevant; looking through those assets would be necessary in order to refine the estimation.

Graph 5: Proportions of equity, corporate bonds, and loans and mortgages in climate-relevant sectors, including a proportional share of assets in the financial sector (in lighter shade)



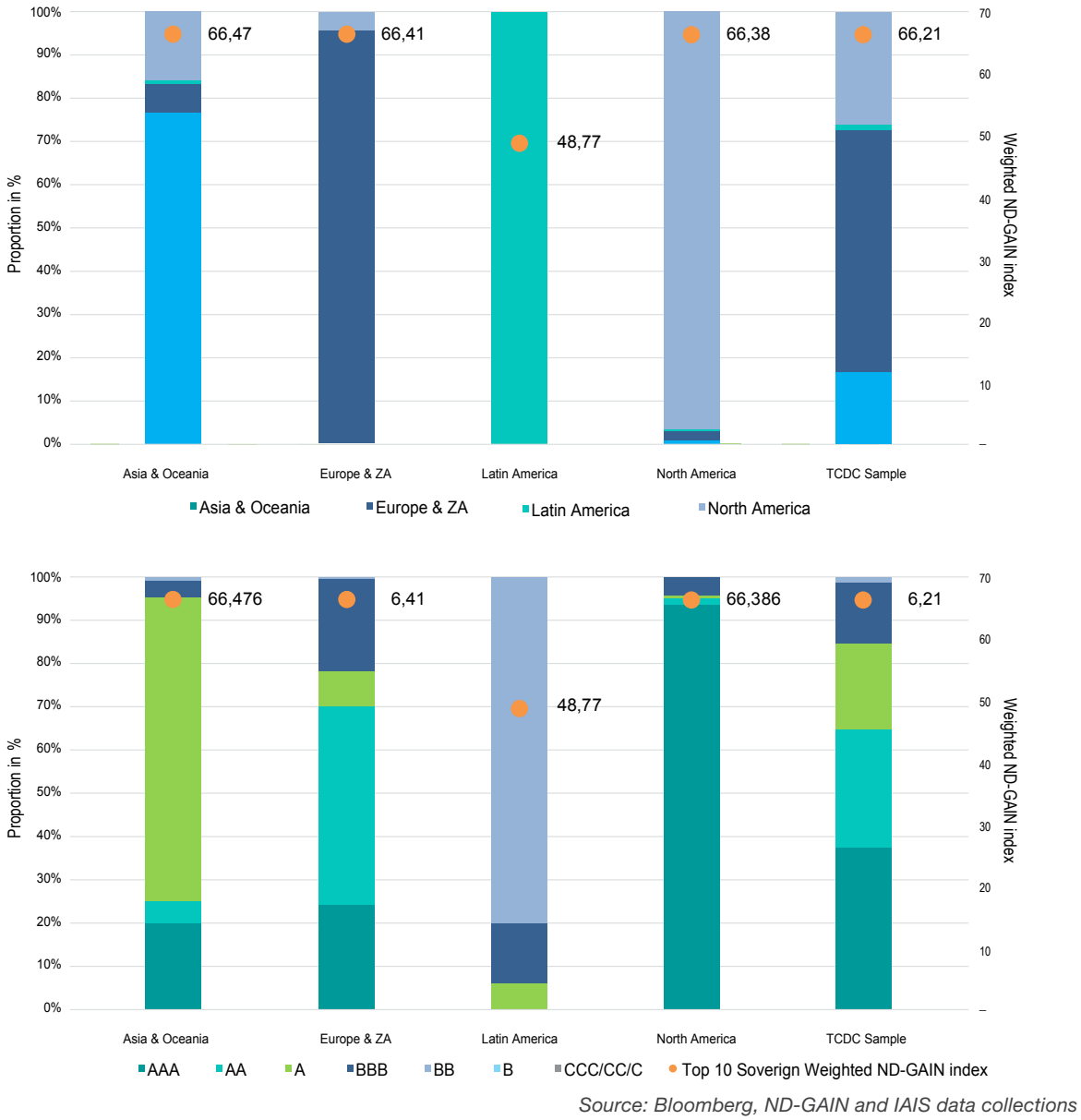
Source: IAIS data collections

3.4.1.2. Quantitative findings on climate relevant exposures

Graph 5 presents the proportions of equity, corporate bonds, and loans and mortgages for each region in the six climate-relevant sectors. Depending on the type of asset and the region, climate-relevant sectors represent between 10% (equity in Latin America) and 76% (loans and mortgages in Europe and South Africa, and North America) of assets. The energy-intensive sector, which is quite broad and encompasses most of the manufacturing industry, is globally dominant among climate-relevant equities, while the picture is more balanced between sectors represented in corporate bonds. Climate-relevant loans and mortgages are almost fully associated with the housing sector, except in the Asian region where all sectors excluding agriculture are represented. It is important to note that assets labelled as "Other" (solid grey) contain both assets that belong to non-climate-relevant sectors and assets for which information is not available. They may therefore contain some climate-relevant assets.

An alternative presentation of those exposures, including the proportions of assets not covered (due to some jurisdictions having reported figures only for a fraction of their market), is provided in the annex.

Graph 6: Top 10 sovereign bonds and weighted ND-GAIN index



Source: Bloomberg, ND-GAIN and IAIS data collections

3.4.2 Sovereign bonds

As shown in Graph 3, sovereign bonds are a significant asset class within the average insurance investment mix.

To examine the relative risk of the sovereign bond portfolio to climate-related risks, a weighted ND-GAIN index was calculated, reflecting the weighted average ND-GAIN index of the sovereign bond portfolio of the insurance sector in a particular market, based on the top 10 largest counterparties where this information was available. A higher score means lower risk in this index. The outcomes are shown in Graph 6, which shows the weighted ND-GAIN index on the right-hand axis and the distribution of the sovereign bond portfolio by geographic region and then by rating. Regional patterns with comparable outcomes could be identified for Asia and Oceania, Europe and North America, namely: relatively high ND-GAIN index, or relatively low risk in terms of climate change vulnerability and resilience. Conversely, Latin American insurance sectors showed exposures to countries with a lower ND-GAIN index.

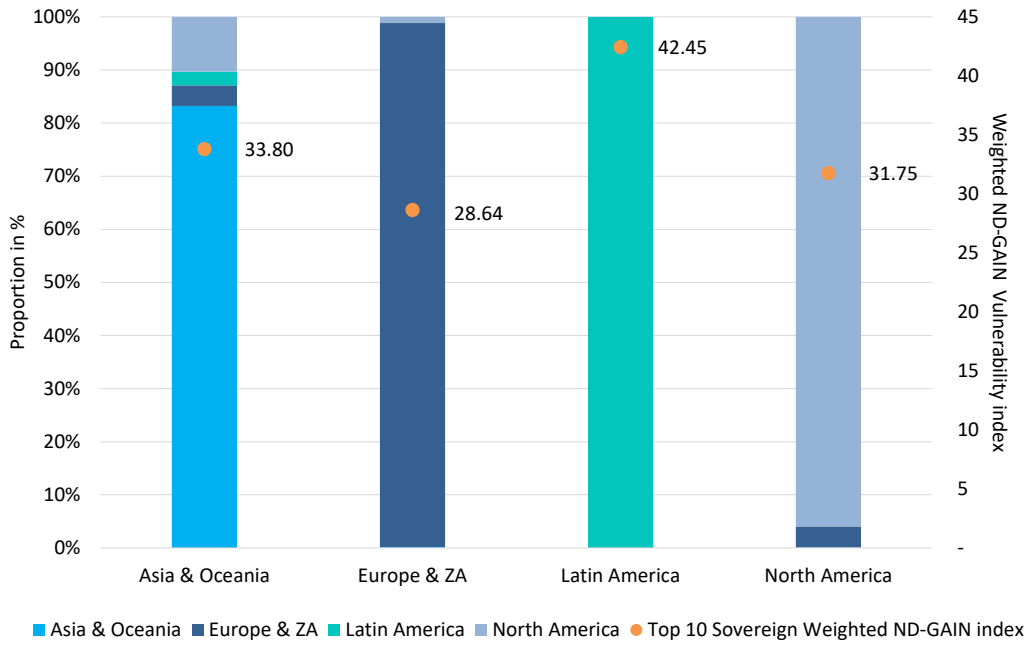
3.4.3 Real estate

As shown in Graph 3, real estate exposures make up a smaller asset class within the average insurance investment mix. For most regions, the majority of the real estate portfolio from insurers is located in the home jurisdiction, therefore the weighted ND-GAIN vulnerability index largely reflects the ND-GAIN vulnerability index of the respective jurisdictions (lower score means lower risk). Graph 7 shows the ND-GAIN vulnerability score and the distribution of the real estate portfolio by region, again based on the top 10 counterparties where this information was available.

3.5 QUALITATIVE RESULTS

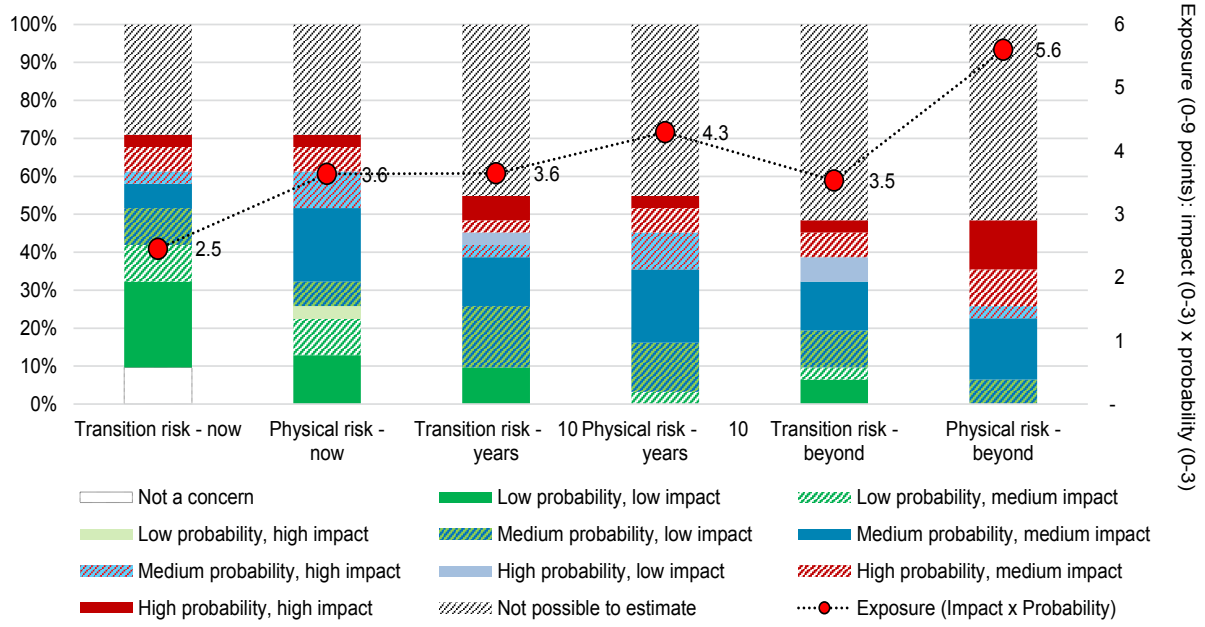
The relevance of climate-related risks for the insurance sector was confirmed in the qualitative responses from IAIS Members. When asked about their supervisory assessment of the relevance of transition and physical risks (in terms of probability and impact of the risk), Members referred to a significant risk that is increasing over time as illustrated in Graph 8.

Graph 7: Top 10 real estate weighted ND-GAIN vulnerability index



Source: ND-GAIN and IAIS data collections

Graph 8: Supervisory probability and impact assessment: transition and physical risks



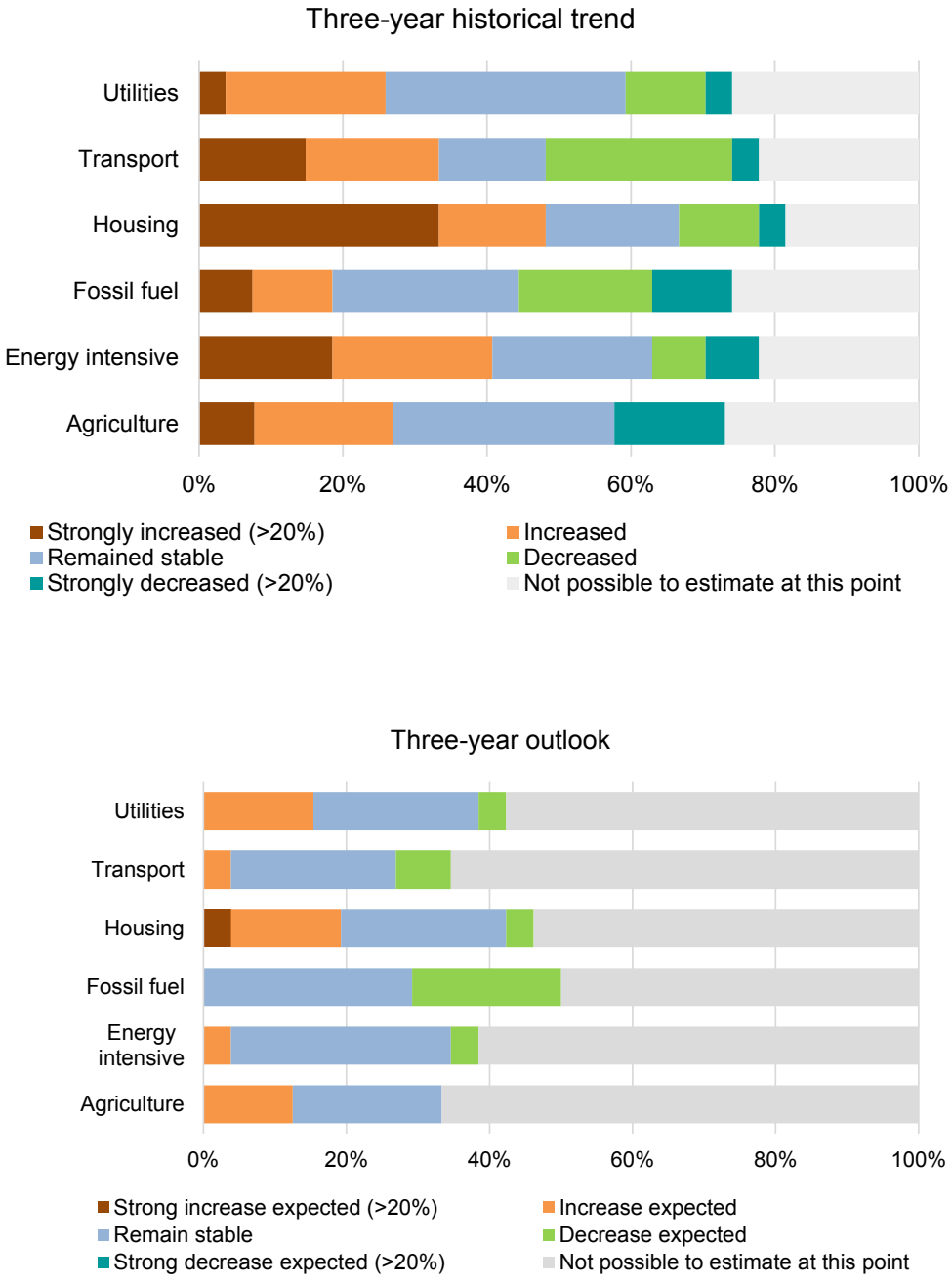
Source: IAIS data collection

In terms of transition risks, more than 80% of Members that respondend with an estimate expect at least a medium probability, and around 50% expect at least a medium impact 10 years from now. For physical risks, 95% of Members that were able to provide an estimate expect at least a medium probability, and around 75% expect at least a medium impact 10 years from now. Members also highlighted high levels of uncertainty, with more than half of the respondents indicating that it is not possible to estimate the probability and impact of the risk for the more distant future (>10 years).

Members were also asked about developments in historical trends and their expectation of future trends in investment holdings of climate-relevant assets, based on information available at the supervisory level. Overall, no clear global trend is visible when looking back at recent years. When asked about future trends, the majority of respondents could not provide a reliable estimate. When estimation was possible, around 75% of Members expected stable or decreasing insurance investment holdings in most climate-related sectors.

WHEN ASKED ABOUT THEIR SUPERVISORY ASSESSMENT OF THE RELEVANCE OF TRANSITION AND PHYSICAL RISKS (IN TERMS OF PROBABILITY AND IMPACT OF THE RISK), MEMBERS REFERRED TO A SIGNIFICANT RISK THAT IS INCREASING OVER TIME.

Graph 9: Supervisory trend and outlook expectations for holdings of climate-related assets



Source: IAIS data collection

4. SCENARIO ANALYSIS

The future path of climate change and related financial risks is highly uncertain and scenario analysis can help clarify these inherent uncertainties.[33] Climate change scenario analysis is an important tool for central banks, supervisors and financial institutions. It provides a framework for exploring how (tail) risks may evolve in the future and how climate factors may drive changes in the real economy and financial system.[34] Scenario analysis can also help inform strategic decisions and thereby ex ante help prevent the materialisation of these risks.

At the same time, climate change scenario analysis is still in its infancy and methodologies are developing and evolving. Furthermore, insufficient standardised and granular data, alongside methodological limitations, may hinder scenario analyses that are consistent and comparable. These limitations also apply to the analysis underpinning this scenario analysis, as noted in section 3.

In this scenario analysis, the impact of different "climate states of the world" is assessed, often in comparison to the Paris Agreement. Scenarios typically include two dimensions: the climate outcome and the transition path towards that state. The analysis requires a framework which selects scenario-relevant variables, projects them in accordance with a specific scenario (pathway) as defined by the IPCC and links these variables to the prices of financial assets. It can be relatively complex, as it implies defining and modelling a large set of climate, technological, socio- and macroeconomic, and financial variables over many years.

In addition, it may include modelling second-order effects in response to public and/or private sector management actions. Therefore, various scenario analysis or stress testing exercises use simplified assumptions by translating the scenarios into instantaneous shocks.
The scenario analysis in this report aims to complement the exposure statistics in section 3 with a more forward-looking perspective. The aim is neither to evaluate the risks from climate change conclusively nor to provide a deterministic sequence of climate variables, but to gain further indicative insights on the risks and uncertainties around different scenarios. It also gives a direction for future work by the IAIS.

4.1 SCENARIO DESIGN

The exploratory scenario analysis employed in this report was conducted as follows:

- The starting point is the scenarios developed by the NGFS. These scenarios describe in a qualitative manner how insurers' asset classes may be impacted by physical and/or transition risks.
- As a second step, the scenarios are translated into numerical stress factors, which are differentiated by sector and asset class. To determine the risk factors, externals sources were used.[35]
- The final step includes an indicative quantitative assessment of the potential impact of the scenarios on the market value of insurers' investments. The investment exposures (see section 3) are multiplied by the risk factors.

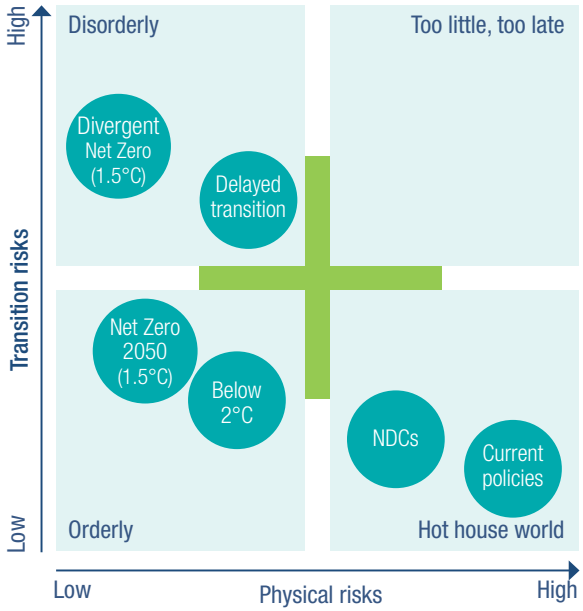
4.1.1 NGFS scenarios

The NGFS distinguishes four main scenarios with escalating severity:

- An orderly (early, ambitious) transition, consistent with a temperature increase of 2°C by 2100. This is the mildest scenario.
- A disorderly (late, disruptive action) transition, consistent with the same temperature increase but amplifying transition risk.
- A "hot house world" scenario consistent with a temperature increase of close to 4°C by 2100 and little or no transition policy, which focuses on physical risk.
- A "too little, too late" scenario which can be considered a worst-case scenario that exhibits both transition and physical risk.

Figure 2 represents these scenarios and Graph 10: illustrates examples of key variables under each scenario.[36]

Figure 2: NGFS scenarios



Source: NGFS (2021)

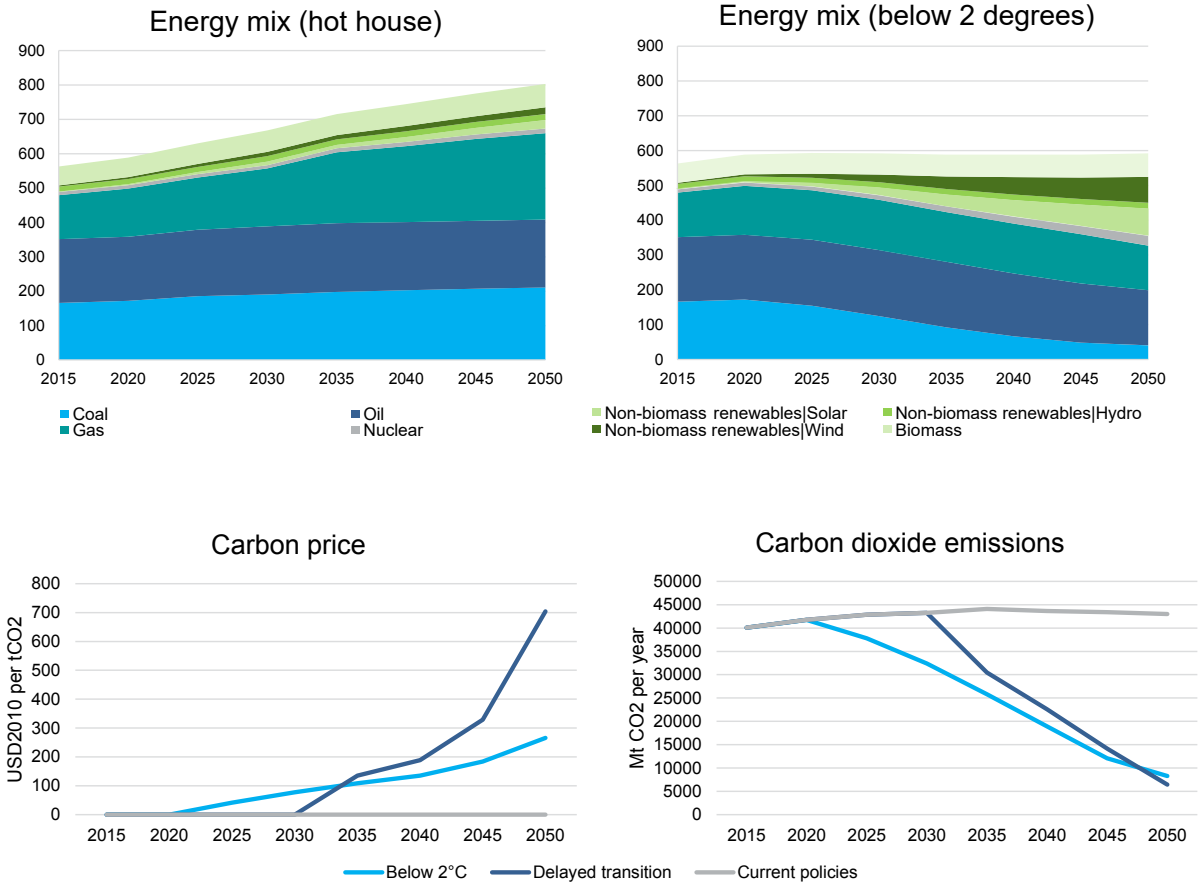
The NGFS has developed detailed quantitative information for three of its scenarios:[37]

- An orderly scenario assumes that climate policies are introduced early and become more stringent gradually. In one such scenario, net-zero emissions are achieved before 2050, limiting temperature rises to 1.5°C. A separate scenario featuring less stringent policy action would yield a 67% chance of limiting global warming to below 2°C. Physical and transition risks are both relatively low in such scenarios and transition risks are illustrated by a gradual shift from fossil fuels to renewable energy and a gradual increase in carbon prices.
- A disorderly scenario assumes that climate policies are not introduced quickly enough to minimise macroeconomic disruptions. As a result of late action, emissions reductions need to be sharper and more sudden or, alternatively, exhibit costly heterogeneity across sectors increasing the overall costs associated with the transition. The difference relative to an orderly scenario is clearly visible in Graph 10, which shows a sudden reduction in the total energy supply and a more sudden shift to renewables. Carbon prices also increase significantly. In this type of scenario, transition risks for carbon-intensive sectors, ie climate-relevant sectors in this study, are high.
- A hot house world scenario assumes that policies currently implemented or pledged at a national level are preserved, which will not be sufficient to meet the targets under the Paris Agreement. Emissions continue to grow, leading to warming of more than 3°C and significant physical risks. This includes irreversible changes like higher sea level rise.

The scenarios above differentiate between physical and transition risks. Actions taken in the disorderly scenario effectively reduce carbon emissions to levels below those in the orderly transition. By 2100, therefore, the manifestation of physical risk is minimal compared to the scenarios where the 2016 Paris Agreement targets are not met. Conversely, a "hot house" scenario is one in which transition risk is minimal, as no (or only limited) actions are taken to mitigate GHG emissions.

The NGFS illustrates an additional, "too little, too late" scenario framework that would contain elements of both risks, although it has not yet been quantified in detail. In this scenario, a critical volume of emissions become concentrated in the atmosphere before a disorderly or futile transition takes place. This "too little, too late" scenario would therefore exhibit both transition and physical risk. It contains pessimistic meteorological assumptions and significant economic disturbances.

Graph 10: NGFS scenarios – illustration on key variables



Source: NGFS (2021)[38]

The scenario analysis in this report estimates the value of insurers' current asset portfolios under an orderly transition, a disorderly transition and a "too little, too late" world. As the report focuses on transition risks, there is no separate analysis of a "hot house" or purely physical risk scenario. Instead, physical risk factors consistent with a hot house scenario are embedded in the "too little, too late" scenario.

4.1.2 Stress factors design for equity, corporate bonds, and loans and mortgages

As noted earlier, the data assessed for this report indicates that about 35% of insurers' assets on average are held in equities (including in investment funds), corporate bonds, and loans and mortgages.

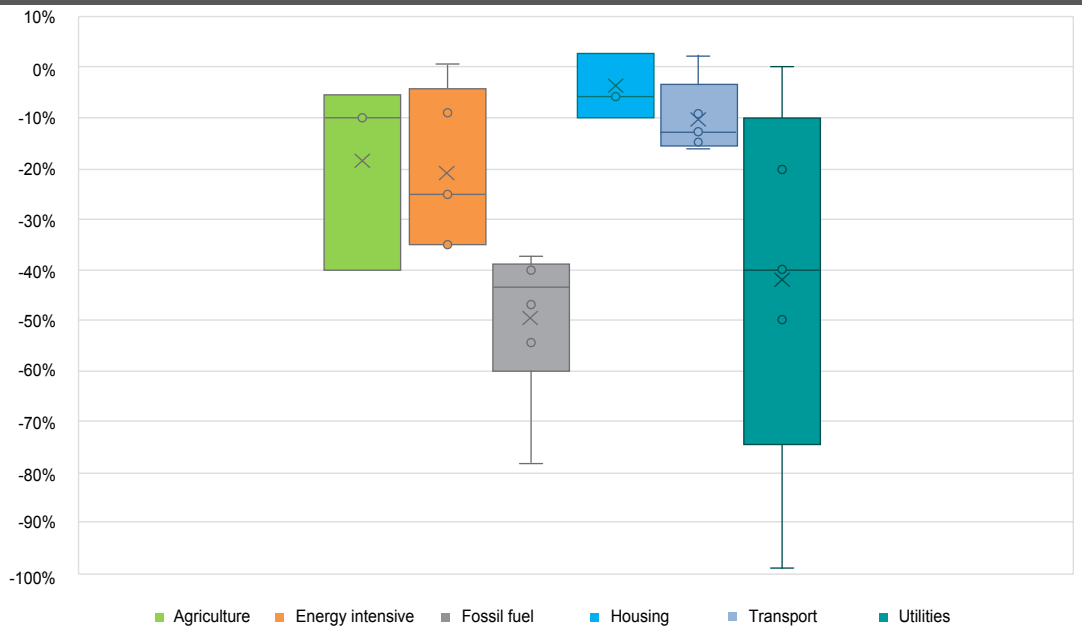
The effects of these adverse scenarios on the market value of insurers' assets are assumed to exhibit sectoral heterogeneity. For sector-level analysis, this report relies on scenario-consistent stress factors derived and applied in both the academic sphere and among supervisory authorities.[39] The stress factors consist of an arithmetic mean for each asset class and each climate-relevant sector, from those used in publicly available methodologies.

4.1.2.1 Orderly and disorderly transition scenarios

Equities

The range of the stress factors varies with respect to the asset class and sectoral segmentation. Graph 11 shows that most sectors exhibit moderate variance across the methodologies, although utilities shows greater uncertainty. By using information from a wide range of methodologies, less weight is given to any single stress factor — some of which may contain intentionally severe assumptions that are difficult to compare with those made in other studies.

Graph 11: Stress factors from supervisory studies and academic literature (equities)



Source: 2Degrees Investing, BdF, BoE, DNB, EIOPA, IMF and own IAIS calculations

Existing methodologies do not standardise the features distinguishing an orderly from a disorderly transition scenario. A disorderly scenario could consist of either late or abrupt policy action, with various degrees of macroeconomic spillover and disruption to the real economy. In contrast, an orderly transition may involve more moderate sectoral impacts and limited second-round effects on the real economy. To help differentiate between the two scenarios, this report assumes that an orderly transition involves half the market risk found in the disorderly scenario. Therefore the disorderly stress factors implemented in the existing literature have been multiplied by 0.5 to derive the stress factors used in the orderly transition scenario.

Corporate bonds, and loans and mortgages

In a number of studies, distinguishing stress factors across asset classes has been more challenging than across sectors. For instance, abundant historical market data for equities make it easier to econometrically estimate the co-movement of equities with macroeconomic variables affected by a carbon tax. It can be more difficult to apply similar quantitative methods for non-traded assets such as loans and mortgages. Certain studies, including that of the Bank of England (BoE) and EIOPA, have simplified the assumptions that derive the shock for assets such as corporate bonds as a fixed proportion of equity shocks in the same sector. Work is under way to derive a widely accepted and harmonised methodology for use within the industry and by supervisory authorities. In the interim, this report uses the same approach as taken by the BoE and EIOPA for the corporate bonds and loans and mortgages asset classes, with a fixed multiplier of 0.15 compared to the assumed impact on equities (for both orderly and disorderly transitions).

4.1.2.2 "Too little, too late" scenario

For the "too little, too late" scenario, the assumed stress factors are calculated as the sum of the following three components:

- A transition risk component: the sector-specific stress factors used in the disorderly transition scenario as described above.
- A physical risk component: sector-specific stress factors as used by BoE[40], ranging between 10% and 30% for equities, and 1.5% and 4.5% for corporate bonds, and loans and mortgages.
- A general market stress component: given the wide-ranging impacts of both physical and transition risks on the real economy in this scenario, it is assumed that all assets – not only those held in climate-relevant sectors – are affected. A constant stress factor of 10% was

applied to all other equities and 1.5% to all other corporate bonds, and loans and mortgages.

4.1.3 Stress factors design for sovereign bonds and real estate

For the sovereign bond and real estate asset classes, a geographic (rather than sectoral) approach is taken.[41]

4.1.3.1 Sovereign bonds

Transitioning towards carbon neutrality can affect a country's ability to issue debt in financial markets (or influence the market value of existing debt), due to the possibility of disturbances that may spillover into the real economy. Furthermore, high exposure to increasingly severe physical risks may affect vital infrastructure. Therefore, sovereign bonds are considered a climate-relevant asset class in this study, and a methodology relying on several data sources has been developed to produce jurisdiction-specific stress factors to apply to government bonds.

Several distinct data sources have been considered to develop this methodology. In order to provide a measure of a country's readiness as well as its vulnerability to the effects of climate change, the combined ND-GAIN Index was used to help demonstrate how a country's exposure to climate-related risks could ultimately impact its sovereign risk (see section 3). By considering readiness and vulnerability, this index reflects a country's exposure to both transition and physical risks.

The vulnerability component of this index specifically measures a country's susceptibility to physical risk ("exposure"), degree of sectoral dependence on at-risk sectors ("sensitivity") and current capacity to implement solutions ("adaptive capacity"). These factors are naturally difficult to quantify and often exhibit considerable inertia; indeed, "exposure" indicators are assumed to not vary over time in the ND-GAIN database. Nonetheless, the measures are based on 36 different variables and are rooted in a wide array of available datasets and scientific studies, providing important insight into the vulnerability of each country to climate change.

The readiness component is composed of nine variables (grouped into "social", "economic" and "governance" categories), which aim to measure a country's ability to cope financially with climate-related shocks.

As the depth and frequency of the underlying time series used can vary, this study integrates additional market-based data, credit default swap (CDS) spreads, to incorporate more current information on a country's creditworthiness. First, a statistical model, which predicts the (composite) ND-GAIN Index of 108 countries as a function of their respective five-year CDS spread data from the Bloomberg Default Risk model, is fitted. Graph 12 represents this visually.

Intuitively, this model yields an approximate measure for the share of cross-country variation in the ND-GAIN Index that can be explained, or determined, using CDS data. The remaining variation, unexplained by the model, reflects any variables unrelated to CDS spreads that influence developments in the ND-GAIN Index. To recognise their impact, this residual component (≈ 1.3), resulting from the statistical model, is added to the CDS spreads. The factors are therefore derived in the following way:

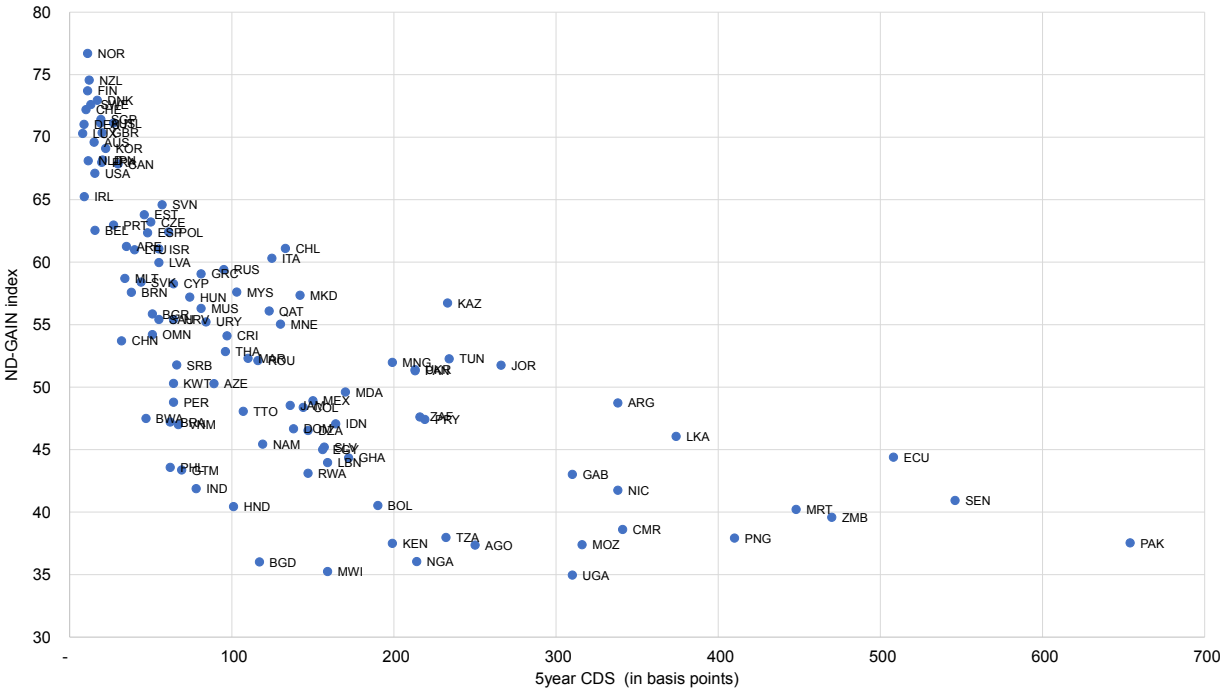
$$f^{Sov}_{country\ i} = 5Y\ CDS^{YE19}_{country\ i} * residual\ component$$

In sum, this approach magnifies the market-based CDS spreads data that is proportionate to the part of the ND-GAIN Index unrelated to a country's creditworthiness.

Financial and macroeconomic impacts are assumed to materialise with differing degrees of severity according to the orderliness of the transition. A higher degree of disturbance in a country's real economy will imply a higher degree of credit risk posed by a given sovereign debt instrument. At present, there is no widely used methodology for applying climate-related financial shocks to sovereign debt. The above method was thus implemented to retain the majority of information embedded in the ND-GAIN dataset, supplemented with more current market data. This approach may be imprecise and is not assumed to project highly certain impacts. Rather, it is a rough method for combining information from different datasets to form a single stress factor that is based on available data and reflects current market expectations.

Graph 13 shows the range of factors resulting from the model for all 108 jurisdictions where ND-GAIN and Bloomberg data are available. For most jurisdictions within the scope of this report,

Graph 12: ND-GAIN index versus five-year CDS spreads



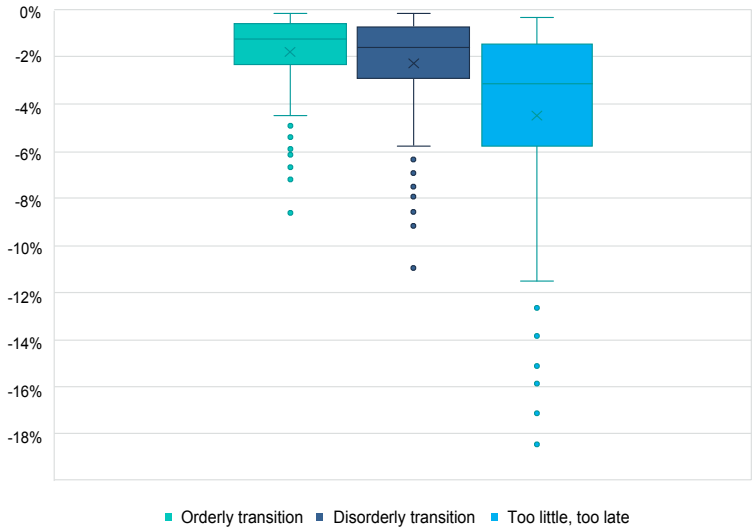
Source: ND-GAIN, Bloomberg and WorldGovernmentBonds

however, the factors are more modest, eg for the "too little, too late" scenario, factors range between 0.3% and 7.3%. This is because many of these jurisdictions either have relatively low CDS spreads and/or relatively high (favourable) ND-GAIN Index scores.

4.1.3.2 Real estate

Factors for real estate exposures were derived similarly to the methods described above. Exposures to climate-related risks differ among countries in line with their vulnerability to physical and transition risks.

Graph 13: Stress factors for sovereign bonds



Source: Bloomberg, ND-GAIN and own IAIS calculations

The real estate factors in this report contain:

- A transition risk-related component calculated using the Readiness ND-GAIN Index and five-year country CDS spread in a statistical model:

$$Transition\ component^{RE}_{country\ i} = 5Y\ CDS^{YE19}_{country\ i} * residual\ component$$

- A physical risk-related component calculated using the WRI[42] and an assumed recovery rate of 40%:[43]

$$Physical\ component^{RE}_{country\ i} = WRI^{2019}_{country\ i} * (1 - recovery\ rate)$$

As noted in section 3, a physical risk component is added using WRI data because the Readiness ND-GAIN Index may not be a comprehensive proxy for the climate-related risks associated with real estate within a particular jurisdiction. These stress factors are principally driven by physical exposure to natural catastrophes such as earthquakes, storms, flooding, droughts and sea level rise. The WRI data focuses specifically on natural catastrophe events most relevant for physical risks to real estate.

Similarly to the sovereign stress factors, various shocks to real estate prices were considered for the scenarios: the median (50th percentile) estimate of the models described above is applied in the orderly scenario for the transition component and in the hot house scenario for the physical risk component; and the 99.5th percentile is applied for the disorderly scenario and the "too little, too late" scenario. Graph 14 shows the range of factors resulting from the model for all 108 countries where information was available. As with the sovereign bonds, for most countries in the scope of this report, the factors may again be more modest, eg the median for the "too little, too late" scenario is 6.3% compared to 12.6% for the full sample.

4.1.4 Summary of stress factors

Table 3 summarises the stress factors employed for the asset classes and economic sectors for each of the scenarios.

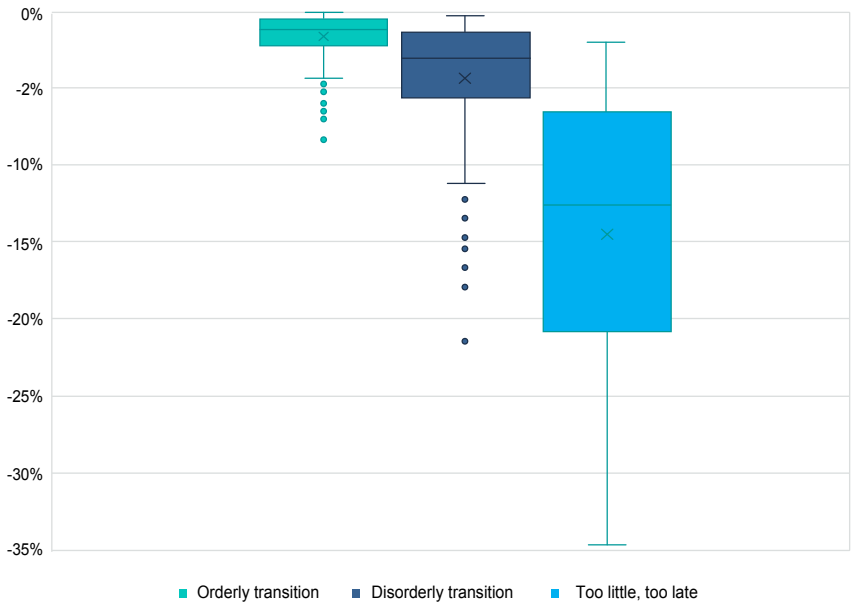
4.2 OUTCOMES OF SCENARIO ANALYSIS

The final step in the scenario analysis is to calculate the potential impact by multiplying the stress factors with the investment exposures. Before moving to the outcomes, it is important to highlight inherent limitations and assumptions within this analysis.

4.2.1 Limitations and assumptions

As the scenario analysis builds on the data collected for this report, the limitations listed in section 3.2 are equally relevant to the scenario analysis.

Graph 14: Stress factors for real estate



Source: Bloomberg, ND-GAIN and own IAIS calculations

Table 3: Stress factors

Asset class/economic sector	Orderly transition	Disorderly transition	Too little, too late
Equity			
Agriculture	9.2%	18.4%	33.4%
Energy intensive	10.3%	20.7%	40.7%
Fossil fuel	24.6%	49.3%	69.3%
Housing	2.2%	4.3%	34.3%
Transport	5.1%	10.2%	20.2%
Utilities	20.9%	41.8%	61.8%
Other	0.0%	0.0%	10.0%
Corporate bonds, and loans and mortgages			
Agriculture	1.4%	2.8%	5.0%
Energy intensive	1.6%	3.1%	6.1%
Fossil fuel	3.7%	7.4%	10.4%
Housing	0.3%	0.6%	5.1%
Transport	0.8%	1.5%	3.0%
Utilities	3.1%	6.3%	9.3%
Other	0.0%	0.0%	1.5%
Sovereign bonds*	0.1-2.8%	0.1-3.6%	0.3-7.3%
Real estate*	0.1-2.8%	0.3-4.9%	3.4-34%
Other (assets out of scope)	0.0%	0.0%	0.0%

** The applied stress factor differs per country (see explanations above).*

For instance, assets out of scope are not taken into account when calculating the impact of scenarios, although they may contain a portion of climate-relevant assets; therefore, the results in this section may not fully reflect the actual impact of the different scenarios.

The longer time horizons over which the risks from climate change manifest also present a challenge for quantitative scenario analysis. In these scenarios, assumptions need to be made about the timing of a shock and the evolution of the balance sheets over the time horizon. Given the limitations of the data, which excludes firm-level data and detailed information on maturities, balance sheets are assumed to be held static at their pre-stress levels (year-end 2019) and an instantaneous shock is applied. This means that changes in the valuation of liabilities or in the level of required capital are not considered.[44] Also, potential management actions are not considered.

Furthermore, second-order effects and other macroeconomic effects (like interest rate movements) are not considered. Finally, only the potential direct losses on asset values are considered. Any potential impact on risk-based capital requirements as a consequence of changes in the asset values, their ratings or assumed probability of and loss given default are excluded.

In addition, the stress factors in this paper are not derived from proprietary methodologies and are not aimed at contributing to the growing body of modelling linking climate risks with finance. This study uses loss factors applied in recent existing analysis and otherwise approximates risk factors using the best available data to capture, however approximately, the exposures to various risks intrinsic to each asset class and sector.

Overall, possible confounding factors on both sides of the balance sheet complicate the direct interpretation of the results provided here from a supervisory perspective. But, consistent with the NGFS guide for scenario analysis, the quantitative assessment is aimed at providing insight on the possible size of the aggregate risks faced by the insurance sector. This will create awareness and trigger a conversation on the need for possible (management) action. The analysis of greater implications for financial stability is also limited;

more sophisticated scenario analysis would be needed to fully assess the feedback loops between climate impact, the financial system and the real economy. For this exercise, the IAIS chose to limit the complexity of the analysis to reflect the current maturity of available tools and data at the global insurance sector level.

4.2.2 Outcomes

Focusing first on equities, corporate bonds, and loans and mortgages, Graph 15 reports the impact by climate-relevant sector for the total sample and by region. For example, for the equity portfolio of the total sample, it shows that the total losses range between 3% and 18% of the pre-stress value of equities, depending on the severity of the scenario. Also, energy-intensive assets appear to be the predominant sector contributing to the overall shock suffered by insurers in the transition scenarios, whereas the housing sector contributes

Graph 15: Scenario impact per economic sector (in % of pre-stress value of exposures)

NB: the Y-axis scale differs for the Latin America region.

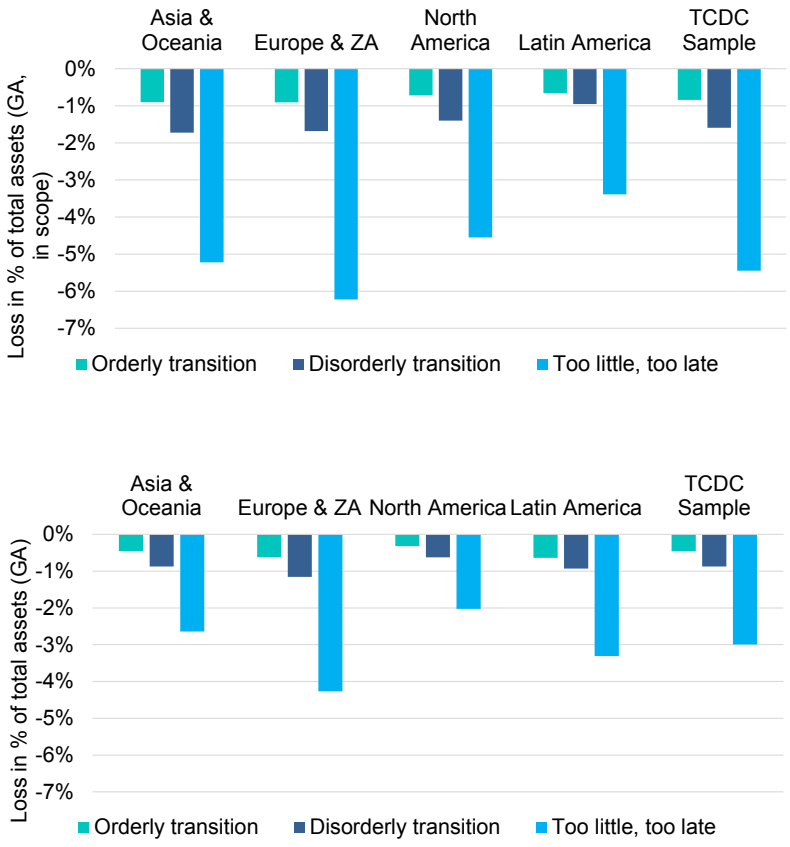
Source: IAIS data collections and own calculations

significantly to the total impact in the scenario that combines physical and transition risks. Graph 15 also shows regional patterns, reflecting the differences in asset composition and in exposures to economic sectors, as described in section 3.

The following graphs present the total impact of the different scenarios in terms of total assets and total required capital. As discussed above, the data collection underlying this study exhibits several heterogeneities. First, as the availability of information on asset classes and sectoral splits varied across jurisdictions, some geographic areas demonstrate a higher overall exposure to losses (in relation to total assets or total required capital) merely as a consequence of a more complete mapping of their portfolios. As more assets are identified (in terms of asset class and climate relevance), losses increase mechanically as unidentified assets remain unshocked. Further, each jurisdiction in the data collection is subject to different prudential standards and accounting principles, precluding a clean comparison of results across regions. Therefore Graph 16 shows the losses represented as a share of total assets from two different perspectives. First, as a proportion of those assets covered in the analysis and, second, as a proportion of total assets. These two graphs thereby illustrate that the impacts are partly driven by the share of the total assets that have been classified and subsequently subjected to a stress factor.

Graph 17 presents the total impact on solvency ratios for different scenarios, for the total sample. Further, as discussed above, these figures do not purport to show a comprehensive post-shock estimate of any one market's solvency position. Rather, these ratios are a useful way to express the relative scale of each impact while speaking to the insurance sector's readiness to face such losses from a prudential point of view.

Graph 16: Impact of scenarios on total assets of insurers



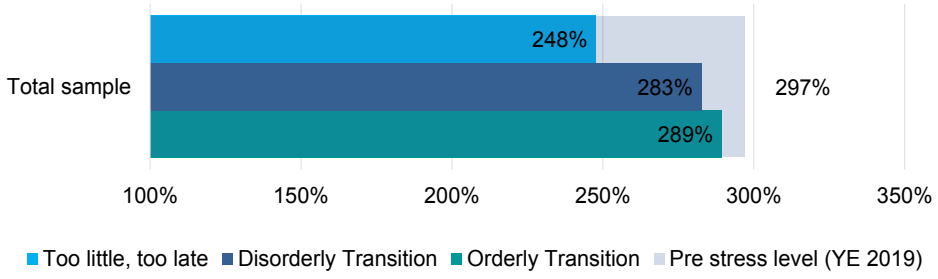
Source: IAIS data collections and own calculations

The results below provide several important insights. First, averaging across all geographic areas, insurers appear sufficiently capitalised to face various magnitudes of transition risk. The risk presented by a disorderly transition amounts to slightly less than 15% of capital requirements of the full sample, while on average insurers are capitalised at almost 300% of this level. When expressed in terms of total assets, the impact of a disorderly transition remains below 1% (Graph 16).

The integration of the physical risk component in the worst-case "too little, too late" scenario significantly magnified the losses. Nonetheless, despite the significant impacts when both types of climate-related risks manifest simultaneously, these results suggest that the insurance sector as a whole remains capable of facing even a severe climate-related shock to its investment portfolio, with an estimated impact of 3% of total assets (Graph 16) and almost 50% of required capital (Graph 17). This finding also holds at regional levels, with post-stress solvency ratios remaining well above the minimum prescribed capital requirement of 100% in all regions, although these high-level findings may hide possible concentrations in exposures at the individual insurer level.

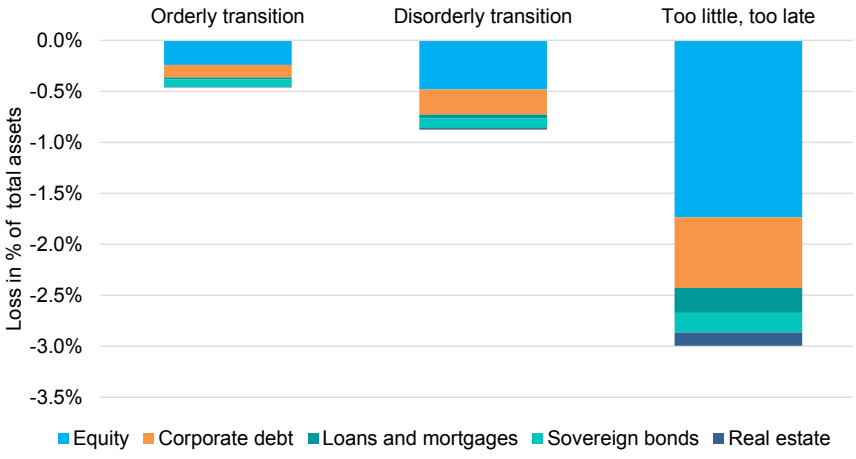
Finally, Graph 18 reports the total impact of the scenarios on the insurance sector, broken down by asset class. On average for the total sample, these results show that equities – while less present than corporate or sovereign bonds in insurers' portfolios – account for the largest share of the losses for the sample as a whole.

Graph 17: Impact of scenarios on solvency



Source: IAIS data collections and own calculations

Graph 18: Contribution of asset classes to the overall shock (TCDC sample)



Source: IAIS data collections and own calculations

5. MEASURES TO ADDRESS CLIMATE-RELATED RISKS IN THE INSURANCE SECTOR

Insurers can take various actions to reduce or manage their exposure to climate-related risks. Supervisors have a role to play by monitoring and assessing the risks as well as by setting out clear expectations and recommendations for insurers. This section provides an overview of measures taken, or in progress, to address climate-related risks in the insurance sector. It mainly discusses actions related to insurers' investments.[45]

5.1 PRIVATE SECTOR INITIATIVES

There is a growing number of industry initiatives aimed at improving the analysis and disclosures of climate-related risks and at supporting a sustainable transition. This section provides some notable examples.

5.1.1 Disclosures

In June 2017, the FSB TCFD released the TCFD Recommendations and Supplemental Guidance (TCFD Framework), which provides a framework for private companies and other organisations to develop more effective climate-related financial disclosures. The recommendations are structured around four thematic areas: governance, strategy, risk management, and metrics and targets. The TCFD has now shifted its focus to support implementation by issuing guidance particularly around the disclosure of forward-looking climate related metrics and use of climate scenarios.

The number of financial institutions that have signed on to the TCFD has increased markedly since the introduction of the TCFD Framework. At the time of writing, more than 2 000 organisations worldwide officially support the TCFD. Various governments and regulators are embedding the TCFD recommendations in policy and guidance, and some have moved toward requiring TCFD disclosures through legislation and regulation (eg the United Kingdom and New Zealand).

While support for the TCFD continues to grow, further progress is needed in implementing TCFD-aligned disclosures. Disclosures vary across regions and disclosures by smaller companies are still lagging. Finally, companies' disclosures of the potential financial impact of climate change on their businesses and strategies remain low.[46]

In September 2020, the International Financial Reporting Standards Foundation Trustees issued a consultation for comment to determine if there is demand for the development of global sustainability reporting standards. Feedback from the consultation confirmed an urgent need for these standards and support for the foundation to play a role in their development. The Trustees are therefore continuing their work to establish an international sustainability reporting standards board. A final decision about a new board is expected to be made before the November 2021 United Nations COP26 conference. The IAIS has expressed support for this important initiative.[47]

5.1.2 Other initiatives

Other initiatives aim to support institutions in assessing the alignment of their portfolios with various climate scenarios and with the Paris Agreement. Such tools also provide insight on possible transition risks associated with a disruptive shift to a low-carbon economy. Examples include the Paris Agreement Capital Transition Assessment tool[48] or the Science Based Targets initiative.[49] Various financial institutions including insurers are using these tools in their own analysis or to support TCFD-aligned disclosures.

MOST IAIS MEMBERS HAVE ISSUED, OR ARE PLANNING TO ISSUE, REQUIREMENTS OR SUPERVISORY GUIDELINES ON PUBLIC DISCLOSURES, SCENARIO ANALYSIS/STRESS TESTING AND INCREASED SUPERVISORY REPORTING.

The United Nations Environment Programme Finance Initiative has various initiatives to support sustainable investments. These include the Principles for Responsible Investment (PRI), a voluntary and aspirational set of investment principles that offer possible actions for incorporating environmental, social and governance (ESG) issues into investment practice. Since the launch of the PRI in 2006, over 3 000 investors have signed on. In September 2019, a further step was taken by setting up the Net-Zero Asset Owner Alliance, a group of institutional investors setting and reporting on targets for net-zero GHG emissions by 2050. At the time of writing, the 37 institutional investors that are part of the alliance, including 15 insurers, represent around US$5.7 trillion assets under management.

5.2 SUPERVISORY MEASURES

5.2.1 IAIS initiatives

To support awareness around, and implementation of, the TCFD recommendations, the IAIS and SIF published an Issues Paper on the implementation of the TCFD recommendations in February 2020.[50] The Issues Paper assesses awareness of the TCFD recommendations and their implementation within the insurance sector, sets out a range of supervisory approaches to encourage implementation, and discusses the relevance of the TCFD Framework to IAIS supervisory material.

In May 2021, the IAIS and SIF published an Application Paper on the supervision of climate-related risks in the insurance sector,[51] providing guidance for supervisors to integrate climate-related risks into their supervision. The sections on investment policy, risk management and disclosures are particularly relevant to the topic of this paper. The Application Paper includes recommendations and examples of good practice on the role of the supervisor, corporate governance and risk management, enterprise risk management for solvency purposes (including on scenario analysis and stress testing), investments, and disclosures.

5.2.2 IAIS Member initiatives

As part of the data collection, IAIS Members were asked to provide information on their analysis of climate-related risks and measures taken, or expected to be taken, to address climate-related risks, with a focus on risks stemming from investment exposures.

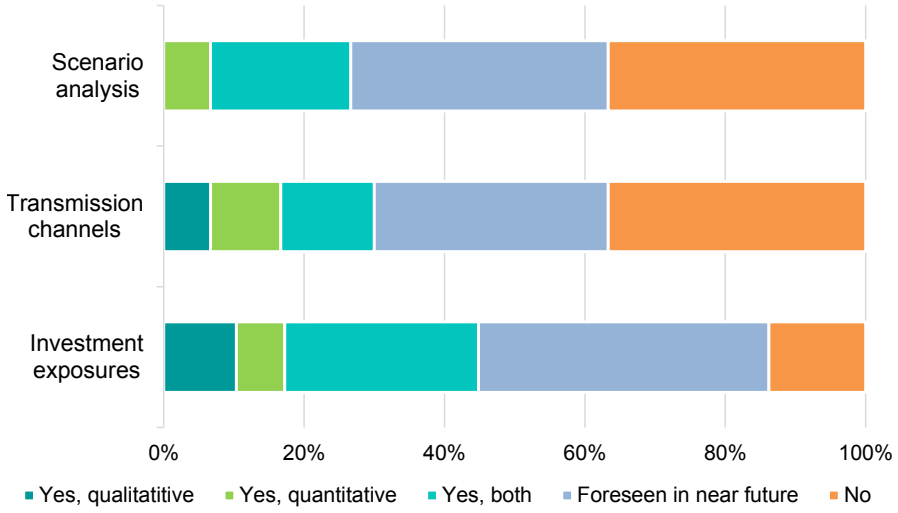
Around 30% to 45% of respondents are already undertaking their own analysis on climate risk, most of which include a quantitative component. An equally sizeable share of Members are planning analytical work in the near future.

Based on information received from Members, it appears that most Members have issued, or are planning to issue, requirements or supervisory guidelines on public disclosures, scenario analysis/stress testing and increased supervisory reporting. Most Members currently are not considering setting investment limits (see Graph 20).

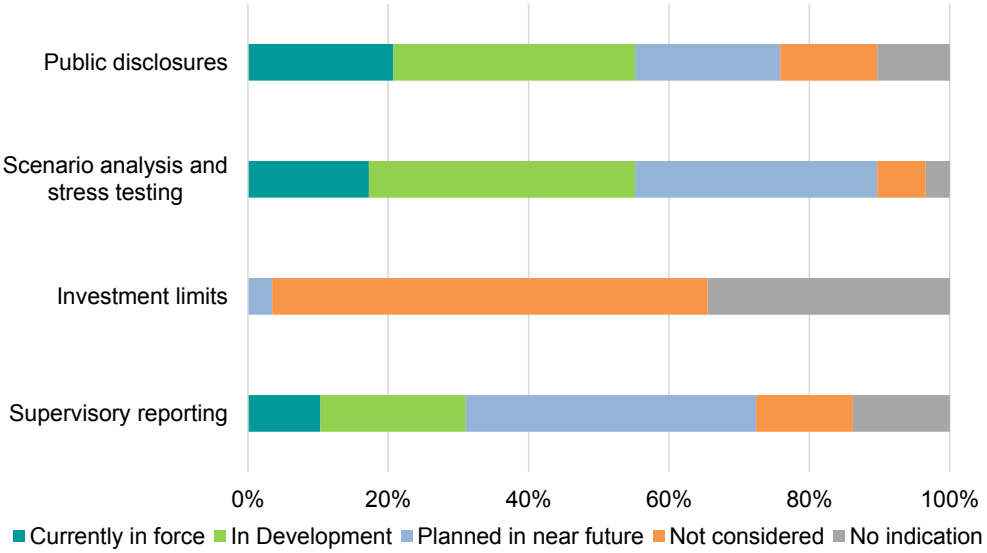
Other supervisory initiatives that are being implemented by Members include:

- Conducting screenings of assets based on ESG criteria
- Maintaining a dialogue with the industry on climate-related risks on a bilateral basis
- Using the “prudent person principle” in assessing investment exposures from insurers (ie, ensuring that insurers only invest in assets

Graph 19: Macroprudential climate risk analysis



Graph 20: Overview of supervisory measures taken or planned to be taken



that they can properly identify, measure, monitor, manage, control and report)

- Other measures not directly related to the investment exposures, such as awareness-raising and training initiatives, setting up dedicated units or hubs within the supervisory authority, considering inclusion of climate in natural catastrophe models used for capital requirements and including climate considerations into the governance and/or Enterprise Risk Management requirements.

6. CONCLUSIONS

Climate change poses a material risk to the economy and the financial sector, including the insurance sector. Changes in climate are already leading to more extreme and frequent weather-related events, thereby increasing the physical risks to which insurers are exposed. Transition risk is also highly relevant for insurers, with the magnitude of the risk dependent on various factors, including the pace of policy action and future changes in technology. Insurers will need to manage their investment exposures to those assets and sectors that are most vulnerable to transition risks. At the same time, the financial sector at large, including insurers and asset managers, is increasingly looking at ways to support a transition to net-zero emissions by reallocating investments to more sustainable investment opportunities.

Despite the increasing attention of the insurance sector (including policymakers and supervisors) to the financial risks posed by climate change, to date there is still little evidence on the magnitude of these risks – in particular at a cross-jurisdictional level. This report represents the first global deep dive analysis on insurers' investment exposures to climate-related risks, building on data collected from 32 IAIS Members covering 75% of the global insurance market and including a forward-looking scenario analysis, with the aim of providing insurers and supervisors with valuable information about insurer climate exposures.

The scenario analysis in this study is only a first step towards an assessment of the impact of climate change, including a possible disruptive transition, on the insurance sector. The outcomes of the scenario analysis depend partly on assumptions and methodological choices. Moreover, as climate change scenario analysis is a relatively new field of study, the uncertainty surrounding the assumptions is larger than in conventional stress tests or scenario analyses.

6.1 RECOMMENDATIONS AND NEXT STEPS

6.1.1 Recommendations for insurance supervision

This report underscores how important it is for supervisors to assess how climate change may affect the insurance sector and develop an appropriate supervisory response. In this respect, it is worth reiterating the following recommendations from the IAIS/SIF 2021 Application Paper:

- Supervisors should assess the relevance of climate-related risks for their supervisory objectives. They should collect quantitative and qualitative information on the insurance sector's exposure to, and management of, physical, transition and liability risks of climate change.
- Climate-related risks should be considered for inclusion in insurers' own risk and solvency assessments. It is expected that insurers will adopt appropriate risk management actions to mitigate any identified risks.
- Insurers should assess the impact from physical and transition risks on their investment portfolio, as well as on their asset-liability management. A forward-looking view, including the use of scenarios, may help insurers gain a better understanding of the risks.
- Material risks associated with climate change should be disclosed by insurers, in line with Insurance Core Principle ICP 20 (Public Disclosure). Supervisors may use the TCFD Framework when designing best practices or as input for setting their own supervisory objectives.

6.1.2 Next steps by the IAIS [53]

Future work by the IAIS on climate-related risks could refine the outcomes, especially with regards to data granularity and quality, analytical tools and broadening the scope of analysis. These activities were also outlined in the FSB roadmap for addressing climate-related financial risks (July 2021), notably the roadmap blocks on data and on vulnerabilities analysis. IAIS work will be important to provide the necessary insurance sector perspective in international efforts to identify and address data gaps, define metrics and analyse financial stability.

THIS REPORT UNDERSCORES HOW IMPORTANT IT IS FOR SUPERVISORS TO ASSESS HOW CLIMATE CHANGE MAY AFFECT THE INSURANCE SECTOR AND DEVELOP AN APPROPRIATE SUPERVISORY RESPONSE.

Data

To continue to monitor the climate-related risks faced by the insurance sector, the IAIS will consider how to embed climate risk into the regular GME in a more structured manner, in line with data needs and uses. This would allow for the assessment of trends over time and help improve data quality. When developing data-related proposals for inclusion in the GME, the following aspects will be taken into account:

- Data and analytical needs to assess climate-related risks to the insurance sector and possible transmission of risks to the financial system and/or real economy
- Progress made at the global and regional level in developing a taxonomy or classification of assets in relation to climate and/or sustainability factors
- Progress made by insurers and IAIS Members in disclosure and supervisory reporting on climate-related risks
- The potential benefits of using more granular data from individual insurers, instead of relying only on data at the sector-wide level, which include the fact that aggregate, sector-wide data do not provide a full picture of possible concentrations in exposures
- The potential additional burden for IAIS Members and/or insurers when increasing the size of the data collection.

Analytical tools

The IAIS will consider further developing its macroprudential analytical tools, including emerging good practices on climate risk scenario analysis. The work on climate risk scenario analysis and stress testing is still in its infancy. Lessons learned from this GIMAR project and from the experience of IAIS Members and insurers may be used to identify good practices. Ultimately, this will also provide support to IAIS Members that want to initiate scenario analysis exercises while also addressing concerns of market fragmentation and supporting the development of a consistent international approach to climate risk scenario analysis.

Scope of analysis

A comprehensive assessment of climate-related risks should consider both physical and transition risks and consider insurers in their roles both as investors and as underwriters. Future work by the IAIS may therefore also include insurance underwriting risk, which is unique to the insurance sector. Another issue gaining attention is the potential supervisory and financial stability risks stemming from a disorderly transition to net-zero emissions. A related analysis could consider questions around product innovation, insurance coverage gaps (availability and pricing of insurance cover) and shifts in investments.

END NOTES

1 The GME is the IAIS' framework for monitoring risks and trends in the global insurance sector and assessing the possible build-up of systemic risk; it is a key pillar of the IAIS Holistic Framework for the Assessment and Mitigation of Systemic Risk in the Insurance Sector (Holistic Framework).
2 An economy where all man-made GHG emissions in a given year are simultaneously removed from the atmosphere.
3 See NGFS (2019), First comprehensive report: A call for action, Climate change as a source of financial risk; BIS / Banque de France (2020), The green swan, central banking and financial stability in the age of climate change; FSB (2020), The implications of climate change for financial stability.
4 Another relevant financial risk is liability risk (the risk of climate-related claims under liability policies, as well as direct actions against insurers for failing to manage climate risks), which is beyond the scope of this report.
5 The data collection was performed on a best-efforts and voluntary basis.
6 This schematic representation builds on the concepts developed within the IAIS Holistic Framework and conceptual frameworks studied by other institutions such as the European Systemic Risk Board, EIOPA and NGFS.
7 FSB report "The Implications of Climate Change for Financial Stability", https://www.fsb.org/wp-content/uploads/P231120.pdf (2020).
8 Inspired from an extract of "The Green swan", https://www.bis.org/publ/othp31.pdf; IAIS/SIF (2021); and NGFS (2020) Guide for supervisors.
9 These dimensions are relevant to any type of financial institution with asset-side exposures vulnerable to these risks, but should be interpreted here as an insurer's balance sheet.
10 Depending on the jurisdictional circumstances, flood risk may be insured fully, to an extent or not at all. If insurance coverage is available, the losses will shift from an investment risk to an underwriting risk of the insurers that offered the coverage.
11 Cf. section 2.1, under « market risk ».
12 Corporates that have subscribed coverages (in excess of loss or against customers' default) when the triggering event of these coverages arises.
13 Changes in assets allocation when many financial actors (including insurers) act against sudden cash outflows happening at the same time.
14 See "NGFS Climate Scenarios for central banks and supervisors" (2020), p.9.
15 There may be significant differences between insurers and regions.
16 Including work undertaken by the BCBS (2021b), EIOPA, such as that published in its 2018 financial stability report: https://www.eiopa.europa.eu/content/financial-stability-report-december-2018_en
17 Stefano Battiston is Associate Professor at University of Zurich - Department of Banking and Finance and Lead Author of IPCC Chapter 15 Climate on Investment and Finance.
18 NACE is the official classification of activities within the European Union. Each activity sector is assigned a 4-digit code, following a hierarchical structure. More information on the NACE Rev 2 is available at https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF
19 "https://www.finexus.uzh.ch/en/projects/CPRS.html" UZH - FINEXUS: Center for Financial Networks and Sustainability - Climate Policy Relevant Sectors
20 This regulation provides a list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage, eg manufacturing of cement or basic iron and steel.
21 To fully assess climate-related risks within a particular country, especially physical risks, information that is more spatially granular (eg at the regional, municipality or postal code level) would be needed.
22 https://gain.nd.edu/our-work/country-index/.
23 See European Investment Bank (2021), which includes references to several studies including by Moody's and Standard and Poors, IMF (2020) and Feyen, E. et al (2020).
24 See for instance an analysis on the Belgian financial sector, National Bank of Belgium Financial Stability Report 2020, 141-150 https://www.nbb.be/doc/ts/publications/fsr/fsr_2020.pdf
25 For example, in the Netherlands, commercial buildings will have to meet a minimum energy standard from 2023 onwards, and in the United Kingdom, properties with an energy performance label in the lowest two categories may not be rented out as new leases or renewals as of April 2018, and this will be extended to existing leases from 1 April 2023, with significant penalties for non-compliance.
26 For example, a financial leasing company that is part of a group producing cars might be allocated to the financial sector by one insurer, while another insurer might classify the same company within the transportation sector.
27 Australia, Austria, Belgium, Bulgaria, Bermuda, Brazil, Canada, Switzerland, Colombia, Costa Rica, Germany, France, United Kingdom, China – Hong Kong, Chinese Taipei, Hungary, Ireland, Iceland, Italy, Japan, Lithuania, Mexico, Malaysia, the Netherlands, Peru, Portugal, Russia, Singapore, Slovakia, Slovenia, South Africa and the United States.
28 The pie charts in Graph 4 include a component for assets with no climate-related information available. That component may include assets that are climate-relevant.
29 For European Union jurisdictions, data by NACE codes were obtained as a combination of data from Solvency 2 reporting and from the European Centralised Securities Database and from the Centralised Securities Database (CSDB) of the European System of Central Banks.
30 Namely, NACE (introduced above), North American Industry Classification System (NAICS) and the International Standard Industrial Classification of All Economic Activities (ISIC).
31 Annex: Regional Factsheets (Global Renewables Outlook) (irena.org).
32 The treatment of assets within the financial sector implied the use of data from the IAIS Sector Wide Monitoring.
33 Basel Committee on Banking Supervision (2021), Climate-related financial risks – measurement methodologies.
34 See NGFS (2020), Guide to climate scenario analysis for central banks and supervisors.
35 No proprietary, micro-founded framework to calibrate sectoral stress factors was developed for this report. Although this approach prevents novel methodological advancements, it increases comparability with results in existing studies.
36 Summary statistics and detailed graphics showing the contents of three of these scenarios can be found on the NGFS website (but have not yet been developed for "too little, too late").
37 The NGFS developed variations on these categories of scenarios, including different assumptions around technology. For this report, these are not further examined. Shifts in technology could, however, have important implications for scenario results and the future paths of the economy and climate. For instance, varying assumptions around wind and solar technology and their prices may have a positive impact on the economy overall, but a strong negative impact on the fossil fuel sector.
38 Carbon prices are defined as the marginal abatement cost of an incremental ton of GHG emissions.
39 Including from the 2Degrees Investing (2019), Bank of England (2019), De Nederlandsche Bank (2018), EIOPA (2020), IMF (2020), and Banque de France (2021).
40 Most publicly available studies focus on transition risk scenarios only when assessing climate-relevant sectors; therefore the factors proposed in BoE (2019) were used for this report.
41 In a limited number of submissions, no information was available on the geographical split of sovereign and real estate exposures. For the scenario analysis, it was assumed in these cases that a proportion equal to that of the weighted average of those submissions with detailed information (~50% for sovereign, ~80% for real estate) was held within the home jurisdiction. The remaining exposures without geographical information were excluded from the scenario analysis.
42 https://weltrisikobericht.de/weltrisikobericht-2020e-neu/.
43 A recovery rate assumption of 40% is commonly used in default risk models and industry reports.
44 Such changes may have material impacts on the actual post-stress solvency ratio, especially relating to "automatic" loss-absorbency features inherent in many insurers' balance sheets, such as the loss-absorbing capacity of deferred taxes or technical provisions.
45 For a more comprehensive overview of initiatives, see also FSB (2020), section 5.
46 See TCFD (2020).
47 See https://www.iaisweb.org/page/supervisory-material/comment-letters/file/94227/iais-statement-ifrs-foundation-trustees-consultation-paper-on-sustainability-reporting.
48 https://2degrees-investing.org/resource/pacta/.
49 https://sciencebasedtargets.org/sectors/financial-institutions.
50 See IAIS (2020).
51 See IAIS (2021).
52 The future work outlined here focuses exclusively on activities related to data collection and scenario analysis. Other IAIS activities, notably those related to supervisory practices, are not further discussed.
53 A recent EIOPA consultation, aimed at improving data quality and the availability of investment exposures to climate-related risks, is a noteworthy example. See https://www.eiopa.europa.eu/content/consultation-amendments-of-supervisory-reporting-and-public-disclosure-documents_en.

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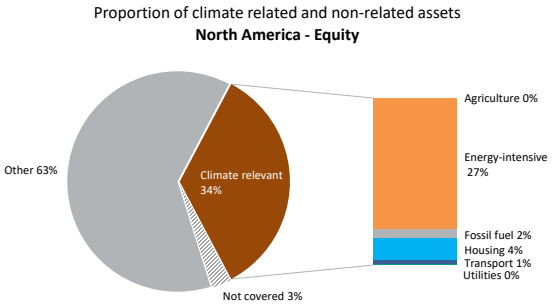
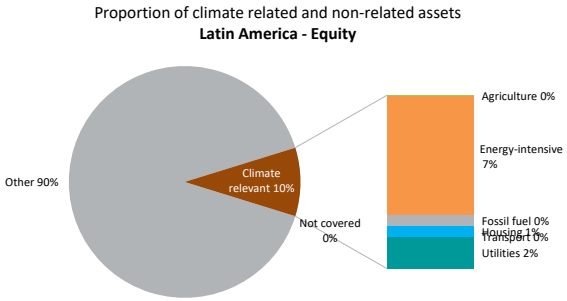
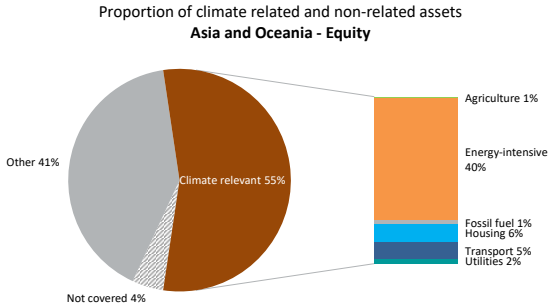
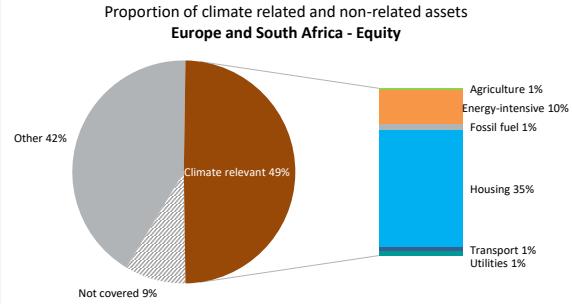
ANNEX

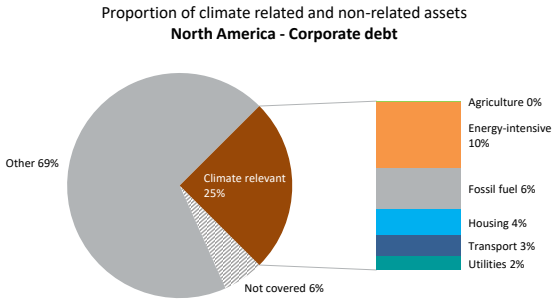
REGIONAL STRUCTURE OF EQUITY, CORPORATE BONDS, AND LOANS AND MORTGAGES

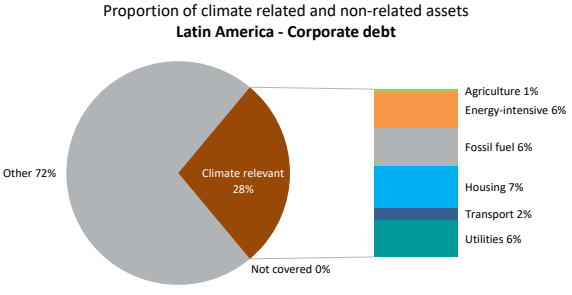






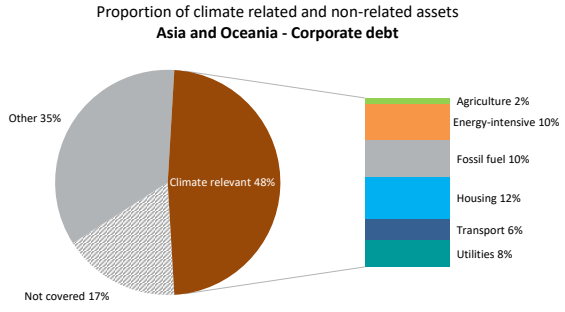


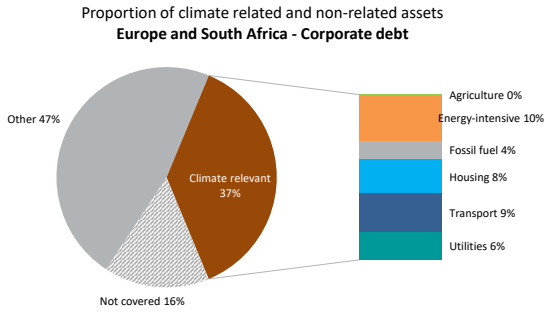


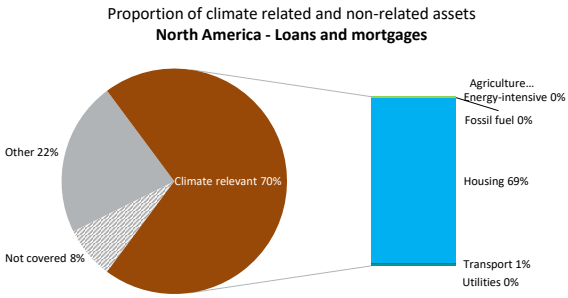


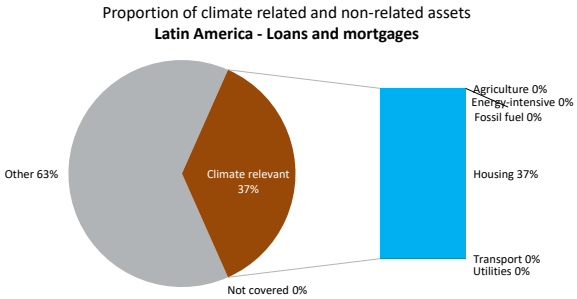
Not covered Other Agriculture Energy-intensive Fossil fuel Housing Transport Utilities

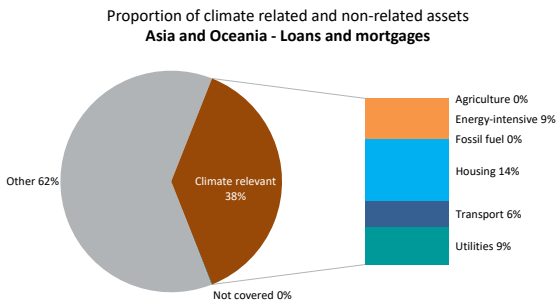
Source: IAIS data collections

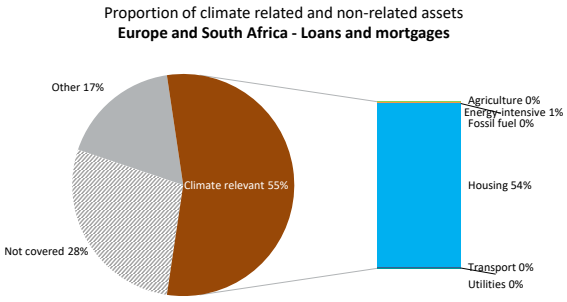












Source: IAIS data collections

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