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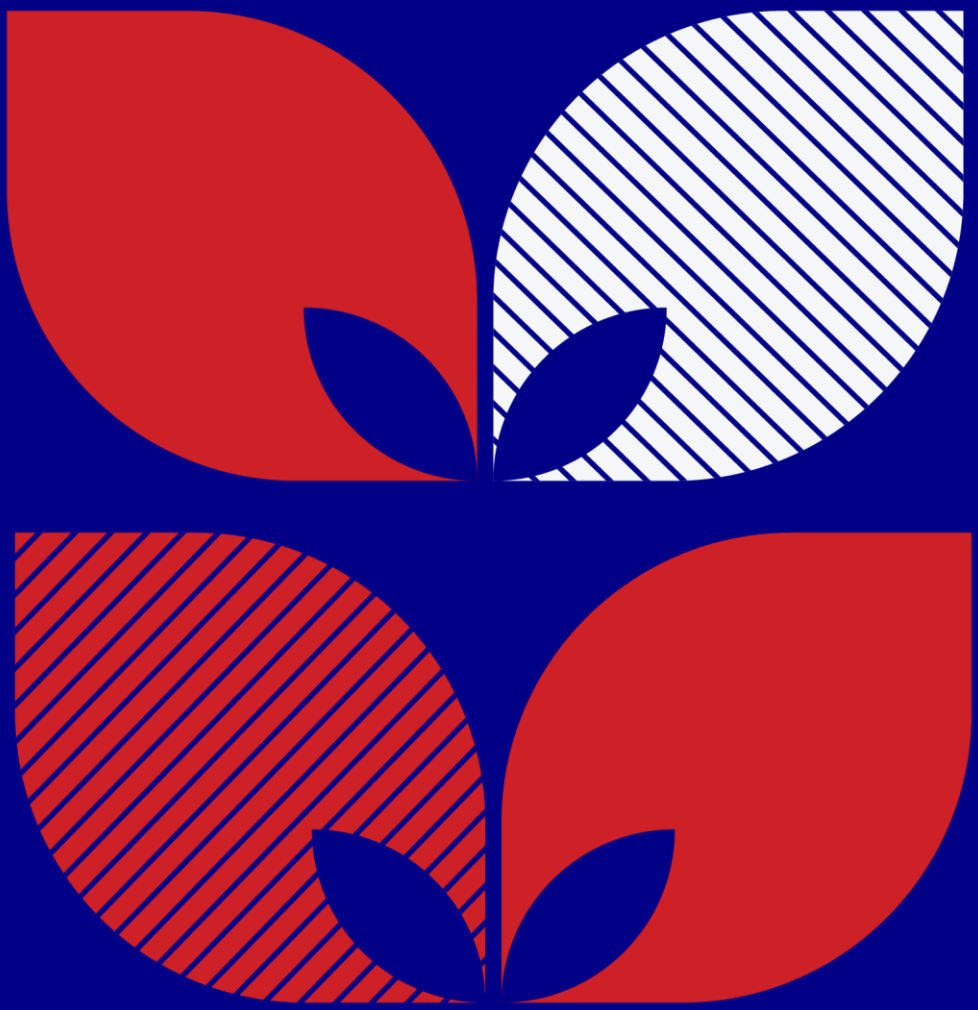

Too Hot To Insure

Avoiding the insurability tipping point

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POLICY PAPER

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Foreword

There is no doubt that climate change is accelerating and will increase the likelihood of significant disruptions to many communities around the world, including the insurance and broader financial sector.

While governments, businesses, and communities will need to do the heavy lifting to achieve the transition to net zero, the insurance sector has an important role in supporting climate risk mitigation efforts. An orderly transition to net zero, where economic incentives are aligned with goals to achieve net zero, is essential to avoid economic disruptions and financial instability.

The insurance sector also has an important role to play in supporting climate risk adaptation activities that will be crucial to maintain affordability and availability of insurance coverage.

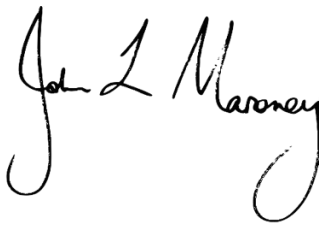
Considering the significance of insurers' pricing and underwriting approaches in addressing climate-related risks, the staff of the Global Asia Insurance Partnership (GAIP) collaborated with Financial Stability Institute (FSI) on this paper to encourage the insurance sector's consideration on how climate change implications should be factored into pricing and underwriting decisions.

This paper draws on a survey of selected insurers and insurance regulators on the current state of development of responses to the increased risks facing global communities, particularly in Asia, due to climate change and how these are relevant for the insurance sector.

The paper concludes that we cannot afford inaction. Understanding and responding to the many implications that climate change presents is crucial. Without a concerted effort, insurability tipping points may be crossed and some communities may lose access to insurance coverage when most needed, thereby increasing protection gaps which are already of major concern in many Asian countries.

GAIP seeks to facilitate close collaboration between the insurance industry, supervisors and policymakers. This paper will be a useful stepping stone to encourage the insurance community in Asia and the global insurance sector to take stock of the current situation and accelerate planning for an uncertain future.

We would like to express our appreciation for the comprehensive analysis and discussion undertaken by the paper's authors, Mr Jeffery Yong, Principal Advisor at the FSI and Ms Felicia Khoo, Director at GAIP. We would also like to thank all those who contributed to survey responses and who provided feedback on earlier versions of the report, including from many GAIP partners.



John Maroney
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Executive Summary

Climate change is accelerating with an increasing likelihood of widespread disruptions to the financial sector including the insurance sector. Global efforts to transition to net zero greenhouse gas (GHG) emissions, while commendable, are still uncertain in terms of their impact in slowing climate change. There is a chance that the global average temperature increase target under the Paris Agreement could be breached, pushing the world, the global economy and financial systems into uncharted territory. Efforts to facilitate a swift transition to a sustainable economy, including adequate risk adaptation, mitigation and coverage by economic agents, are therefore key.

Through their pricing and underwriting policies, insurers play an important role in both supporting climate risk mitigation efforts to transition to net zero as well as in incentivising risk adaptation measures. An increasing number of insurers are publishing transition plans that set out how they intend to support climate risk mitigation, including adjustments to their underwriting policies. An orderly transition to net zero is essential to avoid economic disruptions and financial instability. Some insurers are pulling out from insuring GHG-intensive sectors, and they do so in a gradual manner, recognising that some high emitters are taking steps to reduce their emissions. At the same time, insurers can incentivise climate risk adaptation efforts through their pricing and underwriting policies by recognising risk reduction measures in terms of reduced premiums or more favourable policy terms. Nevertheless, the insurance industry alone cannot mitigate climate-related risks – other actors such as governments, households and businesses need to play their part.

Given the relevance of insurers' pricing and underwriting policies to their safety and soundness, the affordability and availability of insurance coverage and net zero transition goals, supervisors need to assess such policies. Based primarily on a survey of selected insurance supervisors and insurers, this paper examines insurers' pricing and underwriting approaches from those three different perspectives. Depending on their specific mandates, supervisors may place different weights on these considerations in their regulatory or supervisory approaches. Insurance supervisors have an interest in climate risk adaptation, as this has a direct impact on insurers' risk exposures as well as on the affordability and availability of insurance coverage for consumers. On the other hand, while adequate climate risk management should contribute to an orderly transition, the role of insurance supervisors in directly promoting climate risk mitigation is arguably less clear as this could eventually collide with core prudential objectives.

Insurers' approach to underwriting and pricing of climate-related risks may have negative implications for financial stability. Under-pricing and overly optimistic underwriting could lead to solvency or liquidity problems for insurers. In contrast, en-mass withdrawals of coverage from economically significant sectors could cause unintended and disorderly economic dislocations. There could also be spill overs to other financial sectors – including the banking sector – if insurance is no longer available. For example, uninsurable properties may lead to credit becoming unaffordable or financial exclusion, as banks refuse to lend. Such properties may be disqualified as eligible collaterals, thus increasing credit risk exposure to banks.

Although most of the surveyed insurers do not currently explicitly account for climate change impacts when pricing insurance policies, there is a noticeable trend of increasing premiums and retracting insurance coverage. It is important to acknowledge that the rising cost of certain insurance coverage is not due entirely to the increasing frequency and severity of the insured perils, but also to increased exposures from the concentration of assets in high-risk regions. The surveyed insurers consider that any climate change impact would emerge through insurance claims experience, which is taken into account in regular pricing cycles. Moreover, short-term contracts – mainly non-life insurance – can be repriced on an annual basis, reflecting any projected climate change impacts. The surveyed life and health insurers, do not currently see an immediate, significant impact of climate change on the risks that they insure. As most of the surveyed insurers are not currently explicitly considering climate-related risks in their pricing or underwriting processes, it is difficult for supervisors to ascertain whether and to what extent products are under- or overpriced, both of which can lead to prudential problems. Nevertheless, as insurers gain greater awareness and knowledge in incorporating climate-related risks in their pricing and underwriting approaches, it is reasonable to expect further reductions in the availability and affordability of insurance coverage.

Insurance supervisors have a critical role to play in promoting adequate premium pricing and sound underwriting approaches. While insurers may be well-positioned to use their pricing and underwriting "powers" to influence or incentivise risk mitigation and risk adaptation measures, they should not do so at the expense of financial soundness. In other words, there is a limit to which the insurance industry can contribute to supporting climate risk mitigation and adaptation through favourable pricing and underwriting conditions. At the same time, at a broader policy level, supervisors and policymakers are

becoming more concerned with how climate change is reducing the availability and affordability of insurance coverage. This trend, if left unabated, may lead to an insurance market failure for climate-related risks and ultimately force governments to become "insurers of last resort". One way to address this policy concern is for governments, regulators, and the industry to work together to establish climate risk adaptation measures to contain insured losses from physical risks. However, not all supervisors have the mandate to support such policy objectives.

Within existing supervisory mandates, supervisors can address climate-related risks arising from pricing and underwriting processes through climate-related risk management requirements. In general, insurance supervisors expect insurers to adopt risk-based pricing and underwriting for any insurance products they offer. This applies similarly to products exposed to climate-related risks, though a major difference compared with other products is the high level of uncertainty due to unknown future climate change trajectories. Price increases and insurance coverage exclusions of certain climate-related perils are receiving greater supervisory scrutiny. A growing number of supervisors expect insurers to use scenario analysis to better understand the implications of climate change for their underwriting portfolios. Supervisors will need to collect the necessary data and rely on climate-related disclosures to assess insurers' underwriting exposure to climate-related risks. Nevertheless, technical (e.g. data issues) and capacity challenges need to be overcome if insurers are to properly address climate-related risks in pricing and underwriting. A major complicating factor is the uncertainty over future climate change impacts, which may unleash extreme events that have not occurred in the past for example due to climate tipping points.

One thing is clear – we cannot afford inaction. While there are many uncertainties in terms of how climate change might evolve, or whether transition policies will be impactful, one thing is certain – without further measures and concerted efforts by insurers, regulators, governments and the public at large, insurance against climate risks will become less affordable and available. Eventually, the insurability tipping point could be crossed in different regions and for various risks, which will no doubt result in a lose-lose situation for all stakeholders.

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Introduction

Introduction

Climate change is accelerating with an increasing likelihood of widespread disruptions to the financial sector, economy, society and humanity at large. Scientific studies[1] have shown that, without any doubt, human activities are causing profound changes to the Earth's climate system, mainly through greenhouse gas (GHG) emissions. The Intergovernmental Panel on Climate Change (IPCC) estimated that between 3.3 and 3.6 billion people are highly vulnerable to climate change. Climate change impacts are being felt in all regions, from extreme weather events such as heatwaves[2] and heavy precipitation to food- and water-borne diseases. Increasingly, climate change is causing irreversible losses in the Earth's ecosystems. These developments are causing widespread disruptions including in the insurance sector.[3]

Insurance supervisors should be concerned with the impact of climate change on the insurance industry.[4] There are some views that insurance supervisors, and indeed other financial sector supervisors, have no mandate to deal with climate change. Such broad statements are unhelpful. While insurance supervisors are not responsible for policies to directly address climate change, they should be concerned with how climate change is manifesting as financial risks for insurers[5] and policyholders given their mandate to safeguard the safety and soundness of insurers. Some may argue that there is no urgency as climate change is taking place gradually. This would be a mistake, not only because evidence suggests that climate change is accelerating, and climate tipping points[6] may suddenly be exceeded, pushing the world into unchartered territory with potentially rapid and catastrophic consequences. Moreover, policymaking takes time, and certain insurance activities may already be affected by future climate change impact, for example through long-term insurance policies or investments. Inaction or slow action is not a wise policy stance.

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[1] For example, see IPCC Sixth Assessment Report (2023). The World Weather Attribution found that extreme heat in North America, Europe and China in July 2023, which smashed the hottest temperature records in several locations, was made much more likely by climate change.
[2] Zachariah et al (2023) finds that the heatwaves in July 2023 in the United States/Mexico (affecting over 100 million people) and Southern Europe (with thousands of heat-related illness and deaths) would most likely not have occurred without human activities contributing to climate change. Nevertheless, it is important to acknowledge that not all weather events or natural catastrophes are due to climate change. Attribution studies are needed to derive scientific evidence of the extent to which climate change is a driver.
[3] A major study by The Geneva Association (2020a), (2020b), (2020c), (2020d), (2020f) and (2020g) on managing flood risks in a changing climate has taken a deep look at flood risks in five mature economies (Australia, Canada, England, Germany, and the United States) and the implications for insurance.
[4] See IAIS (2021b).
[5] In this paper, unless explicitly stated otherwise, the term "insurer" refers to both direct insurers and reinsurers, and "insurance" includes reinsurance policies.
[6] See McKay et al (2022).

Insurers play a central role in enabling consumers and businesses to cope with financial losses from various risks including financial risks arising from climate change. By pooling and diversifying risks, insurers are able to provide insurance coverage against unexpected events. However, there is a limit to this capability not least due to increasing difficulties in reliably estimating the expected cost of insurance coverage against climate-related risks.[7]

Climate change is testing the limits of insurability of climate-related risks and, consequently, the crucial role that insurers play in mitigating potential financial losses to consumers and businesses. For example, Bank of England (2022) estimates that around four million households in the United Kingdom will become uninsurable against flood risk by 2030 if no further action is taken to stem climate change. In Australia, Climate Council (2022) projects that one in 25 homes in Australia will be effectively uninsurable by 2030 due to climate impacts.[8] Insurers from Australia to the United States are withdrawing home insurance cover in several states or localities due, in part, to increasing climate-related natural catastrophe risks such as wildfires and hurricanes.[9] CRO Forum[10] (2023) highlights how climate change can have an impact on life, non-life and health insurers, which may lead to "socially undesirable effects and insurability dilemmas".

The insurance industry has a long history of and experience in dealing with new risks, and this adaptability will be useful in dealing with climate-related risks. Insurers are in the business of risks, and time and again they have managed to deal with new uncertainties, from providing coverage against HIV/AIDS – and, more recently, Covid-19 – to dealing with complex risks such as cyber risk. Through their traditional risk pooling and diversification role, insurers are critical actors in the financial system. In this regard, they are well placed to provide insurance solutions to consumers and businesses to protect against financial losses arising from climate change, provided climate-related risks continue to fulfil the key tenets of insurability.[11]

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[7] In this paper, "climate-related risks" refer to financial risks arising from climate change. These risks can arise from physical and/or transition risks.
[8] Paddam et al (2023) estimates that 12% of Australian households (or 1.2 million households) are experiencing home insurance affordability stress, spending on average 8.8 weeks of their income on home insurance.
[9] See M Maddison, "Where home insurance costs $30,000 a year – or you can't get a policy at all", *The Sydney Morning Herald*, 23 July 2023; J McDaniel, "Citing climate change risks, Farmers is latest insurer to exit Florida", *The Washington Post*, 13 September 2023; and State Farm General Insurance Company, "California new business update", 26 May 2023.
[10] The CRO Forum is an influential group of professional risk managers from the insurance industry that focuses on developing and promoting industry best practices in risk management. It consists of chief risk officers from large multi-national insurance companies.
[11] The Geneva Association (2020e) discusses the criteria of insurability, which include independent and predictable loss exposures, manageable maximum possible loss, large number of exposure units for risk diversification etc. In the context of Covid-19, the paper concluded that "uncontrollable aggregation and correlation elements of pandemic risk defy insurability in the commercial insurance space"; this may draw parallel comparisons with the insurability of climate-related risks.

Insurers play a key role in supporting climate risk adaptation and mitigation. In this paper, "climate risk adaptation" refers to addressing financial risks arising from climate change, while "climate risk mitigation" refers to contributing towards the transition to a low carbon economy. Arguably, insurers are already contributing to climate risk adaptation by providing coverage against certain natural catastrophes without explicitly pricing or underwriting for climate-related risks. Some insurers are going a step further by coming up with innovative risk mitigation products to support consumers and businesses in doing their part to contribute to a low-carbon economy, which in itself could entail new risks.[12]

Addressing climate-related risks is becoming a key priority for an increasing number of insurance supervisors. Global efforts to increase awareness of the relevance of climate-related risks are bearing fruits. The link between climate change and the financial sector is no longer disputable. There is general acceptance that climate change impacts can manifest in "traditional" risk categories, such as insurance, market, credit and operational risks. This fact alone should be sufficient to place climate change front and centre on the supervisory agenda. The main focus of insurance supervisors so far has been on the climate-related risk management practices of insurers.[13] Various insurance authorities have issued climate-related risk management guidelines, many of which refer to the work of the International Association of Insurance Supervisors (IAIS). In the context of risk management practices, some supervisors are monitoring the impact of climate change on the pricing and underwriting of insurance products.[14]

Insurance product pricing and underwriting practices are critical to insurers' solvency position, as well as to broader policy objectives relating to the availability and affordability of insurance. This paper aims to highlight the urgency of addressing climate change impacts in insurers' product pricing and underwriting practices [15], while acknowledging that many insurers have taken concrete steps to address climate change impacts. The paper also describes the role that insurance supervisors can play in integrating climate-related risks into insurance product pricing and underwriting. Based on a survey of eleven insurance regulators and nine insurers and brokers[16], this paper

[12] The Geneva Association (2020a), (2020b), (2020c), (2020d), (2020f) and (2020g) shows examples of what insurers can do in the areas of climate risk adaptation and risk management for floods, with detailed examples from Australia, Canada, England, Germany, and the United States.
[13] See Cleary et al (2019) for the initial focus of insurance supervisors on climate risk assessments.
[14] See PRA (2015). As far back as February 2015 the Prudential Regulation Authority held roundtable discussions with the industry on the pricing implications of climate change.
[15] To contain the scope of the paper, it does not cover niche climate-related insurance products such as parametric insurance.
[16] Insurer survey respondents include: AIA Singapore Private Limited, Allianz Insurance Singapore Pte Ltd, Aon Singapore Pte Ltd, The Great Eastern Life Assurance Company Limited, Manulife (Singapore) Pte Ltd, Prudential Assurance Company Singapore, SCOR Reinsurance Asia-Pacific Pte Ltd, Willis Towers Watson Brokers (Singapore) Pte Ltd and Marsh (Singapore) Pte Ltd. Regulatory survey respondents include: Australian Prudential Regulation Authority, Office of the Superintendent of Financial

outlines the extent to which some insurers are addressing climate-related risks in their product pricing and underwriting practices and the relevant regulatory requirements or supervisory expectations in these areas. Section 2 of the paper describes how climate-related risks affect the pricing and underwriting of insurance products; Section 3 provides a stocktake of relevant regulatory approaches in these areas; Section 4 provides a snapshot of industry pricing and underwriting practices; Section 5 highlights potential implications of existing regulatory and industry practices; Section 6 outlines challenges in integrating climate-related risks into pricing and underwriting and Section 7 concludes with key points for further reflection.

Institutions (Canada), Financial Supervisory Commission of Chinese Taipei, European Insurance and Occupational Pensions Authority, Insurance Regulatory and Development Authority of India, Financial Services Agency of Japan, South African Reserve Bank, Monetary Authority of Singapore, Office of Insurance Commission (Thailand), Prudential Regulation Authority (United Kingdom) and National Association of Insurance Commissioners (United States).

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Inter-relationships between climate-related risks and insurance product pricing and underwriting

Inter-relationships between climate-related risks and insurance product pricing and underwriting

Climate-related risks can be broken down into physical, transition and liability risks[17], each of which can affect the pricing and underwriting of insurance products.

- **Physical risks** can directly lead to increased insurance claims due to property damage or loss of lives arising from the heightened frequency and severity of climate-related events such as heavy precipitation or heatwaves, as well as secondary perils.[18] Heightened claims would eventually lead to premium increases and/or withdrawal of coverage. While physical risks are typically associated with non-life insurance products, the risks may also have an impact on life insurance through increased mortality and morbidity rates (for example due to extreme heat or cold), especially amongst vulnerable populations such as those with comorbidities, the elderly and outdoor workers.
- **Liability risks** can directly affect the pricing and underwriting of insurance products through litigation costs. PRA (2019a) highlights that insurers can be exposed to liability risks through directors and officers (D&O) liability insurance policies, from parties who have suffered a loss or damage from physical or transition risks seeking to recover losses from those they hold responsible. Australian Prudential Regulation Authority (APRA) (2021) notes that liability risks can also stem from potential litigation when institutions and boards do not adequately consider or respond to the impacts of climate change. An emerging risk that could add to insurers' liability risk exposures of insurers arises through the greenwashing of their investment-related insurance products.[19,20] From a broader policy perspective, increased litigation against players in GHG-intensive sectors may make it more difficult for them to obtain insurance coverage.
- **Transition risks** have relatively the most distant impact on insurance product pricing and underwriting compared with physical and liability risks. For example, businesses that suffer losses from transition risks may cancel or not renew their insurance coverage. D&O liability insurance policies[21] can be directly affected by transition risks, through litigation for action or inaction against climate change and greenwashing. Policyholders of investment- or unit-linked insurance products may be exposed to transition risks through stranded assets in their investment funds.

Climate change presents both risks and opportunities to insurers in relation to their product offerings. From a risk perspective, physical risks will increasingly affect insurance products that provide coverage against climate-related events. On the other hand, the

[17] IAIS (2021a) defines physical risks as risks arising from increased damage and losses from physical phenomena associated with both climate-related trends (e.g. changing weather patterns, sea level rise) and events (e.g. natural disasters, extreme weather); transition risks as risks arising from 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; and liability risks as risks of climate-related claims under liability insurance policies, as well as direct actions against insurers for failing to manage climate risks.
[18] Secondary perils are knock-on impacts from primary perils. Examples of secondary perils include floods following a hurricane.
[19] EIOPA (2023b) states that certain unit-linked products with sustainability-related words in their names can mislead consumers into thinking those have a positive impact on sustainability when in fact they do not.
[20] NGFS (2023b) examines the potential impact of climate-related litigation on financial institutions. The Geneva Association (2021b) reviews the climate litigation risk landscape and implications for (re)insurers.
[21] An insurer in our sample highlighted a potential emerging risk from "silent" coverage against climate risks, borrowing the term from "silent" cyber insurance coverage. This may occur in insurance policies that inadvertently or unknowingly provide coverage against climate change due to, for example, poor policy wording.

transition to net zero GHG emissions may provide opportunities for insurers to offer new insurance products that can support this goal (e.g. products that cover renewable technology such as carbon capture or special motor insurance policies for electric vehicles.) Nevertheless, such new products entail new risks that will need to be properly assessed and managed. While this paper focuses primarily on insurance product pricing and underwriting from the perspective of climate-related risks, it also covers new transition-related products for completeness.

Climate change can have an impact both on life and non-life insurance products (see Annex 1); however, the focus currently is mainly on non-life products. The relative importance placed on non-life products probably reflects the more evident physical risk impacts of climate change on property damage, though it should be understood that not all extreme events can be scientifically attributed to climate change alone.[22] Some of the surveyed regulators do not expect climate change to have a significant impact on life insurance exposures in the short term, though there is a growing body of studies[23] analysing the impact of climate change on mortality and morbidity rates. IPCC (2023) highlights that in all regions, increases in extreme heat events have resulted in human mortality and morbidity, and there are more occurrences of climate-related food-borne and water-borne diseases in certain regions and particular segments of society. As such, it can be expected that life insurance exposure to climate-related risks will receive greater attention.[24]

The main factors that determine the pricing of insurance products – probability of occurrence, severity of insured risk and exposed amount – are all on an upward trajectory for climate-related risks. Scientific studies point to an increased frequency and severity of certain climate-related events due to climate change. At the same time, risk exposures in terms of properties or populations located in climate-vulnerable areas are also increasing, along with repair or rebuilding costs.[25] On top of these factors, margins are typically added to allow for uncertainties, and these margins can be large given considerable future climate change uncertainties. It follows that premium rates for such

[22] Increasing insured losses from weather-related events may not be solely attributable to climate change. For example, Swiss Re (2023b) explains that insured losses are also driven by increased risk exposures from urbanisation and economic growth, putting properties and populations in exposed areas. Moreover, some extreme weather events cannot be conclusively attributed to climate change. For example, the World Weather Attribution (see Limited net role for climate change in heavy spring rainfall in Emilia-Romagna, 31 May 2023) found little evidence of climate change as the cause of the heavy rainfall in the North Italian region of Emilia-Romagna in May 2023. Such scientific precision is crucial in discussions about climate change impacts in the financial sector in order to avoid misleading statements that can over- or under-represent their implications.
[23] See for example McDermott-Levy et al (2021) and Vicedo-Cabrera et al (2021).
[24] The Geneva Association (2021a) describes how physical, transition and liability risks affect both life and non-life insurers.
[25] Swiss Re estimated that global insured natural catastrophe losses are increasing by around 5 – 7% annually, driven partly by a warming climate but even more so by rapid urbanisation.

products can be expected to increase at an accelerated rate. Box 1 provides a conceptual description of how the pricing of insurance products can take account of climate-related risks.

Insurance underwriting is a critical tool not only for managing risks but also for incentivising positive policyholder behaviours. Insurers' underwriting process determines which risks they are willing to accept and under what conditions and price, as well as those that they are unable or unwilling to underwrite. As such, underwriting plays a crucial role in determining the availability of insurance products that cover climate-related risks. In addition, underwriting is also useful for assessing the risk adaptation measures (e.g. fortifying building quality) that policyholders may take to enhance their resilience against physical risks. Such adaptation measures may increasingly become preconditions for insurance coverage to be provided or for premiums to be charged at affordable levels.

Another factor that determines the availability and affordability of climate-related insurance products is reinsurance. Insurers rely heavily on reinsurance to manage their risk exposures so that the insured losses that they incur remain within acceptable risk tolerance limits. According to the European Insurance and Occupational Pensions Authority (EIOPA) (2021), after a natural catastrophe event (which can be caused by climate change), reinsurance premiums typically increase due to higher demand for reinsurance cover, and lower availability of capital. Any reinsurance premium increase will ultimately flow through to the premiums charged to policyholders, thus sharply reducing the affordability of climate-related insurance cover. The US Federal Insurance Office (FIO) (2023) observes that reinsurers have been increasing reinsurance rates, limiting reinsurance coverage or even exiting certain markets due to the increasing frequency and severity of climate-related disasters.

Box 1

Pricing of climate-exposed insurance products

In general, the pricing of life insurance products based on actuarial principles involves projecting future cash flows using historical data, adjusted to reflect the insured risks and expected future developments, including climate change.o For non-life insurance products, event-based probabilistic loss exposure models may be used, taking into account scientific insights and engineering knowledge. Allowing for climate change impacts in the pricing of insurance products is easier said than done, partly due to uncertainties over future climate trajectories and the lack of relevance of historical data.

PRA (2019b) provides a practical guide for non-life insurers on how they can assess financial impacts from physical risks. It includes practical examples of how insurers can incorporate climate-related risks into the pricing of non-life insurance products. The following provides a selection of pricing considerations from the guide:

- Relevance and proportionality: Identify climate-related perils that are covered in the product and determine which are the most likely to alter as a result of climate change over the policy duration, noting that some perils that are currently not considered relevant may become relevant in the future due to climate change. Address material exposures that are most likely affected by physical risks.
- Scientific underpinning: Where a peril or territory exposure is material but there is limited scientific evidence of climate change impact, undertake research to establish whether scientific evidence suggests that climate change may affect risks unfavourably.
- Risk assessment tools: Existing risk assessment tools such as hazard maps,o footprintso and natural catastrophe models can be used to assess climate-related risks, recognising that each tool has certain pros and cons. The limitations and assumptions of each model should be made clear to decision-makers.
- Time horizons: Importantly, any tool adopted should be calibrated for expected future climate conditions over the relevant pricing time horizon.o
- Expert judgement: Expert judgement from professionals who are familiar with the perils concerned will be needed to calibrate the risk assessment tools and translate scientific results into impact on the perils' frequency and severity.o
- Uncertainties: Given the large degree of uncertainty of the modelling results, sensitivity analysis based on different climate scenarios will be critical to understanding the variability of results based on different assumptions. There could be multiple sources of uncertainty in a model (for example, with respect to each peril) which may lead to compounding effects.

Below is a stylised example of the steps that can be followed to price an insurance product with climate risk exposures:

Step 1: Identify materiality of insured risk exposure to climate change, by peril and location.

Step 2: Undertake background research based on studies done by government agencies or scientific climate bodies, acknowledging any uncertainties in those sources.

Step 3: Select a pricing tool or tools and calibrate the model based on the studies selected.

For example, in pricing property insurance that covers against flood risk, a hazard map approach can be used. Hazard maps based on national climate projections under different climate scenarios can be produced. Such maps with information on the maximum depth of flooding can be applied to a portfolio of property insurance policies to identify the expected loss due to flooding under each climate scenario, as well as the corresponding pricing uplift needed to cover the losses.

In practice, insurers use pricing models developed in-house or licensed from risk modelling vendors. Some reinsurers may offer pricing tools to their clients. Section 4 further elaborates on such pricing approaches.

O Professional actuarial bodies can support actuaries working in insurance companies to price climate-related products. Rothwell et al (2019) is one such example.

O Hazard maps provide location-specific information on the severity of a peril given a return period.

O Footprints are maps that show the severity of an individual catastrophe event based on historical events, single stochastic events or synthetic events.

O Rothwell et al (2019) states that some of these pricing models implicitly account for climate change trends, though it warns that the historical data used to calibrate these models can be irrelevant. For example, a once in 50 years flood in historical data may be very different from a once in 50 years flood in the future, as climate change will most likely alter the probability and/or severity of such occurrences.

O For example, translating rainfall rate change into flood loss impact.

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Overview of regulatory approaches to insurance product pricing and underwriting

Overview of regulatory approaches to insurance product pricing and underwriting

Regulatory objectives

Few insurance authorities have set explicit objectives in relation to climate-related risks. The Bank of England states that its climate objective is "to play a leading role, through our policies and operations, in ensuring the macroeconomy, the financial system, and the Bank of England itself are resilient to the risks from climate change and support the transition to a net zero economy." The objective flows through to its prudential regulatory framework, culminating in expectations for financial institutions, including insurers, to incorporate climate-related risks into their governance and risk management practices. EIOPA seeks to ensure that insurers integrate sustainability risks (including climate-related risks) into their risk management in order to protect consumers and secure financial stability. More specifically, the authority aims for insurers to continue offering relevant and affordable risk management solutions against natural catastrophes.

While other authorities do not have an explicit objective for climate-related risks, they do expect insurers to address climate-related risks in the pricing and underwriting of insurance products. This is in line with general supervisory expectations for insurers to manage any material risk exposures, including climate-related risks. In addition, many authorities acknowledge that climate-related risks may compromise the objectives of insurance supervision and threaten financial stability. The following are examples of how selected authorities consider climate-related risks within their insurance supervisory frameworks, noting the different areas of emphasis:

- **Australian Prudential Regulation Authority** (APRA) (2021) explains that the authority regards risks arising from climate change in the same way as other risks in discharging its mandate, which seeks to ensure that promises made by APRA-regulated institutions are met within a stable, efficient and competitive financial system.
- **Financial Services Agency** (FSA) in Japan states that addressing climate change is related to its supervisory activities and notes that financial institutions need to ensure both sound climate-related risk management and financial intermediary functions (including insurance underwriting) to support the decarbonisation of their clients and industries.[26]
- **The Prudential Authority**[27] in South Africa has signalled that it will integrate climate-related risks into its regulatory and supervisory approach and will articulate supervisory expectations about how firms should manage their climate-

[26] See FSA (2022).
[27] See Prudential Authority (2022).

related risk exposures. The authority expects insurers' boards and senior management to deal with changes to the pricing and insurability of affected assets as individuals, businesses and governments adapt to the effects of climate change.

A new common supervisory focus relates to encouraging insurers to use their "influence" to nudge customers to support the transition to a low-carbon economy. Insurance authorities in Chinese Taipei, Singapore, the United Kingdom and the United States expect insurers to engage with their clients to take climate risk mitigation measures. This may be seen as a new supervisory initiative with the supervisors taking a more active role in contributing to the decarbonisation of the global economy. Nevertheless, there are other insurance supervisors that take a more general view and do not specifically promote climate risk adaptation or mitigation measures. These regulators may instead focus efforts on climate risk adaptation on the grounds that there is well-established evidence on the linkage between risk adaptation measures and pricing or underwriting approaches.

Risk-based pricing and underwriting

The primary objectives of regulatory requirements or supervisory expectations on the pricing of climate-related risks are generally the same as those for other types of insured risk. The primary regulatory/supervisory objectives include ensuring that:

- premium rates are adequate and commensurate with risks (prudential/safety and soundness perspective);
- risks arising from inadequate pricing of insurance products are properly managed; and
- premium rates are not excessive and that policyholders are treated fairly (conduct perspective).

As with any insurance products, insurers are expected to apply risk-based pricing for insurance products exposed to climate-related risks. In the United States, state insurance regulators expect premium rates to be actuarially justified, which means charging more for higher risks and vice versa. If consumers take steps to lower their risk exposure to climate impacts, such measures should be reflected in their premium rates. In certain regulatory frameworks, supervisors specify risk-based pricing expectations in terms of insurers taking account of forward-looking factors such as expected climate change trajectory, interaction between different climate-related perils, geographical location of the risks and cost of reinsurance. While the risk-based pricing concept is difficult to disagree with, it may be difficult to implement in practice for insurance products exposed to climate-

related risks. This is because of uncertainties over future climate change as well as technical challenges such as the lack of data.

In regulatory regimes that require supervisory approval of insurance products, most insurance authorities apply existing governance requirements for products exposed to climate-related risks. Insurers are expected to consider all relevant risk factors when pricing and underwriting insurance products. They should also establish product-related risk mitigation and control measures such as ongoing monitoring of loss experience including from climate change. In Chinese Taipei, the Financial Supervisory Commission (FSC) (2022) requires insurance companies to include a catastrophe risk analysis and an underwriting risk control evaluation in the product submission materials.

Impact underwriting promotes underwriting practices that foster the important objective of climate change adaptation in insurance markets. EIOPA (2019) defines impact underwriting as "the development of new insurance products, adjustments in the design and pricing of the products and the engagement with public authorities without disregard for actuarial risk-based principles of risk selection and pricing". Consistent with actuarial risk-based principles, EIOPA (2021) explains how insurers, as risk managers and underwriters, can contribute to climate adaptation and mitigation. They can do so by applying their data, expertise and risk assessment capacity to incentivise policyholders to mitigate insured risks via risk-based pricing and contractual terms. Insurers can consider in their underwriting strategy measures that contribute to climate change adaptation and/or mitigation. For example, policyholders who take steps to reduce their exposures to physical risks would receive favourable underwriting and/or pricing terms.

Climate change, coupled with rising concentration of assets and populations in high-risk areas, is expected to impair the availability and affordability of certain insurance coverage. [28] PRA (2015) cites a study on rain-induced inland flooding insurance that projected a 27% premium increase under a four-degree temperature increase scenario, and a 47% premium increase under a six-degree temperature increase scenario in Great Britain. Beyond climate change, the biggest factor impairing the affordability and availability of certain insurance coverage has to do with the rising concentration of assets in high-risk regions, urbanisation and development choices, the destruction of nature-

[28] EIOPA (2022c) highlights that climate change can negatively affect the availability and affordability of non-life insurance products in the future. It would be interesting for future studies to assess by how much premium rates might increase for each product category in response to a 0.1-degree temperature increase, and at which point will cover will evaporate completely.

based systems, ageing infrastructure, and interconnected supply and value chains. Continued permission to rebuild in high-risk areas, and a lack of measures to stop destruction of natural systems, such as wetlands that can mitigate certain climate-related events will increase the impact of climate-related risks.[29]

Reduced affordability and availability of insurance coverage against climate-related risks is becoming a concern for some insurance authorities.[30] In Europe, EIOPA has made addressing protection gaps a priority of its broader work programme on sustainable finance. EIOPA (2022c) pointed out that risk adaptation measures are crucial to maintain the long-term availability and affordability of non-life insurance products in the light of climate change. In the United States, the FIO has been tasked with assessing the potential for major disruptions of private insurance coverage in regions of the country particularly vulnerable to climate change impacts.[31] The US National Association of Insurance Commissioners (NAIC) plans to collect data to help state insurance regulators better understand property insurance coverage and protection gaps in the light of increasing frequency and severity of weather events, rising reinsurance costs and inflationary pressures affecting the affordability and availability of property insurance.[32]

Some regulators are putting in place requirements for insurers to justify any premium increase or new exclusions for climate-related insurance coverage. EIOPA (2022b) highlights that, following the occurrence of systemic events (which it defines to include climate change), there is an increased risk that insurance products may become unaffordable, or unavailable for such events. Some insurers may review existing products to clarify the wording on exclusions or to include new exclusions without a proper application of product oversight and governance rules. To facilitate proper conduct by insurers and insurance intermediaries, the supervisory statement lays out expectations for the steps that these industry players need to follow before excluding coverage against systemic events including natural catastrophes arising from or affected by climate change. These steps include proper disclosure to customers and consideration of the needs and characteristics of the target market. Importantly, insurers are expected to strike an appropriate balance between the need to limit their losses and the need for products to align with the target market's needs, objectives and characteristics. Nevertheless, care

[29] The Geneva Association (2022) demonstrates how destruction of nature-based systems linked to development is also increasing the risk of extreme events.
[30] See IAIS (2023).
[31] See White House (2021). Some US states have introduced programmes that make basic insurance coverage available to high-risk policyholders who are unable to get insurance from private or "traditional" insurers. Examples of such programmes include Fair Access to Insurance Requirements and Beach and Windstorm Plans.
[32] See NAIC, "NAIC to issue data call to help regulators better understand property markets", 15 August 2023.

should be taken to avoid artificially capping premiums of certain products, despite rising risks, as this will lead insurers to withdraw cover.

Risk management

Most of the surveyed jurisdictions cover pricing and underwriting activities in general climate-related risk management requirements. [33], [34] Most climate-related risk management regulatory guidelines cover the key components of the Task Force on Climate-related Financial Disclosures (2017) recommendations. [35] The following are examples of how pricing and underwriting aspects are covered in selected risk management guidelines:

- **APRA** (2021) outlines supervisory expectations for financial institutions regarding how they consider climate-related risks in their risk management frameworks, including in their pricing and underwriting approaches. Insurers are expected to understand the interaction between climate-related risks and their business activities, as well as the compounding effect the risks may have on their insurance risk exposures through potential increases in insured losses.
- **In Canada**, in line with the principles-based supervisory approach, insurers are expected to have a sound forward-looking climate risk management framework that adequately identifies, manages and measures their climate-related risk exposures. The Office of the Superintendent of Financial Institutions (OSFI) (2023) places overall climate risk management responsibilities on senior management of financial institutions. Firms are required to incorporate physical and transition risks into their business model and strategy, as well as to establish transition plans to guide the management of these risks. They are expected to consider the effectiveness of their risk mitigating actions (including pricing and underwriting processes) and their impact on insurers' safety and soundness.
- **EU legislation** [36] requires insurers to manage sustainability risks and potential impact from inadequate pricing of insurance products.
- **Central Bank of Ireland** (2023) expects insurers to operationalise actions set out in their strategy and business model in their business-as-usual activities that include underwriting and pricing. Insurers are also expected to consider the potential impact of climate change on any models used in pricing and underwriting activities.
- **MAS** (2020) expects insurers to assess each customer's environmental risk as part of their underwriting assessments. Insurers are expected to consider a customer's ability and willingness to introduce risk adaptation measures and work with customers to set environmental-related metrics and targets.[37]

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[33] As with other regulatory issuances, the principle of proportionality would apply when incorporating climate-related risks into insurers' pricing and underwriting practices. APRA, MAS and the United Kingdom's PRA expect insurers to apply risk management expectations commensurate with their size, nature of activities and risk profile.
[34] Care should be taken to avoid generalising natural catastrophe-related guidance as addressing climate-related risks. Such an approach could give false comfort that existing regulatory guidelines cover climate-related risks adequately. There is a distinction between natural catastrophes and climate-related events. Not all natural catastrophes are due to or are affected by climate change.
[35] The TCFD recommendations cover four main components: governance, strategy, risk management and metrics, and target. These recommendations have been integrated into the recently published sustainability disclosure standards of the International Sustainability Standards Board (2023)
[36] See Article 260 in European Union (2014). The legislation defines sustainability risk as an environmental, social or governance event or condition that, if it occurs, could cause an actual or a potential negative impact on the value of the investment or on the value of the liability.
[37] See MAS (2022).

Control functions are expected to play a key role in addressing climate-related risks in insurers' pricing and underwriting approaches. In many jurisdictions, the actuarial function has the statutory responsibility to ascertain the soundness of insurers' pricing and underwriting policies and practices, though this is not specific to the context of climate-related risks. The EU's Solvency II requires the Actuarial Function Holder to express an opinion on an insurer's overall underwriting policy of an insurer as well as the adequacy of an insurer's reinsurance arrangements, both of which could cover climate-related risks. Given this supervisory reliance on the actuarial profession, a close interaction between insurance authorities and professional actuarial bodies can help insurers meet the relevant supervisory expectations properly.[38] Broader governance arrangements, for example accountability mechanisms, should support the role of control functions.[39] Some insurance regulators expect insurers to align their remuneration policies for senior management and control functions with sound pricing and underwriting practices.

Insurance regulators can support the integration of climate-related risks into insurers' pricing and underwriting practices by facilitating the sharing of industry good practices. MAS (2022) highlights emerging and/or good practices by selected insurers to serve as a reference for other insurers in order to facilitate their efforts to strengthen resilience to environmental risks. For example, it noted that insurers that have integrated climate-related risks into their underwriting policies would describe their sectoral approach to risk mitigation, such as prohibitions and restrictions or heightened customer engagement in the identified higher-risk sectors. In the EU, EIOPA undertook a pilot exercise in 2022 to better understand how insurers integrate climate-related adaptation measures into non-life underwriting practices and to foster discussion and knowledge-sharing across the industry.[40]

Risk adaptation

Climate risk adaptation is gaining the attention of insurance supervisors. "Climate risk adaptation" refers to measures to adjust to current and future impacts of climate change

[38] Chow et al (2023) is an example of how professional actuarial bodies (in this case, the Actuaries Institute in Australia) can support insurance authorities and policymakers, providing policy recommendations to address specific problems arising from climate change. The report offers a framework for prioritising policy actions to address the flood insurance affordability problem.
[39] For example, the PRA in the UK expects accountability from senior management in financial institutions when addressing risks and opportunities arising from climate change. The regulator requires firms, including insurers, to nominate a member of senior management to be responsible for that response.
[40] See EIOPA (2023a).

in order to minimise or prevent damage.[41] Clearly, insurance supervisors have an interest in climate risk adaptation as this has a direct impact on insurers' risk exposures as well as on the affordability and availability of insurance coverage for consumers.

Some insurance supervisors expect insurers to support consumers and businesses by providing insurance coverage against climate-related risks. The FSC of Chinese Taipei has been encouraging insurers to offer coverage against typhoon and flood risks as part of fire insurance products. The Office of Insurance Commission in Thailand has established a fourth Insurance Development Plan (2021-25) that includes encouraging insurers to develop crop insurance that provides coverage against natural perils such as windstorms, hail, floods, and fires.

Insurers can play a key role in enhancing the climate resilience of consumers and businesses by recognising risk adaptation measures in their pricing and underwriting policies. Where insurers pricing is risk-sensitive, insurance can incentivise policyholders to take risk adaptation measures to the extent that insurers recognise their impact in their pricing. Supporting clients' climate risk adaptation can minimise insurance claims pay outs. Central Bank of Ireland (2023) encourages insurers to consider how they may influence the activities of those they underwrite, for example by incentivising policyholders to mitigate insured risks through adaptation measures via risk-based pricing and contractual terms. FSA (2022) states that non-life insurers are expected to encourage their clients to enhance their resilience against natural disasters (including from climate change) by providing a consulting function for disaster risk reduction and disaster mitigation. In the United States[42], some states require insurers to provide premium discounts for consumers who have taken risk adaptation measures to a certain standard.[43]

Nevertheless, insurers face challenges in encouraging policyholders to take climate adaptation measures. EIOPA (2023a) notes that, for non-life insurance products, policyholders may not take adaptation measures due to a lack of appreciation of their climate-related risk exposures. In addition, insurers may not recognise adaptation

[41] See the European Environment Agency website for an example of a definition of climate risk adaptation. EIOPA (2023a) defines climate-related adaptation measures as structural and non-structural measures and services that are implemented by insurance undertakings or policyholders ex ante to a loss event, which reduce the policyholder's physical risk exposure to climate-related hazards through (i) lowering the frequency of climate-related losses or (ii) lowering the intensity of climate-related losses.
[42] NAIC has a database on climate risk adaption measures that consumers can take as well as state insurance requirements for climate risk adaptation premium discounts.
[43]For example, the Insurance Institute for Business and Home Safety (IBHS) Fortified standard for home insurance in Alabama.

measures due to high cost and a lack of financial incentives for policyholders to take such measures.

Increasingly, insurers are expected to engage with policyholders to understand their climate risk exposures. PRA (2019a) states that financial institutions, including insurers, should seek to understand the current and potential future impacts of physical and transition risk factors on their clients, including policyholders. If insurers do not have the necessary information, they are expected to engage with policyholders where this information is considered material to their own risks.[44] MAS (2022) recommends that insurers strengthen engagement with their customers, for example to consider their ability and willingness to introduce risk adaptation measures.

Insurance supervisors are increasingly focusing on high-risk consumers and businesses. This is probably because such segments can become exposed to significant climate-related financial losses without insurance support. Examples of regulatory requirements or supervisory statements in this area include:

- **Australia:** Insurers may choose to work with customers in areas exposed to greater climate-related risks in order to reduce underlying risks through building improvements. However, if such efforts do not adequately address those exposures, insurers may need to consider other actions such as applying exposure limits to such customers or, if no measures can be taken, terminating the relationship with those customers.
- **Singapore:** Insurers should put in place formal processes – for example by imposing underwriting conditions, premium loading or setting exposure limits – to manage high-risk customers who are unable or unwilling to manage their climate-related risks adequately.[45]

Supervisory efforts alone may not be sufficient to encourage risk adaptation measures by consumers. For example, several US states have introduced grant programmes and tax exemptions to help policyholders pay for home fortification measures in order to benefit from premium discounts from insurers. However, insurers also have a critical role to play. NAIC (2008) states that insurers have an interest in supporting public policy that reduces risks and makes them more predictable. For example, insurers can heavily influence land-use policy either directly as advocates for sustainable growth or indirectly through actuarial-based pricing and availability of insurance coverage. These efforts can encourage

[44] It should be noted that such engagement with policyholders may also be required in order for insurers to properly disclose their carbon emissions in their climate-related disclosures.
[45] See MAS (2022).

policymakers to limit development or develop thoughtfully in high-risk areas such as coastal locations.

Regulatory capital requirements may indirectly incentivise insurers to support risk adaptation measures taken by their clients. In risk-based capital regimes – such as the EU's Solvency II – that recognise physical risk reduction measures in terms of lower capital requirements, insurers have incentives to underwrite insurance risks that are climate-resilient. EIOPA (2022c) explains how climate risk adaptation measures may smooth the probability distribution of insurance claims and thus reduce capital requirements for premium risk. Such a feature in a regulatory capital adequacy framework could encourage insurers to further engage with their customers in taking risk adaptation measures so that they can benefit from reduced capital requirements.

Risk mitigation

Some insurance supervisors are going a step beyond climate risk adaptation, encouraging insurers to support consumers and businesses in transitioning to more sustainable lifestyles and business practices through climate risk mitigation measures.[46] Climate risk mitigation aims to minimise the impact of climate change by preventing or reducing GHG emissions. Unlike climate risk adaptation, the relevance of climate risk mitigation for insurance supervisors is arguably less clear and would very much depend on the mandate and supervisory priority of the supervisors concerned. The following are examples of regulatory initiatives relating to risk mitigation:

- **The FSC of Chinese Taipei** encourages the development of green insurance to meet the needs of the growing green energy industry and green economy transformation in its jurisdiction.[47] The authority has been encouraging insurers to offer electric vehicle insurance, electric vehicle charging station insurance and public bicycle insurance.
- **MAS (2020)** expects insurers to engage with corporate customers that pose higher environmental risks in order to encourage them to transition to sustainable business practices over time. In doing so, insurers should still maintain their risk management standards. The authority also expects insurers to consider the ability and willingness of their customers to introduce environmental risk mitigation measures as part of their underwriting assessments.

The development of innovative insurance products to support climate risk mitigation objectives must be underpinned by risk-based pricing and sound underwriting. NAIC (2008) describes how insurers may offer mileage-based motor insurance or actuarially

[46] See the European Environment Agency website for an example of a definition of climate risk mitigation.
[47] See FSC (2020).

justified premium discounts, which in turn could encourage the use of low-emission vehicles, fuel-efficient hybrid vehicles and alternative-fuel vehicles.[48] As these and other new technologies are introduced, insurers will need to assess their risk characteristics in order to set actuarially sound premiums. Regulators may need to be mindful that whenever a new technology is introduced, its risk characteristics are generally unknown. FSA (2022) highlights that for certain insurance products, it is essential to utilise various relevant datasets and analyses of the latest research to develop risk models.

There are differing views on whether insurance supervisors should take a proactive approach in encouraging insurers to offer transition-friendly insurance products.[49] Careful consideration of direct promotion of climate risk mitigation actions may be warranted to avoid potential unintended consequences. Over-stretching the use of regulatory tools to fulfil other policy objectives could go against prudential aims. APRA (2021)[50] makes it clear that the authority does not seek to influence insurers' underwriting decisions. Even though there might be general support for insurers addressing both climate risk adaptation and mitigation in their product offerings, some supervisors may find it difficult to explicitly express support for risk mitigation products. This is because they may consider they do not have the mandate to do so. As such, such these authorities may not consider that it is within their responsibilities to encourage any form of products.[51]

Supervisory review

Existing supervisory review frameworks can be expanded to cover climate-related risks. For example, supervisors may assess how insurers' pricing and underwriting of climate-related risks could manifest in traditional risk categories such as insurance risk or operational risk. Supervisors can review insurers' assessment of inherent climate-related risk exposures and evaluate the adequacy of governance controls and other mitigants in place to manage these risks. For example, if an insurer underwrites a business that is concentrated in a coastal area and whose earnings are impacted by flood losses, supervisors may recommend or require that the insurer mitigates these losses in pricing or product adjustments.

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[48] At a conceptual level, it may be difficult to justify differential premium pricing for motor insurance cover against accidental damage involving a petrol/diesel car versus an electric car. The risk of an accident may not depend (entirely) on the type of vehicle, but rather on the driving behaviour or experience of the insured driver.
[49] Two forthcoming reports from the Geneva Association (Dec 2023 and Feb 2024) will offer ways in which (re)insurers, as risk managers, underwriters and investors, can support commercialisation and wide-scale deployment of new climate technologies to help expand industrial decarbonisation.
[50] APRA (2021) is a regulatory guidance that applies to all regulated financial institutions, not just insurers.
[51] A few of the surveyed supervisors are prioritising risk adaptation measures over risk mitigation efforts. With regards to risk adaptation, some of the surveyed authorities are prioritising risks impacting non-life products rather than life, as physical risks are deemed to be more relevant in their jurisdictions.

Supervisors may need to assess the potential impact of climate change on the availability and affordability of insurance products and the potential consequences regarding protection gaps. Some supervisors are planning to undertake climate scenario analysis for this purpose, examining sectoral and geographical concentration. This is to assess whether further actions may be needed to mitigate reduced product availability or affordability, for example through efforts to widen risk adaptation by policyholders.

Insurance supervisors may undertake surveys to identify how the insurance industry is taking account of climate-related risks when pricing and underwriting insurance products. Such reviews are typically undertaken as part of broader thematic supervisory reviews in order to understand the industry's climate risk management approaches and the level of insurers' preparedness to deal with climate-related risks. These exercises can also be useful to signal supervisory attention and intent for the industry to improve their pricing and underwriting practices. The US FIO is proposing to undertake a collection of granular data from selected homeowners insurers in order to obtain comparable insurance data to assess how insurance coverage is being affected by climate-related risks. An industry-wide stocktake exercise, such as that undertaken by the Insurance Regulatory and Development Authority of India, can also help to size the exposure to climate-related risks faced by insurers.

Supervisory engagement with insurers' boards and senior management of insurers can be an effective way to improve pricing and underwriting practices. PRA (2022), in its letter to chief executive officers of insurers in the United Kingdom highlighted weaknesses in their climate risk management. It pointed out that insurers' management should review their underwriting practices. In South Africa, the Prudential Authority plans to engage with the boards of directors of selected financial institutions, including insurers, on their climate risk management practices, which would cover pricing and underwriting approaches.[52] This is a signal that the authority is taking a more direct approach to the regulation and supervision of climate-related risks.

Supervisors may require insurers to quantify their underwriting exposures to climate-related risks, which can provide useful information for supervisory review assessments. MAS (2022) expects insurers to institute formal processes to measure and

[52] See Prudential Authority (2023).

monitor underwriting exposures to environmental risks using appropriate qualitative and quantitative indicators. APRA (2021) provides certain criteria that insurers can use to determine risk differentiation, including the vulnerability of a sector to extreme weather events, climate-related supply chain disruptions, climate-related business disruptions and unsustainable business practices. Having identified the level of climate-related risks for each sector, insurers are advised to establish appropriate underwriting policies for those sectors.

A growing number of insurance supervisors are using scenario analysis to better understand the implications of climate-related risks including underwriting risks. This is the case in Japan[53] and Singapore. Although not specific to pricing or underwriting purposes, PRA (2019a) and APRA (2021) expect insurers to use scenario analysis to identify short- and long-term financial risks to their business model from climate change. Presumably, such risk identification would cover insurers' underwriting activities. Scenario analysis may be useful to identify risk transmission channels that can have an impact on certain insurance products. For example, the July 2023 heatwave in the United States that affected more than 100 million people led to record-breaking power demand and outages. This scenario can provide an idea of how heatwaves can affect supply chains and, consequently, have an impact on business interruption insurance policies due to failure of power infrastructures.

Some authorities are developing internal guidelines to support supervisory staff in assessing insurers' climate risk management practices, including the pricing and underwriting of insurance products. The Prudential Authority in South Africa has developed an internal supervisory guideline on climate-related risks that its supervisors can leverage in supervisory interactions with financial institutions. The guidelines have been developed based on international standards including IAIS (2021a).

Other relevant regulatory elements

Other regulatory elements can have a bearing on insurance pricing and underwriting approaches. Sound enterprise risk management (ERM) practices by insurers are critical to support proper pricing and underwriting of insurance products exposed to climate-related

[53] FSA/BOJ (2022) outlines findings from its pilot scenario analysis exercise involving three major non-life insurance groups in Japan. It found that analysing specific scenarios (disasters) is insufficient to assess changes in the probability or frequency of future disasters and that the results vary due to the diversity of assumptions and risk models used. In order to overcome these issues, the authorities will consider conducting a stochastic analysis that takes into account the probability of occurrence of various scenarios which incorporate the impact of future climate change, using the same risk model across the non-life insurance companies.

risks. Existing ERM requirements may need to be enhanced to address climate-related risks explicitly within traditional risk categories. A specific aspect of ERM that can have a direct impact on the affordability and availability of climate-related insurance products is insurers' risk appetite, which can dictate pricing and underwriting limits. EIOPA (2022c) highlights that the EU non-life insurance sector's ability to continue providing financial protection in the light of climate change relies on its ability to measure the impact of climate change on loss exposures and to adapt its business practices and strategies to climate change.

Insurance supervisors may reasonably expect insurers to incorporate climate-related risks, if considered material, into their Own Risk and Solvency Assessment (ORSA) exercises. ORSA is an important tool that insurers can use to assess the likely impact of climate change on their underwriting portfolios. If insurers are unable to assess the financial consequences of climate-related events for their insurance risk exposures, they may be taking on more risks than they are aware of or willing to accept, or excluding risks that would otherwise be underwritten on a risk-based basis. Therefore, ORSA requirements can have a bearing on insurers' ability to underwrite and price adequately for climate-related risks. The NAIC is considering enhancing its ORSA guidance for insurers to include a description of how climate- related risks (including underwriting risks) are addressed in their risk management frameworks. The FSC of Chinese Taipei expects insurers to consider climate-related risks in their ORSAs. The Prudential Authority in South Africa is considering plans to provide guidance on incorporating climate-related risks into ORSA requirements.

Capital adequacy requirements can be a "backstop" to enable insurers to underwrite insurance products exposed to climate-related risks. Indeed, the main role of capital adequacy requirements is to absorb unexpected losses that insurers may incur, including from their underwriting activities. Given huge uncertainties about future climate change, it seems reasonable to rely on capital as a tool to address potential unexpected losses or tail events that may manifest in insurers' underwriting portfolios. Nevertheless, there may be alternative views that capital requirements are not well suited to address climate-related risks given the perceived long time horizon over which such risks may materialise. Moreover, imposing additional capital requirements for climate-related risks may further reduce the affordability and availability of certain insurance products.

As reinsurance capacity plays an important role in supporting insurers' ability to underwrite and price climate-related risks, some regulators expect insurers to review their reinsurance strategy regularly. Central Bank of Ireland (2023) expects insurers to consider the future pricing and availability of the reinsurance contracts that they rely on to manage their climate-related risks. As reinsurers generally take on a range of risks across multiple countries and may, as a result, have a systemic risk exposure and/or concentration of certain climate-related risks, insurers are expected to consider any systemic risk exposure of their reinsurance counterparties that may impair their ability to pay claims.

Climate-related disclosure requirements may influence insurers' underwriting strategy in order to minimise their GHG emissions disclosure. APRA (2021) considers it better practice to produce any disclosures to be produced in line with the framework established by the TCFD.[54] The guidance also calls for insurers to set appropriate climate-related targets in line with their business strategy. Such targets may include the level of GHG footprint that an insurer may be willing to tolerate or accept from its insurance underwriting activities. In practice, this may mean limiting the volume of insured risks in GHG-intensive sectors, repricing to better reflect their climate-related risks or pulling out altogether from those sectors. Some insurers may take a more measured approach by continuing to support clients from GHG-intensive sectors provided they have a credible climate or transition strategy.

Disclosure by insurers can also provide useful information for supervisors in assessing the approaches taken to incorporate climate-related risks into insurance product pricing and underwriting. In the United States, many states have issued climate risk disclosure requirements, which include questions related to underwriting, such as whether an insurer has considered the impact of climate-related risks on its underwriting portfolio and whether the insurer has taken steps to encourage policyholders to manage their potential climate-related risks. Such disclosures provide useful information in supervisory review processes.

[54] The TCFD recommendations include the disclosure of direct and indirect emissions by the financial sector, including insurance underwriting activities.

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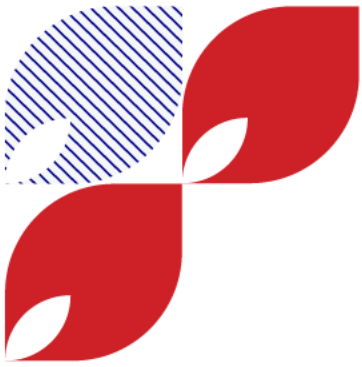

Overview of industry practices on insurance product pricing and underwriting

Overview of industry practices on insurance product pricing and underwriting

Sound underwriting and pricing approaches are key to managing insurers' insurance risk exposures. In this section, we summarise how the surveyed insurers (and to some extent, brokers) reflect climate-related risks in their underwriting and pricing processes. Overall in this survey, the non-life insurers appear to be relatively more advanced in incorporating climate-related risks in the pricing and underwriting of insurance products, possibly because physical risks have more direct impacts on their business lines.

Underwriting practices

General industry guidelines have been helpful in assisting insurers in adapting their underwriting processes to address climate-related risks. Three guidelines in particular (see Box 2) were highlighted by the surveyed insurers.

Box 2

Industry-led underwriting guides

Various industry-led initiatives have been formed to support the global target to achieve net zero GHG emissions in order to meet the Paris Agreement and broader climate and environmental objectives.

CRO Forum's Carbon footprinting methodology for underwriting portfolios

CRO Forum (2020) provides a range of options and methodologies that insurers can use to determine the carbon footprint of their underwriting portfolios. While these are aimed at supporting insurers' climate-related disclosures, the methodology can also be used to identify the carbon intensity of their product lines and inform their underwriting decisions. The general methodology is based on the weighted average carbon intensity of insurance portfolios capturing Scope 1 and 2 emissions.o The guide cautions that the methodology is only a first step, and that users should acknowledge its limitations such as potential double-counting of carbon footprint or the scope of underwriting portfolios included.

AIG, one of the pioneer insurers that has used this methodology, estimated that forty-eight per cent of its total emissions in 2021 were from companies that it underwrote. Eighty-two per cent of AIG's estimated emissions were from its non-life business in the utilities, manufacturing, mining, quarrying and oil and gas extraction, management of companies and enterprises, and transportation and warehousing sectors.

Poseidon Principles for Marine Insurance

In the shipping industry, the Poseidon Principles for Marine Insurance provide guidance to marine insurers on how to measure the GHG emissions of their insurance portfolios.o The principles are aligned with the International Maritime Organisation's (IMO) goal for GHG emissions to peak as soon as possible and to reduce the shipping industry's total annual GHG emissions by at least 50% by 2050. The principles provide a voluntary framework for assessing and disclosing the alignment of hull and machinery insurance portfolios with net zero targets. The four principles cover assessment of climate alignment, accountability, enforcement and transparency. Insurers that sign up to the principles will need to align their activities, including underwriting processes, with the principles.

In shipping, carbon intensity represents the total operational emissions generated to satisfy a supply of transport work (grams of CO2 per tonne-nautical mile). Signatories of the principles use the Annual Efficiency Ratio with input parameters comprising fuel consumption, distance travelled and deadweight at maximum summer draught to measure carbon intensity. They are also required to measure the climate alignment of a vessel, policy or portfolio, and this is defined as the degree to which a vessel, policy or portfolio's carbon intensity is in line with the prescribed decarbonisation trajectory. Insurers that sign up to the principles must contractually require shipowners to provide any information needed to calculate carbon intensity and climate alignment.

Principles for Sustainable Insurance Underwriting Guide for Life and Health Insurance

The United Nations Environment Programme's Principles for Sustainable Insurance Initiative developed this guide with objectives that include:

- providing guidance to insurance industry participants on developing approaches to evaluate the potential impact of environmental, social and governance (ESG) risks on underwriting risks in life and health insurance business; and
- highlighting the potential materiality of certain ESG risks to underwriting risks in the life and health insurance business, with examples for consideration to mitigate such risks.

Unlike the other two industry guidelines, these principles do not solely target net zero goals, nor do they advocate quantitative metrics to assess the carbon footprint of life and health insurance business. They take a more qualitative approach, providing a heatmap that breaks ESG down into specific themes and risk criteria to highlight their impact on four risk categories in the life and health insurance business: mortality, longevity, morbidity and hospitalisation.

O "Scope 1" refers to direct GHG emissions from sources controlled or owned by a company, and "Scope 2" describes indirect GHG emissions associated with the purchase of electricity, steam, heat or cooling by the company.

O See Poseidon Principles for Marine Insurance, "Principles Overview".

As the impacts of physical risks vary according to geographical location, some insurers use geographical segmentation as an underwriting criterion. A life insurer in our sample uses a country classification scheme that rates different countries according to

"environment health" and "natural disaster" risks. These criteria take into account climate change in terms of its impact on environmental degradation (e.g. water pollution, biodiversity loss) and natural disasters such as storms, floods and wildfires. For example, countries with severe poor air quality and greater vulnerability to natural disaster will have a high country risk classification. There is a range of possible approaches that might include charging people living in higher-risk countries more for life insurance through a "mortality loading", or excluding them from coverage altogether, an approach taken by several insurers in our sample. Alternatively, the expected impact of climate change could be reflected less directly through long-term trend assumptions for mortality and morbidity.

Geographical locations can also be an underwriting factor in assessing transition risk impacts on financial lines of business for non-life insurers. A surveyed insurer considers legal, regulatory and political environments to be drivers of potential losses in its financial lines of business (e.g. for D&O liability insurance policies). It noted that greenwashing litigation against companies may be more prevalent in certain countries than others, and hence such factors will influence underwriting decisions regarding financial lines risks based on geographical location.

Client engagement by insurers is critical in underwriting climate-related insurance policies. The main purpose is to gather sufficient information on the nature of climate risk exposures, as well as any risk adaptation measures that might have an impact on the profile of the insured risks. One of the surveyed insurers relies on public ESG disclosures or reports by financial data providers.

Withdrawals and exclusions

In the context of climate change, insurers may withdraw coverage or introduce exclusions to mitigate increased physical risk exposures and/or meet their net zero transition commitments. These are two different drivers that should be considered separately as the motivations and criteria used to determine the exclusions may be different.

Most of the surveyed insurers consider profitability to be the main criterion in determining whether to withdraw an insurance product due to physical risks. Sustained underwriting losses from products exposed to climate-related risks may arise due to the increasing frequency and severity of climate-related events, as well as increased

exposure (in terms of either assets or lives) due, for example, to urbanisation. Other factors that may drive product withdrawal include sustained premium increases, low business volume, exceedance of risk appetite, adverse impact on capital adequacy and lack of availability or affordability of reinsurance coverage. Some life insurers in our sample do not see an immediate need to withdraw any of their products due to climate change. Nevertheless, one life insurer in our sample cautioned that, as climate risks evolve, lives that are currently insurable in certain countries may become uninsurable in the future.

To support the global transition to net zero, some insurers have stopped or are planning to stop underwriting policies that cover carbon-intensive sectors and/or vulnerable geographical regions. In 2022, global insurance marketplace Lloyd's of London[55] announced that it would cease to provide new cover for thermal coal-fired plants, thermal coal mines, oil sands and Arctic energy exploration activity and would phase out existing cover by 2030. This change in its underwriting policy has knock-on impact on insurers globally. Examples of similar exclusions in our sample of insurers, by sector, are as follows (see Annex 2 for detailed exclusions by the surveyed insurers):

- Coal
  - Exclude insurance coverage for new thermal coal mine and coal-fired power plant projects;
- Oil and gas
  - Exclude insurance coverage for new oil field production projects
  - Exclude insurance coverage for oil and gas exploration or production projects in the Arctic National Wildlife Refuge

Insurers can influence businesses to support the global transition to net zero through their underwriting policies. This can take the form of not underwriting businesses that have exposure to carbon-intensive sectors above a certain threshold or that do not have credible plans to reduce their GHG emissions. Some global insurers have publicly committed to phasing out insurance coverage for coal-fired power plants without capture and storage of CO_2 emissions by 2030 for OECD countries and by 2040 for the rest of the world.

Insurers are mindful of the need to carry out an orderly withdrawal of insurance coverage from carbon-intensive sectors by phasing in such exclusionary underwriting policies over a number of years. Some of the surveyed insurers recognise that businesses

[55] See Lloyd's of London (2022).

that currently have a high GHG footprint may be working towards decarbonisation, and therefore a blanket exclusion would not be appropriate. Insurers may use third-party assessments to validate the credibility of such transition plans.[56] Not many insurers in our sample exclude coverage against transition risks impacts e.g. litigation related to future climate change.

This is not an easy policy discussion because insurance may be needed in some carbon-intensive sectors to avoid unintended, disorderly economic dislocation. The challenge here is about how insurers can facilitate an orderly transition of those carbon-intensive sectors without exposing themselves to litigation risks. A related question is how insurers can provide information relating to their underwriting policy in their climate-related disclosures without attracting negative consequences. In addition, insurers may lose out on opportunities if they do not work with corporate policyholders that, although currently carbon-heavy, are working towards clear decarbonisation targets.

Pricing practices

Most of the surveyed insurers consider climate-related risks to be one of many risk factors that they need to take into account when pricing insurance products, even though this is not being done explicitly. They rely mainly on regular pricing processes that prompt revisions of premium rates based on actual loss experience, as any climate change impact is assumed to be reflected in the claims data. A surveyed life insurer stated that it is impossible to explicitly attribute certain insurance claims to climate change. As such, the practical pricing approach is to monitor all mortality and morbidity trends and assume that climate change impacts are reflected implicitly in that loss experience. EIOPA (2021) notes that most non-life insurers in the EU do not include climate-related risks in their pricing methodology. The main reason is because many non-life insurance businesses have short-term duration contracts (typically 12-month contracts), which allow them to reprice annually. Effectively, climate change is reflected in the annual repricing because recent events are included in the data used for the pricing process. Nevertheless, such an approach can miss changes over the long term, such as chronic physical risks.

Although insurers can reprice short-term insurance contracts annually, there is a limit to doing so. EIOPA (2021) and (2022a) point out limitations to such repricing possibilities, including the fact that historical data do not fully capture emerging climate trends and

[56] The Science Based Targets initiative (SBTi) is an example of a third-party assessment that insurers use to validate their net zero commitments.

that insurers crowd themselves out of certain markets. Central Bank of Ireland (2023) expects insurers to consider the potential effects of pricing and underwriting decisions over the short, medium and long terms, as well as the implications that those decisions may have on their future viability. Moreover, some insurance policies are "long-tail", which means that the full extent of insurance claims will only be established over a long period of time. For example, a lawsuit against a mining company may take years to settle and be claimed against a liability insurance policy.

Some surveyed insurers rely on their in-house expertise, often located at their headquarters, to price products exposed to climate-related risks. They may use in-house or vendor pricing models. For products exposed to physical risks, natural catastrophe models are typically used, with adjustments to attempt to reflect expected climate change impacts. The adjustments involve calibrating the models to reflect plausible potential future events that may not have occurred in the past, based on the latest climatic observations and expected trends. The pricing exercise requires various specialists such as meteorologists, hydrologists and geophysicists, in addition to more typical pricing experts such as actuaries. Smaller insurers may not have such internal expertise and, as a result, may need to rely more on vendor models or rates from reinsurers to inform their pricing. The more advanced insurers use well established climate scenarios[57] in their pricing models.

Some life insurers and actuaries may consider climate risks to be less directly relevant when pricing and underwriting life insurance products. This can probably be attributed to less visible manifestation of physical risk impacts on mortality and morbidity. One of the surveyed life insurers noted that the prevalence of physical risks has not yet been observed to be statistically relevant enough to affect pricing strategies and decisions. Nevertheless, scientific studies are emerging that draw links between certain climate change-induced weather patterns, such as heatwaves, and mortality rates.[58] Under an unmitigated climate change scenario, scientists expect an increased frequency and intensity of heatwaves, increasing air pollution from wildfires and possibly greater incidence of zoonotic events leading to more vector-borne diseases that can increase mortality in the future. Life insurers are expected to closely follow scientific studies on how climate change may have an impact on the risks that they insure, particularly since some of the risks may have been underwritten on an overly optimistic basis.

[57] For example, the IPCC Representative Concentration Pathways, which reflect different global average temperature increases relative to pre-industrial times.
[58] See Ballester et al (2023).

Climate risk adaptation and mitigation measures

Insurers can play a key role in enhancing the climate resilience of consumers and businesses by recognising risk adaptation measures in their pricing and underwriting policies. Insurers have an incentive to support climate risk adaptation by their clients, as these measures can minimise insurance claim payouts. It is therefore surprising that some insurers do not explicitly recognise risk adaptation measures taken by policyholders in terms of premium loadings or discounts. This is especially the case for short-term non-life insurance contracts, as such measures can be more easily taken into account in annual renewable policies. New information about an insured property or risk can be considered upon renewal of policies. Nevertheless, in practice, it may be difficult for insurers to assess the potential impact of such measures on insured losses due to the multitude of influencing factors.

It is not straightforward for insurers to support or encourage climate risk mitigation measures that their clients may take to support the transition to net zero. For instance, in relation to liability-related insurance policies, policyholders who make representations on climate risk mitigation could be engaged in greenwashing. On the other hand, policyholders who do not make public statements that show how they are supporting the climate transition may face reputational backlash for inaction. Both cases could lead to a claim on the liability insurance coverage to cover, for example, litigation costs. It is also a difficult task for insurers to make a judgment call on whether they should support or challenge customers in the transition towards a low-emission global economy. They may need to consider whether or not to move quickly to support new and emerging (and sometimes unproven) low-emission technologies.

Some insurers are offering innovative insurance products and services that support broader net zero policy objectives. EIOPA (2021) provides industry examples of insurance products that support risk mitigation, such as pay-as-you-drive insurance and discounts on motor insurance premiums for policyholders that hold public transportation passes. FSA (2022) describes an example of how insurers in Japan facilitated offshore wind power generation by providing an end-to-end insurance solution, from construction to operation as well as protection against natural disasters. A non-life insurer, through its subsidiary, provided risk management services to support project financing arrangements. Examples of other risk mitigation products include:

- investments/savings products that offer investments in funds that support transition objectives;
- motor insurance policies for electric vehicles with favourable terms;
- insurance for renewable energy infrastructures;
- products that cover climate tech innovations (e.g. coverage against carbon credit-related fraud, carbon sequestration equipment); and
- products that provide additional payments to support the rebuilding of damaged properties in a more climate-friendly way.

Risk management

In addition to underwriting processes, insurers employ a range of other risk management tools to manage the climate-related risk exposures of their products. At an insurance policy level, insurers may impose various limits to control the level of risk they take, for example retention limits[59] or geographical concentration limits. Lower limits may apply for locations prone to physical risk impacts. Reinsurance plays a critical role in insurers' risk management strategy, as global reinsurers are well placed to diversify climate risks across geographies, perils, economies and sectors. Insurers may also impose deductibles so that policyholders pay a certain sum before their insurance coverage kicks in. Deductibles can be used as a tool to incentivise policyholders to establish risk adaptation measures, e.g. lower deductibles may be set for more climate-resilient properties.

An increasing number of insurers are publishing transition plans[60], which may commit themselves to moving away from underwriting insurance risks in carbon-intensive sectors or geographical areas in order to reduce their Scope 3 emissions.[61,62] In practice, insurers may face difficulties identifying and quantifying their Scope 3 emissions from their insurance underwriting activities due to a lack of data.[63] Efforts are under way to support Scope 3 disclosure, which may accelerate changes in insurers' product offerings, pivoting from more GHG-intensive to less GHG-intensive sectors.[64] Box 3 describes the Net-Zero Insurance Alliance, an insurance industry network that has come together to develop a common approach to establishing transition pathways.

[59] Retention limits are insured exposures that insurers retain on their books and above which the exposures are passed on to reinsurers.
[60] NGFS (2023a) outlines different types of transition plan based on the different industry frameworks and regulatory approaches.
[61] See for example the announcement from Helvetia, a Swiss insurer.
[62] "Scope 3 emissions" refers to indirect GHG emissions outside Scope 2 (emissions associated with the purchase of electricity, steam, heat, or cooling by a company) that occur in the supply chain of a company or as a consequence of using that company's products and services.
[63] See MAS (2022).
[64] Partnership for Carbon Accounting Financials (2022) sets out guidance for insurers on how to measure and disclose GHG emissions from their underwriting portfolios.

Box 3

Net-Zero Insurance Alliance

The Net-Zero Insurance Alliance (NZIA) is a coalition of insurance companies that are committed to decarbonising their insurance underwriting portfolios to net zero GHG emissions by 2050. Formed by eight global (re)insurers in July 2021, the NZIA is convened by the United Nations Environment Programme (UNEP)o and is part of the Glasgow Financial Alliance for Net Zero (GFANZ).

The NZIA's membership grew to around 30 insurers, but shrank rapidly from March 2023. As of August 2023, it had 11 members (with only two of its founding members remaining). The main reason for the departures was reportedly because of antitrust concerns following alleged political pressures from within the United States and potential litigation against NZIA members.o A group of 23 Republican state attorney generalso wrote to NZIA members, warning that they could be violating US antitrust laws as the alliance could be deemed to be an illegal boycott of certain carbon-intensive industries.

In contrast, in Europe, the European Commissiono and the UK Competition and Markets Authorityo respectively published and consulted guidelines to scope out sustainability-related initiatives such as the NZIA, provided certain conditions are met.

Such regulatory fragmentation in terms of competition requirements underscores the challenging legal environment that insurers need to navigate in addressing climate-related risks in their business activities. Unintended consequences from participating in well intentioned industry forums may evolve into prudential concerns if insurers face legal and reputational implications. As such, it is important that insurance supervisors monitor such potential unintended consequences when pursuing policy objectives to address climate-related risks in the insurance sector.

O See UNEP, "Statement from the UN Environment Programme on the Net-Zero Insurance Alliance", 5 July 2023. O See K Rives and R Barrett, "Net-zero alliances jittery as GOP attorneys general play antitrust card", *S&P Global Market Intelligence*, 8 June 2023. O See Office of the Attorney General, State of Utah and Department of Justice, State of Louisiana (2023). O See European Commission (2023). O See Competition & Markets Authority (2023).

Insurers may be exposed to reputational risks if they do not follow through on commitments made in their transition plans, including in their pricing and underwriting strategy. Some insurance supervisors are monitoring the commitments that insurers make in transition plans to avoid greenwashing risks. EIOPA (2022d) sets out the regulator's work programme to identify, assess and mitigate greenwashing risks. MAS (2022) highlights that insurers' transition plans are coming under increasing scrutiny by stakeholders. Indiscriminate withdrawal of insurance coverage from carbon-intensive sectors could adversely affect companies with credible transition plans, increase protection gaps and lead to a disorderly transition overall. As such, insurers are expected to manage their reputational risk as they work towards supporting an orderly transition.

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Potential implications of existing regulatory approaches and industry practices

Potential implications of existing regulatory approaches and industry practices

Reduced availability and affordability of insurance coverage

Reduced availability and affordability of insurance coverage against climate risks is a major concern for policymakers and many insurance regulators. As the cost to insurers rises due to a higher frequency and/or severity of climate-related events and/or due to increased risk exposures[65], they may withdraw coverage or increase premiums, or both. Moreover, modelling difficulties (due partially to data challenges) may also push insurers to resort to hiking premiums and/or excluding coverage in order to overcome such challenges. This is a less than desirable outcome from a public policy perspective. Overcoming such technical challenges will require improvements in data availability and quality as well as enhancements to modelling capabilities.

Some supervisors are particularly concerned with withdrawal of insurance cover from critical economic sectors such as agriculture or real estate.[66] Central Bank of Ireland (2023) highlights that climate change could affect the insurability of climate-related risks given an insurer's risk appetite, resulting in an increase in the protection gap and challenges for an insurer's future business model. EIOPA (2021) highlights that steady annual premium increases (or similar actions e.g. higher deductibles or wider exclusions) could have unintended consequences such as higher costs or reduced availability of insurance, resulting in an increasing share of uninsured risks.

There is a trend of premium increases, exclusions and withdrawal of non-life insurance coverage in certain geographical locations following extreme climate risk events.[67,68] According to a report by Swiss Re, property losses in the United States from natural disasters due to climate change could increase by more than 60% by 2040. As a result, homeowner policy premiums in the United States are projected to increase on average by

[65] For example, larger insured populations or properties in low-lying, climate-exposed locations.
[66] US Treasury Secretary Janet Yellen noted that in 2022 only 60% of USD 165 billion in economic losses from climate-related disasters in the United States was covered by insurance. She pointed out that, as more insurers withdraw insurance coverage or increase rates, more needs to be done to understand changes in property insurance for real estate markets and other financial institutions that rely on insurers to manage risks, as well as the implications for systemic risk. See C-SPAN, "Secretary Yellen holds Financial Stability Oversight Council meeting", 28 July 2023.
[67] A surveyed insurer noted that some risk mitigation products, such as electric vehicle (EV) insurance policies, may see premium increases due to higher repair costs, though this is not expected to continue as the cost of EV spare parts and repairs is expected to stabilise with the growing market.
[68] In Asia, the trend of increasing premiums has not been observed specifically for climate-related risks amongst the surveyed insurers. This could be because those insurers are in the early stages of incorporating climate-related risks into pricing and underwriting. Some of the surveyed life insurers have not increased premium rates because, so far, climate change impact on life policies has not been significant. Nevertheless, one surveyed life insurer is considering the feasibility of offering long-term life insurance policies with guarantees (in terms of premiums or benefits) or increasing pricing given uncertainties arising from climate change impacts.

2.4% per year assuming no risk adaptation measures are taken. Some health insurers have also increased premiums for more frequent claims resulting from climate change-related events. In Canada, non-life insurers have been adjusting their product offerings via deductibles, coverage limits and outright exclusions in order to mitigate physical risk impacts. Table 1 shows premium increases across selected jurisdictions for home insurance products, as a proxy for insurance products that are exposed to climate-related risks. Due to the significant heterogeneity of insurance products within and across jurisdictions, the figures shown are not directly comparable, though they show the general increasing trajectory of premiums for such products.[69] While the premium increases can be attributed to general inflation rates, climate change has been cited as a contributing factor.

Table 1: Examples of average premium increase for home insurance

Jurisdiction	Premium increase	Other information
Australia	28-50% annual increase as at August 2023[70]	
United Kingdom	6% annual increase as at end 2022[71]	Projected to increase by 30% in 2023, partly due to warmer temperatures increasing subsidence claims
United States	21% annual increase as at May 2023[72]	

Overpricing of climate-related insurance products can also be a supervisory concern. Deliberate overpricing can be equivalent to withdrawing cover albeit in an indirect way. This has obvious financial exclusion implications, leaving consumers and businesses that cannot afford the products uninsured against climate-related risks. While some supervisors may not be concerned with this, it is generally not a desired regulatory or policy outcome, as it effectively deepens financial exclusion, passing on the financial impact of climate change on to governments and societies at large. Consumers and businesses, including other financial institutions, may become financially exposed to climate-related catastrophes.

[69] EIOPA (2022a) summarises the industry expectation that all property-related lines of business will be affected by physical risks and that premiums are likely to increase. As a result, adaptation and mitigation measures will play a crucial role in reducing future risk levels.
[70] See Paddam et al (2023).
[71] See J Gibbs, "UK home insurance statistics 2023", *Confused.com*, 22 May 2023.
See P Howard, *Home insurance pricing report 2023*, Policygenius, 12 September 2023.

Insurance regulators may need to provide guidance on how insurers can withdraw or not renew insurance coverage in a manner that respects policyholder interests. Supervisors may need to prepare early for such a worst-case scenario, given emerging evidence of pressure on the insurability of certain assets or populations due to climate change.[73] To guide proper conduct by insurers and insurance intermediaries, EIOPA (2022b) describes the steps that insurers need to follow before excluding coverage against systemic events including natural catastrophes arising from climate change. These steps include proper disclosure to customers justifying the exclusion and consideration of the needs and characteristics of the target market. Importantly, insurers are expected to strike an appropriate balance between the need to limit their losses and the need for their products to align with the target market's needs, objectives and characteristics.

There is a difficult policy trade-off between adequately pricing climate-related risks and maintaining the affordability and availability of insurance coverage. As insurers incorporate climate-related risks into their pricing and underwriting practices, they may end up increasing premium rates to reflect heightened risk exposures and/or greater uncertainties arising from climate change. They may well reach a pricing or underwriting tipping point beyond which they would prefer to exit the market altogether. Box 4 describes several government- and industry-sponsored insurance schemes to provide coverage in markets where private insurance is unavailable or unaffordable.

[73] EIOPA (2022b) highlights that following systemic events (which it defines to include climate change) there is an increasing risk that insurance products may become unaffordable or unavailable for these events. Some insurers may revise policy terms on exclusions or introduce new exclusions without proper application of product oversight and governance rules.

Box 4

When the private insurance market fails

In certain jurisdictions, governments have had to step in to establish public-private insurance solutions to cover weather-related perils, including those influenced by climate change such as floods. The following are two examples focused on flood risk:

- The United Kingdom's Flood Re:O Flood Re is a joint industry and government flood reinsurance scheme that aims to (1) promote the affordability and availability of insurance for UK households exposed to high flood risk and (2) manage the transition to risk-based pricing of flood insurance for household premises. Flood Re charges insurers a fixed premium for flood risks that they reinsure. The premium is based on a property's local council tax band. Flood Re is also funded through an annual levy from every insurer offering home insurance in the United Kingdom. In total, Flood Re has GBP 135 million annually to reimburse valid claims by insurers. Flood Re will be wound up in 2039, with the hope that the private insurance market is able to resume taking on flood insurance risk.
- US National Flood Insurance Program (NFIP):O,O The NFIP is a public-private partnership between the US federal government, the non-life insurance industry, states, local officials, lending institutions and property owners. It was created by the US Congress in 1968 to provide insurance to help reduce the socio-economic impact of floods due to hurricanes and river floodings. The NFIP is administered by the US Federal Emergency Management Agency (FEMA), while insurance policies are sold and serviced by a network of more than 50 insurance companies. The policy terms of the flood insurance are standardised, including for example the coverage limit. The NFIP has received more than 2.5 million claims throughout its history and currently protects over USD 1.28 trillion in assets through nearly five million policies. In 2022, NFIP validated over 54,000 claims, which provided more than USD 1.6 billion in policy coverage. Hurricane Ian alone resulted in more than 46,000 claims costing USD 1.5 billion. The NFIP has USD 18.3 billion of capacity to pay claims, alongside FEMA, which has USD 2.5 billion of total reinsurance coverage against qualifying NFIP flood losses from a single event.

These schemes have in common efforts to improve households' flood risk adaptation of households:

- Flood Re also provides tips to homeowners on how they can be "flood smart" through a list of Property Flood Resilience measures. These measures can reduce the cost of flood repairs by up to 73%. The measures are grouped into three categories: resistance measures to keep flood water out as much as possible; recoverability measures to minimise flood damage; and preparedness measures.
- The NFIP provides a list of flood mitigation actions that policyholders can take in order to reduce the premiums they pay. Such actions include elevating the properties or utilities. Policyholders who come together as a community to take group risk adaptation actions can enjoy further discounts.

The insurance industry has also formed partnerships to improve flood resilience in communities. For example, the Zurich Flood Resilience AllianceO is a partnership consisting of humanitarian, NGO, research and private sector partners with the aim of increasing public and private investment in evidence-informed community-based flood resilience. One example of its initiatives is its Flood Resilience Measurement for Communities, which allows communities to generate evidence on how a given area or community is resilient to floods. Its study found that every USD 1 invested in flood risk reduction has been documented to save on average USD 5 in future losses.

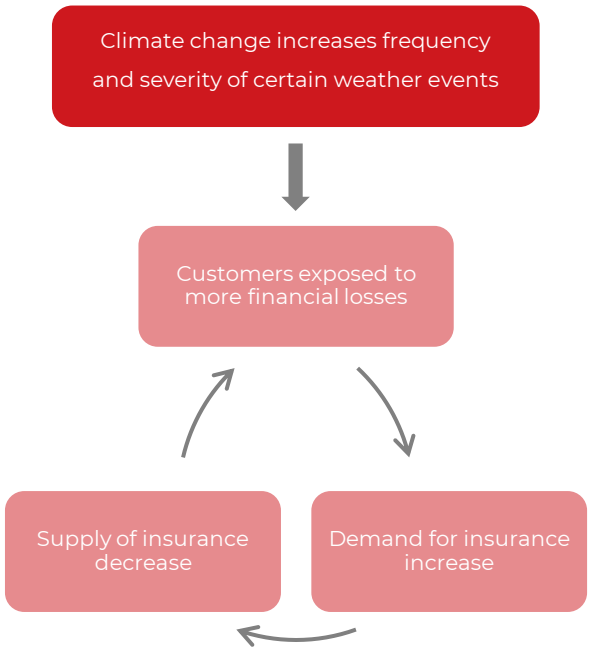
In any form of climate disaster recovery scheme supported by governments and public entities, care should be taken to avoid moral hazard behaviour by policyholders. Subsidised rates or favourable insurance coverage may result in policyholders not taking sufficient risk adaptation measures. This could lead to a downward spiral in terms of the affordability and availability of such insurance coverage. As a result of subsidised rates, policyholders may not return to private markets even if capacity returns.

O See Flood Re's "About us" page on its website. O See the National Flood Insurance Program website. O Williams et al (2023) analyses the NFIP and regulatory frameworks for flood insurance in six US states, and outlines factors to ensure the long-term viability of private flood insurance programmes. O See the Zurich Flood Resilience Alliance Flood Resilience Portal.

Consumers may face a catch-22 situation whereby they would need greater insurance protection in the face of climate change and yet less insurance is likely to be available. Essentially, climate change exposes consumers to more frequent and/or severe financial losses, increasing their need for insurance protection to buffer the impact (see Chart 1). At the same time, climate change increases the cost of insurance coverage as well as uncertainties over future pricing conditions. EIOPA (2021) provides an example where insurers in Germany increased premiums or withdrew coverage in the aftermath of the "flood of the century" in 2002. Premium calculations, based on maximum flood-related losses, increased from EUR 2.5 billion over an observation period of 100 years to EUR 11–15 billion over a 200- to 300-year observation period. As a result, premiums in high-risk regions such as Saxony increased by up to 60%. To break this catch-22 chain, consumers will need to take risk adaptation measures and insurers will need to recognise such measures in the pricing and underwriting of relevant insurance products.[74] At the same time, efforts to decelerate climate change through transition policies will also be needed.

[74] Swiss Re highlighted that protective measures need to be taken in order for insurance products to remain economical for high-risk properties, for example those exposed to coastal and riverine areas.

Chart 1: Catch-22 dilemma arising from increasing climate change impact, and reduced affordability and availability of insurance coverage



Withdrawing insurance coverage en masse may expose insurers to reputational risks. EIOPA (2022c) points out that raising premiums and reducing or excluding coverage could have detrimental consequences for policyholders and the insurance sector itself, including through reputational risk. MAS (2022) highlights the potential impacts of indiscriminate withdrawal of insurance coverage from sectors deemed to pose greater climate-related risks, including:

- adverse implications for companies with credible transition plans
- increasing the risk of a protection gap; and
- a disorderly transition

Insurers have to therefore manage their reputational risk against this backdrop as they support an orderly transition. Recent reports of insurers withdrawing from certain US states have attracted criticisms from regulators and legislators. While there may be sound risk management reasons for doing so, it raises broader policy and societal questions as to the raison d'etre of insurance. If climate risks are not properly priced or underwritten, the resulting lack of affordable insurance solutions will harm the insurance sector's value proposition.

Nevertheless, it should be well recognised that, like other insured risks, climate-related risks need to fulfil certain criteria to remain insurable. Swiss Re highlighted three criteria:

- Assessability: The insured climate-related risks need to be quantifiable, in terms of their frequency and severity.
- Economic viability: There is a limit to premium increases; beyond a certain point, the cost of an insurance policy may not make financial sense for policyholders.
- Randomness of risk: If a climate-related risk is no longer random and occurs with (almost) certainty, insurance is not the right risk mitigation tool.

Reinsurance is one of the most critical risk management tools that insurers use to manage their climate-related exposures from the products they underwrite. Direct insurers transfer climate-related risks that they underwrite to reinsurers so that the risks remain within their risk tolerance levels. Some insurers may not have in place sufficient reinsurance coverage against their climate-related exposures. This may contribute to solvency and liquidity problems in the event of a climate-related catastrophe. Inadequate reinsurance coverage can result from repricing by reinsurers or higher cost of capital after a "bad year" with heavy climate-related natural catastrophe losses.

It is worrying that some reinsurers have started to limit their exposures to climate-related perils. They are increasing their clients' risk retention limits and underwriting fewer policies, especially those that aggregate losses across perils or geographies. If reinsurance capacity continues to shrink or becomes unaffordable, this will directly affect the ability of insurers to underwrite climate-related risks. The lack of affordable reinsurance capacity is a real constraint for smaller insurers or those in smaller jurisdictions (e.g. low-lying islands) when it comes to underwriting critical insurance policies that provide coverage against climate-related risks.

At the same time, unsound pricing and underwriting by direct insurers could have a knock-on impact on the availability and cost of reinsurance. An increase in insured losses from climate-related risks that are passed on to reinsurers may force them to hike reinsurance rates or withdraw cover (or not renew the coverage).[75] As such, it is important that direct insurers price and underwrite climate-related risks properly and work with reinsurers to ensure alignment of risk management expectations. Moral hazard behaviour by direct insurers in terms of loose pricing and underwriting practices must be avoided in

[75] Fitch Ratings has been quoted as reporting that natural catastrophe business has become largely loss-making in recent years as premiums have not kept pace with increasingly frequent, severe and volatile weather-related losses due to climate change. This has reduced reinsurers' appetite for providing natural catastrophe cover, particularly as other business lines are benefitting from premium increases that are higher than claims inflation.

order to ensure that insured losses are within expectations and remain reinsurable. Working with policyholders on risk adaptation measures to become more climate-resilient may prove to be increasingly important going forward given the climate trajectory.

At a global level, policymakers need to deal with the disproportionate impact of climate change on emerging markets and developing economies or the so-called Global South. Studies[76] have shown that poorer populations and jurisdictions are likely to be among the most adversely affected by climate change, and yet they are also likely to suffer the most from a lack of insurance protection. As such, there is an urgent need to find a global solution[77] to ensure the continued availability and affordability of insurance protection against climate-related risks. Internationally active insurers and reinsurers may have a key role to play in this regard, as they have the capacity to diversify risks geographically. It follows that supervisors too may need to consider their role in contributing to the wider global objective of ensuring the continued availability of insurance protection against climate change impacts in the Global South.

Safety and soundness of insurers

Insurance supervisors may be concerned with insurers underpricing their products if they do not adequately address climate-related risks in their underwriting and pricing policies. Several insurance regulators view such inadequacies as a direct threat to their primary regulatory mandate, in terms of safeguarding the safety and soundness of regulated firms and protecting policyholders. Ultimately, supervisors are concerned that underpricing and overly optimistic underwriting could lead to solvency or liquidity problems and possibly failure to meet insurance claims payments when a climate-related event occurs.

While the impact of physical risks on insurance products is evident, insurers may also be exposed to heightened claims costs from transition or liability risks It can be expected that climate-related litigation against companies for not taking action to combat climate change or to decarbonise their operations will flow through to increased claims. This trend of increasing transition and liability risks can be expected to pick up as consumer

[76] IPCC (2022) states that, with increasing global warming, losses and damages increase and become increasingly difficult to avoid, while highly concentrated among the poorest vulnerable populations. Climate-sensitive livelihoods are more concentrated in regions that have greater socio-economic vulnerabilities and lower adaptive capacities, exacerbating existing inequalities. These populations have reduced capacities to adapt to climate change impacts. Observed mortality and losses due to floods and droughts are much greater in regions with high vulnerability and vulnerable populations.
[77] At COP27 held in November 2022, there was an agreement to provide "loss and damage" funding for vulnerable countries most exposed to climate disasters. The G7 and the V20 launched the Global Shield against Climate Risks, which, amongst other objectives, aims to close the protection gap for poor and vulnerable people against climate-related losses.

awareness increases and climate-related public disclosures become more prevalent. Similar to the concept of financed emissions in the banking sector, insurers may be criticised or even litigated for their insured emissions activities.

As insurers withdraw from certain climate-related business lines, the remaining players may accumulate climate-related risks. This may give rise to concentration risks for the remaining insurers in certain economic sectors or geographical locations. Those insurers may be exposed to underwriting losses and potential capital adequacy problems, as the other insurers that withdrew from the market may have done so due to expected losses that they are not prepared to sustain.

Although climate-related risks may not (yet) significantly affect any insurer, the materialisation of these risks can certainly be a contributing factor to solvency and liquidity problems. Some insurers' credit ratings have been downgraded in recent months due to deteriorating underwriting results, and these downgrades have knock-on impacts in terms of higher capital and borrowing costs. This trend is, surprisingly, affecting certain business lines not normally associated with climate-related events. For example, some motor insurers have suffered higher than expected losses to the point that it has started to affect their capital adequacy. This is partly due to increased losses arising from climate-related events. While it is inaccurate to attribute all these losses to climate change, the point here is that climate change could be a contributing factor going forward, perhaps significantly so. With persistent high inflationary pressures, including in the cost of repairs, rebuilding and recoveries, insurers that are not monitoring their climate-related exposures may be caught off guard when the confluence of risks materialises.

There is a trade-off between safeguarding insurer solvency and maintaining the availability and affordability of insurance coverage. Specifically, any capital requirements to address the manifestation of climate-related risks in traditional risk categories (e.g. underwriting risk) will increase the cost of capital for insurers. This increased cost will eventually be passed on to policyholders through higher premiums, which may be counterproductive to the aim of maintaining the availability and affordability of insurance coverage. As such, policy measures should work in concert and avoid such unintended negating consequences.

Financial stability

Increasing climate risk protection gaps could pose a threat to financial stability. ECB/EIOPA (2023) states that only about a quarter of climate-related catastrophe losses are currently insured in the EU. This insurance protection gap could widen in the medium to long term as a result of climate change, partly because the repricing of insurance contracts in response to increasingly frequent and intense events may lead to such insurance becoming unaffordable. This would further increase the burden on governments, in terms of both macroeconomic risks and fiscal spending to cover the uninsured losses. A widening insurance protection gap may also reduce credit provision in countries with large banking sector exposures to catastrophe risk events through considerable real estate exposures. Nevertheless, it should be acknowledged that there is a limit to which the insurance industry can contribute to combating climate change through favourable pricing and underwriting conditions to support climate risk mitigation and adaptation. Other policies beyond the remit of insurance supervisors may be needed to decelerate reductions in the availability and affordability of insurance coverage.

There is a risk that a collective industry underwriting or pricing approach could lead to financial instability if major or multiple simultaneous climate-related disasters cause widespread damage. For example, the observed common practice amongst the surveyed insurers of not explicitly addressing climate-related risks in the pricing of their products may expose multiple insurers to common climate-related perils. Knock-on impacts on other parts of the financial system, for example through supply chain disruptions, may reveal unexpected losses. While insurers can minimise these risks by repricing policies upon renewal or covering unexpected losses using capital, there are limits to such tools. Capital is also not a full solution, especially if capital requirements are not calibrated to capture climate-related risks.

Increasing premium rates and/or reducing insurance coverage could have adverse implications for other parts of the financial system.[78] PRA (2021) describes how corporate borrowers could become more exposed to business interruptions arising from the materialisation of physical risks. More expensive business interruption insurance could widen the protection gap, increasing the probability of default by those borrowers who may

[78] Burt (2023) estimates that economic losses from wildfires in the United States in 2021 were six times higher than the premiums collected by insurers for home insurance coverage. If insurers were to close the pricing gap, the author estimated that property values would decline by about USD 595 billion, thus significantly affecting the banking sector due to increased mortgage default rates.

not be able to repay their loans without insurance cover. Other regulators may be concerned with cross-sectoral disruptions that can arise from lenders exposed to uninsurable mortgage portfolios in certain geographical locations.[79]

[79] PRA (2015) cites an example in the Bahamas, which saw insurers withdrawing flood cover for properties in low-lying areas following several hurricanes. As a result, mortgage lending for properties in these areas dried up, pushing down their values. Finally, homeowners abandoned those properties altogether.

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Challenges faced in integrating climate-related risks into insurance product pricing and underwriting

Challenges faced in integrating climate-related risks into insurance product pricing and underwriting

Challenges

The main challenge cited by insurers in integrating climate-related risks into pricing is the lack of data. The lack of relevant data and research needed to attribute financial losses to climate change makes it difficult to factor climate change impacts into the pricing and underwriting of insurance products. It is also difficult to identify direct and indirect [80] climate change impacts in claims analysis in order to feed them into pricing processes. The surveyed insurers highlighted difficulties in differentiating between claims occurring because of climate change and those occurring because of natural catastrophes that would have occurred even without climate change. Some of them considered that more years of data and research will be required to accurately attribute causes of claims experience to climate change. The lack of meaningful climate-related disclosures by businesses is another data-related challenge. Data for certain lines of business such as liability insurance may not be publicly available due to, for example, private legal settlements and confidentiality agreements more generally.

Some insurance regulators have found that insurers are not using relevant data to price climate-related products. This may be due to the lack of relevant data or because insurers may be forced to use proxy data, which may not be entirely suitable, when pricing those products. In addition, insurers may not have granular enough data (e.g. the spatial attributes of houses) to properly assess their physical risk exposures. As a result, it may be difficult for insurers to accurately price products exposed to climate-related risks or to "reward" policyholders who take risk adaptation measures.

Traditional actuarial pricing models may not be suitable for capturing future climate change impacts. Actuarial pricing models typically rely on historical data to price an insurance product. For example, to price property insurance, an insurer would typically consider the frequency and severity of past claims and adjust the pricing variables to reflect expected future claims. Even with extensive experience in modelling natural catastrophe risks, incorporating climate change impacts is a challenge for insurers. The models may not reflect human activities that might be contributing to climate change, or may miss indirect

[80] For example, a wildfire may cause deaths, and there could also be indirect impacts such as cardiovascular and respiratory illnesses due to smoke inhalation or mental stress or post-traumatic stress disorder from having to flee from the disaster.

factors such as exposure movement (e.g. population relocation), risk adaptation measures, policy changes or secondary impacts (e.g. supply chain shocks).

As climate change is profoundly altering the frequency and severity of certain insured events, historical claims data is unreliable. For example, according to the IPCC[81], local sea level rises that historically occurred once per century are projected to become at least annual events in most locations within this century. The impact of such scientific projections, especially climate tipping points, on the pricing of insurance products can be very significant and yet unknown with any degree of certainty. The non-linear nature of climate change impact and the lack of relevance of historical data are further factors that make traditional actuarial pricing models unsuitable for pricing products exposed to climate-related risks.

There are many uncertainties relating to transition and physical risks that pose in pricing and underwriting challenges.

- For transition risks, it is difficult to accurately assess potential changes in consumer preference, policies and technological advancements, and how these may affect the pricing and underwriting of relevant insurance products.
- From a physical risk perspective, it is difficult to establish with certainty how climate change may increase the frequency and severity of climate-related events. Moreover, the potential impact of climate policies, technological advancements and consumer behaviour on future climate trajectories is unknown.
- The interconnections of various financial risks arising from climate change as well as the evolving, multi-faceted nature of climate-related risks, make it very uncertain and challenging to assess.
- The long term nature of climate-related risks means that there are significant uncertainties around modelled outcomes including secondary perils, cumulative and compound effects, and economic transition pathways.

As a result of the technical challenges and climate-related uncertainties, insurers and insurance supervisors may not be able to accurately assess premium adequacy.

From a supervisory perspective, insufficient climate-related disclosures by insurance companies pose a challenge for supervisors in assessing insurers' pricing and underwriting practices. Disclosures may lack the depth needed to fully understand the approach taken. Insufficient information disclosure can be due to either a lack of resources and capacity or deliberate protection of proprietary information (e.g. in-house risk models).

[81] See IPCC, *Special report on the ocean and cryosphere in a changing climate*, figure SPM.4.

The lack of information and the lack of consistency in and comparability of insurers' approaches in addressing climate-related risks in their pricing and underwriting make it challenging for supervision staff to assess insurers' pricing and underwriting approaches. Insurers may run the risk of underpricing certain insurance products or may unknowingly accumulate concentration risks by underwriting multiple products that are exposed to the same source of climate change risk.

Product design and practical challenges make it more difficult for insurers to fully address climate-related risks and recognise adaptation measures in their pricing and underwriting processes. EIOPA (2021) highlights how legislation may restrict risk-based pricing by imposing a prescribed premium calculation method for certain insurance products. It also lists studies on product design challenges, for example the bundling of risk coverage into a single product or the mixing of climate- and non-climate-related risks, which makes it difficult to price for climate change impacts. Cross-subsidisation of risks within a policy may mask the true cost of insurance that would otherwise be prohibitively expensive for properties located in high-risk areas. Insurers may find that the cost of verifying risk adaptation measures is too high and, as a result, ignore such measures that could otherwise reduce premiums. Some of the surveyed insurers highlighted difficulties in engaging with high-risk customers in order to encourage them to take risk adaptation or mitigation measures.

Insufficient technical capacity of both insurers and supervisors is a challenge to adequately accounting for climate-related risks. Some insurers face shortages of suitably skilled staff with the knowledge to price and underwrite climate-related risks. Insurance supervisors may not have adequate resources or technical expertise, or may have other priorities. It is very challenging for supervisors to gain the necessary skills and expertise to assess the diverse range of pricing or underwriting approaches taken by insurers. For example, insurers use a variety of natural catastrophe models to price exposures to climate-related events, and each of these models can be very complex and sophisticated. Supervisors may not have sufficient technical expertise to assess such models. As a result, those supervisors may not be able to assess the extent to which insurers are adequately allowing for climate-related risks in their pricing and underwriting practices. This is not an ideal situation as it may lead to an accumulation of excessive risks or unfair treatment of consumers who may be paying more than necessary. In the worst-case scenario, consumers may be excluded completely from much needed insurance protection.

Ways to overcome challenges

Pricing models that do not rely on historical data may be needed to overcome data challenges. Examples provided by the surveyed insurers include the use of forecasts of losses from climate-related events or the development of probabilistic natural catastrophe models that can capture the probability distribution of perils that have not been observed in historical data. Given challenges in projecting climate change impacts and difficulties in isolating them in claims experience, some insurers may focus efforts on monitoring all claims data, based on the assumption that climate change impacts would be reflected therein, without necessarily attempting to identify or isolate them.

Regional and international climate-related disclosure standards can help address some data gaps. Examples of such standards include standards by the International Sustainability Standards Board and the EU Corporate Sustainability Reporting Directive. Information disclosed under these requirements may help insurers understand how their counterparties are addressing climate risks, which may provide useful information for their own underwriting purposes. Various international and national efforts supported by financial sector regulators are also under way to supplement these disclosure standards by directly providing relevant data to support the global policy objective of transitioning to net zero.[82] While these data sets are generally geared towards addressing investors' needs, they can nonetheless provide useful information to insurers for their underwriting purposes.

The surveyed supervisors and industry players concur that capacity building and awareness raising are important measures that may help address some of these challenges.[83] There needs to be greater awareness of how climate change can have an impact on the risks underwritten and how product design and pricing may need to be adjusted to reflect climate-related risks. Only when insurers are convinced that climate change will have an impact on their business model and compromise their viability will they react on a timely basis. From a regulatory perspective, supervisors can issue guidance on how insurers can incorporate climate-related risks into their pricing and underwriting practices, or guidance on data and modelling approaches. Such guidance may include emerging good practices observed within the industry or from other jurisdictions.

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[82] The Climate Data Steering Committee (2022), convened by French President Emmanuel Macron and UN Special Envoy for Climate Ambition and Solutions Michael R Bloomberg, is one such example. The Committee has published recommendations to develop a Net-Zero Data Public Utility (NZDPU) that will be an open, free and centralised data repository for easy access to key climate transition-related data, commitments, and progress of businesses and financial institutions toward those commitments. In Singapore, MAS's Project Greenprint aims to harness technology and data to enable a more transparent, trusted and efficient ESG ecosystem to enable green and sustainable finance. The project includes the development of an integrated disclosure portal to ease sustainability reporting and enhance access to ESG data.

[83] The BIS-IAIS-NGFS-Sustainable Insurance Forum Climate Training Alliance portal supports capacity building of central banks and financial authorities on climate- and environment-related topics by centralising relevant training materials in the portal.

Supervisors may also support capacity building of insurers and the public to enhance their understanding of climate-related risks. This can involve the direct approach of partnering with local academic institutions to offer relevant courses for the insurance industry, or a less direct approach of bringing in foreign experts or leveraging overseas climate expertise. Supporting consumer education and financial literacy will also be important to close the protection gap and to support the implementation of risk adaptation measures.

Insurance supervisors can also indirectly support the development of industry expertise by contributing to relevant industry forums or using their influence to nudge relevant bodies. For example, in Canada, the Actuarial Division of the OSFI works with the Canadian Institute of Actuaries to develop educational notes on emerging risks, including climate-related risks. Engagement with industry associations is another way to facilitate knowledge exchange. In Chinese Taipei, the FSC has encouraged the Non-Life Insurance Association to set up a task force to facilitate the development of green insurance products, leveraging experiences from other jurisdictions. The FSC also ordered the Taiwan Insurance Institute to collect relevant loss experience data and conduct research to support the development of green insurance products. In addition, it asked the Actuarial Institute to formulate relevant codes of practice to guide actuarial professionals in pricing or underwriting green insurance products. In Europe, EIOPA engages regularly with the insurance industry to discuss underwriting- and pricing-related topics in the context of climate change, as well as to foster developments around climate change adaptation.

Regulatory-industry partnerships can be particularly useful to identify emerging good practices.

- PRA (2019b) is an example of how the industry can work with supervisors to develop practical guidance that provides concrete examples of how non-life insurers can assess the impact of climate change on their insurance liabilities. The guide also provides a framework that insurers can apply in incorporating climate-related risks into their pricing and underwriting approaches.
- EIOPA (2023a)[84] showcases industry underwriting practices in relation to climate change adaptation in order to promote the further development of climate-resilient products.
- MAS (2022) highlights emerging and/or good practices by selected insurers, identifies areas where further work is needed and serves as a reference for insurers

[84] The pilot exercise also aims to assess the appropriateness of the prudential consideration of climate-related adaptation measures in Solvency II, which may prevent insurers from incorporating adaptation measures into insurance products.

to facilitate their efforts to strengthen their resilience to environmental risk, including underwriting practices.

Insurance supervisors have a critical convenor role to play, coordinating multi-party solutions to address some of these challenges. Supervisors may facilitate information exchange amongst industry players on how they can overcome common challenges.[85] For example, to address the modelling challenge, supervisors can bring together relevant experts from the industry, scientific community and modelling companies to work together. Supervisors may also "nudge" industry associations and professional actuarial bodies to support insurers by providing relevant technical expertise, for example by coordinating the collection of loss experience data for pricing purposes or developing pricing guides for actuaries. Supervisors may even need to engage with consumers and local government authorities such as land planning or building standard authorities to support climate adaptation efforts that can in turn maintain the availability and affordability of insurance coverage. Public-private partnerships in various forms may be needed to tackle the challenge of maintaining affordable insurance protection in the face of climate change.

Some insurance supervisors may take a more direct approach in addressing capability and product availability challenges. For example, supervisors may develop risk assessment models (e.g. scenario analysis tools) to support smaller insurers that lack the technical expertise or resources to do so themselves. Other supervisors may promote the development of specific insurance products, such as parametric insurance, to support the accessibility and affordability of insurance protection against climate-related perils.[86] Supervisors are increasingly open to experimenting with innovative solutions to tackle pricing and underwriting challenges, for example by facilitating the uptake of technological solutions through the development of open source models.[87]

[85] For example, EIOPA (2023a) outlines underwriting practices in the context of climate change adaptation.
[86] Some of the surveyed insurers highlighted that parametric insurance can be an innovative product solution that addresses some of the modelling and data challenges.
[87] For example, EIOPA has developed a user interface to facilitate the use of open source catastrophe model CLIMADA by insurers in the EU.

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Concluding remarks

Concluding Remarks

There is growing recognition by insurers and regulators of the need to incorporate climate-related risks into pricing and underwriting processes. This is important not only to safeguard the safety and soundness of insurers but also to preserve financial stability more generally. Moreover, insurers can contribute positively to climate risk adaptation and mitigation efforts through pricing and underwriting incentives. Insurers that have a solid understanding of the impact of climate risks will be better positioned to formulate and implement effective risk management processes, including sound pricing and underwriting practices, that could enhance financial resilience and inform appropriate strategic and business decisions.

Both over- and underpricing can have adverse prudential and financial stability implications. The former could potentially result in reduced affordability and accessibility of insurance coverage, and the latter in potential solvency and liquidity issues for insurers. Supervisors therefore have an interest in ascertaining the appropriateness of insurers' pricing methodologies and, while this is true for any type of product, it is a particularly pertinent issue for climate-related risks given the potential wide-ranging policy implications.

It is worrying that not many insurers are able to account for climate-related risks explicitly, mainly due to capacity and technical constraints. Nevertheless, increased insured losses – mainly due to increasing risk exposures, which are being exacerbated by climate change impacts – are resulting in premium increases and withdrawal of non-life coverage from certain geographies. As insurers gain more understanding and expertise in addressing climate-related risks, it is reasonable to expect further reductions in the affordability and availability of climate-related insurance products. There is growing evidence that this trend is already occurring. Such a catch-22 situation can have systemic risk implications should insurers withdraw critical insurance coverage that cannot be substituted or whose absence paralyses the functioning of certain parts of the economy or the financial system.

Insurance supervisors have a key role to play in ascertaining adequate premium pricing and sound underwriting practices in order to safeguard the resilience of the insurance sector against future climate change impacts. A growing number of insurance regulators are providing guidance through climate-related risk management guidelines

on how insurers can address climate-related risks in their pricing and underwriting activities based on emerging industry good practices. In addition, concerted efforts by the industry, regulators and other stakeholders including the scientific community are needed to improve pricing and underwriting methodologies. While some supervisors are going a step further to encourage insurers to offer products that support the transition to net zero, this may not be part of the main priority for other regulators. Nevertheless, insurers may use their influence as underwriters to positively support net zero policy objectives.

Regulators have a role to play to support sustainable and continuous availability of private insurance coverage. This may require providing incentives for proper, affordable and reasonable risk adaptation and mitigation measures. Care should be taken to avoid overly accommodative pricing and underwriting practices that could disincentivise the reduction of climate-related exposures and compromise the safety and soundness of insurers.

At the same time, other policymakers may need to face the potential for private insurance market failure and step in to backstop climate-related insurance losses. Climate-related perils may become uninsurable if the risks are no longer diversifiable or if the risks become too large to insure by any single private insurer. Withdrawal of reinsurance capacity may accelerate this problem. Policies beyond the remit of insurance supervisors, ranging from government tax incentives to consumer education, will be needed to achieve the goal of continued availability of affordable insurance coverage against climate change impacts. Yet, a government scheme in which it acts as insurer of last resort could be counterproductive as it could lead to potential moral hazard by the general population, which may assume that any climate-related losses will be (partially) covered by governments. In such a scenario, there will be little or no incentive for the public to improve their climate resilience or, indeed, purchase private insurance.

Increasingly, insurance supervisors are putting more efforts into addressing the protection gap against climate-related risks. While addressing the affordability and availability of insurance coverage was not considered a prudential concern in the past, it is becoming increasingly evident that a widening protection gap due to climate change can have far reaching economic and financial stability implications, not to mention social and political consequences. It is important that efforts to close the protection gap be consistent with sound pricing and underwriting. It would not be a desirable outcome, for example, to

encourage policyholders to purchase flood insurance that is underpriced due to underestimation of climate-related risks.

Insurance alone is not sufficient to protect society at large from climate change impacts. However, it does have a key role to play, and needs to act in concert with other policy measures that go beyond the remit of insurance supervisors. This calls for close cooperation between regulators and other governmental and non-governmental agencies. Coordinated efforts from all parties – insurers, regulators and governments – will be required to mitigate and address the climate challenge.

At a global level, jurisdictions need to recognise the disproportionate impact of climate change on the poorest nations. Many less developed countries are highly exposed to climate change and, at the same time, have the largest protection gaps. As such, they are the most vulnerable when physical risks manifest, affecting the general population, businesses and governments, which will need to bear a large part of the losses. Clearly, this is not a sustainable situation. In this broader context of a just transition to net zero, policymakers will need to consider a just climate adaptation policy. Insurers and insurance regulators will have a role to play in any such policies.

One thing is clear – we cannot afford inaction. While there are many uncertainties about how climate change will evolve, whether transition policies will work etc, one thing is certain – without further measures and concerted efforts by insurers, regulators, governments and the public at large, insurance against climate risks will become less affordable and available. Ultimately, we may one day go over the insurability tipping point, which will no doubt result in a lose-lose situation for all stakeholders.

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Annex 1: Summary of survey responses on impact of climate-related risks on insurance products

Exposure to physical and transition risks from climate change may affect insurance products in various ways. Table 2 below shows a summary of the exposure to physical and transition risks of various product lines across life, health and non-life insurance sectors:

Table 2: Climate change impacts on insurance products

Sample products offered by sampled insurers			
Product Line	Examples of products offered	Description of nature of exposure to physical risks	Description of nature of exposure to transition risks
Life – Protection	Whole life, universal life, term life, participating life[88]	Increased mortality projections (more deaths than expected) due to higher frequency and severity of extreme heat events, leading to aggravation of cardiovascular and respiratory illnesses.	
Life – Investments/ Savings	Savings plan, segregated funds[89], annuities	Higher frequency of policy lapses due to change in policyholder behaviour.	
Health/ Medical	Critical illness, long-term care, short- and long-term disability, hospital and medical plans, etc.	Increased morbidity projections due to higher frequency and severity of extreme heat events, leading to more critical illnesses than expected and aggravation of cardiovascular and respiratory illnesses. More frequent and longer duration of disability, higher medical claims. Higher hospitalisation rates due to weather	

[88] A participating (par) life insurance policy is a policy that enables a policyholder to participate or share in the profits of the insurance company's par fund. Par policies provide both guaranteed benefits from the sum assured and non-guaranteed benefits such as bonuses and cash dividends.
[89] A segregated fund is an investment pool structured as a deferred variable annuity and used by insurance companies to offer both capital appreciation and death benefits to policyholders.

		changes, (e.g. heat stress, discomfort among seniors).	
Non-life – Property	Commercial property, engineering (renewable), motor, business interruption	Lower long-term profitability and insurability due to increased damages to assets and business interruption from extreme weather events, i.e. floods (river flooding and pluvial flooding), hurricanes (storm surges and pluvial flooding), heatwaves, wildfires, droughts, sea level rise, erosion or biodiversity loss.	Lower insurability for businesses related to the use of coal-fired power plants (e.g. due to technological advancements which phase out fossil fuels) Higher premiums and claim costs due to a shift towards electric vehicles (expensive batteries, in-car technology) Higher premiums and claims costs due to changes in building codes (to generate lower energy costs and reduce emissions). Lower insurability due to climate-related emissions in operations or productions
Non-life – Casualty	Work injury compensation, general liability, public/product liability, financial lines	Work-related or physical injuries to customers/employees arising from climate-related emissions in operations or productions; extreme weather events, e.g. floods (river flooding and pluvial flooding), hurricanes (storm surges and pluvial flooding), heatwaves, wildfires, droughts, sea-level rise, erosion and biodiversity loss; environment impact and soil/water/plastic pollution or over-consumption; and increased claims due to lack of proper controls, procedures, or governance potentially resulting in a large physical loss event.	Increased probability of repayment defaults due to lower profitability and competitiveness of companies in high-emission sectors as a result of policy and regulatory risks, such as changes in carbon pricing, subsidies, or emission standards. Increased claims due to higher risk of greenwashing or inaction by the insured resulting in legal charges.

Others	Group benefits, employee benefits, personal accident, travel	Changing demand from employees to counter effects of climate change leading to increased claims. Reinsurers are exposed to frequency perils mainly through aggregate excess of loss structures, event excess of loss structures that have a low attachment point and proportional treaties.	Lower demand for products due to change in consumer behaviour (i.e. lower volume of travel to reduce emissions). Increased climate change litigation arising from contribution to climate change, improper disclosure, misleading product disclosures and mismanagement of climate-related risks. Uncertain profitability due to insufficient underwriting, loss adjustment and claims handling experience in relation to insurance covering new technology (e.g. offshore wind projects).

Annex 2: Overview of insurance exclusion and withdrawal from surveyed sample

Table 3 summarises publicly available information from selected surveyed insurers on their planned exclusion and withdrawals from certain geographical locations and sectors, as well as other underwriting/pricing-related pledges as part of net zero commitments.

Table 3: Insurance underwriting exclusions and withdrawals

Life and health insurers			
Name of insurer	Year by which net zero target will be reached	Sectors excluded from underwriting	Other underwriting / pricing pledges
AIA Singapore Private Limited	2050	None	Confirmed support for the Paris Agreement and launched first Climate Statement in 2018. Became a signatory to the UN Principles for Sustainable Insurance (PSI) in 2021. Signed up to the Science Based Targets initiative (SBTi) in 2021.
The Great Eastern Life Assurance Company Limited	Not available	None	Launched first green life insurance plan, Great Green SP, in 2021.[90]
Manulife (Singapore) Pte Ltd	2050	None	Expanded sustainable investing offerings with the launch of the Global Climate Action Plan strategy in Europe and Asia.
Prudential Assurance Company Singapore	2050	None	ESG policy encourages policyholders to be environmentally responsible. Launched two ESG investment-linked policy sub-funds, PRULink Global Impact ESG Equity Fund

[90] A short-term endowment plan that provides customers a green alternative to wealth accumulation with returns from green investments.

			and PRULink Global Climate Change Equity Fund, in 2021.
Non-life insurer			
Allianz Insurance Singapore Pte Ltd	2050	Coal Does not accept single-site coverages related to the construction and operation of: thermal coal power plants and mines where coal is extracted and coal-related infrastructure which predominantly serves the coal value chain. Oil & gas Does not accept single-site coverages related to the exploration and development of new oil and new gas fields (upstream); the construction of new midstream infrastructure related to oil; construction of new oil power plants; practices relating to the Arctic (as defined by the Arctic Monitoring and Assessment Programme, excluding operations in Norwegian territories) and Antarctic; coal-bed methane; extra-heavy oil and oil sands; and ultra-deep sea. This pertains to both new and existing projects/operations. As of 2025, no more coverage for oil and gas companies without a	Increasing revenues from transition solutions[91] (property damage and business interruption) by 150% by 2030. Engaging with 20 million motor retail customers to support transition to electric mobility. Calling on governments and regulators to address sustainability and promoting 1.5 degree-aligned public policy. Co-leading a project in collaboration with the Insurance Development Forum, in alignment with the InsuResilience Solutions Fund, to develop a flood risk insurance solution for Ghana with support from the local UN Development Programme and other public sector stakeholders such as the Ministry of Finance of Ghana.

[91] Allianz defines transition solutions as renewable energy technologies and related technologies, battery storage, grid stability solutions, electric transportation (including EV manufacturing and suppliers, battery manufacturing and electric mass transit infrastructure (rail)), certified green buildings and other industry projects related to the energy transition.

		1.5 degree-aligned transition plan.	
Reinsurer			
SCOR Reinsurance Asia-Pacific Pte Ltd	2050	Excluding insurance and facultative reinsurance coverage for new thermal coal mine and coal-fired power plant projects. Excluding Appalachian Mountain top removal operations. Phasing out insurance and reinsurance coverage for coal-fired power plants without capture and storage of CO_2 emission by 2030 in OECD countries and by 2040 for the rest of the world. Excluding insurance and facultative reinsurance coverage for oil and gas exploration or production projects in the Arctic National Wildlife Refuge. Excluding insurance and facultative reinsurance coverage for new oil field production projects from 2023. Excluding insurance and facultative reinsurance coverage for the tobacco industry. Aligning with the UNESCO, Principles for Sustainable Insurance and World Wildlife Fund initiative to protect World Heritage Sites.	Transitioning all operational and attributable GHG emissions from its insurance and reinsurance underwriting portfolios to net zero emissions by 2050.