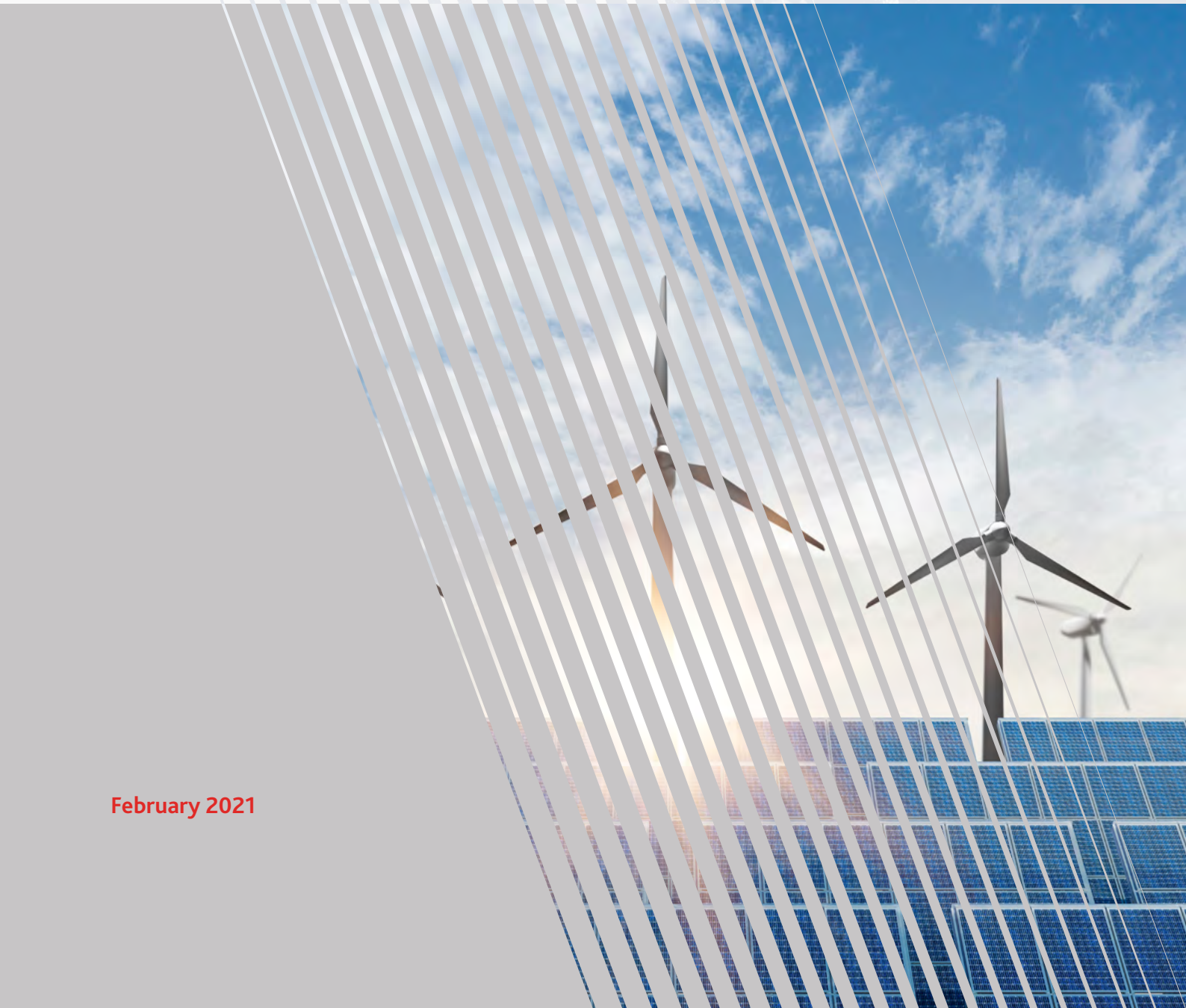
THE GENEVA ASSOCIATION

INSURANCE FOR A BETTER WORLD

Climate Change Risk Assessment for the Insurance Industry

A holistic decision-making framework and key considerations for both sides of the balance sheet



February 2021

Climate Change Risk Assessment for the Insurance Industry

A holistic decision-making framework and key considerations for both sides of the balance sheet

The Geneva Association Task Force on Climate Change Risk Assessment for the Insurance Industry

Maryam Golnaraghi (project leader and coordinating author), The Geneva Association

Drafting team:

Ian Adamczyk, Moya Chew-Lai (retired)**, Li Liu, Sean Collins**, Prudential Financial
Hjörtur Thrainsson, Munich Re
Michèle Lacroix, Paul Nunn, SCOR
Martin Bertogg, Swiss Re

Other team members:

Gijs Kloek, Achmea | **Pedro Nascimento de Oliveira**, Aegon
Jennifer Waldner, David Buckle, Anthony L Zobl, AIG
Sebastian Fischer, Allianz | **Ben Carr, Bianca Hanscombe, Jean-Francois Coppenolle**, Aviva **Dora Elamri, Olivier Poissonneau, Helene Chauvea**, AXA | **Gloria Jimenez, Alex Speers,** Chubb
Hidenao Makiuchi, Kazumi Hayashi, Dai-ichi Life | **Jörg Steffensen**, Hannover Re
Brandon Blant, Mandy Dennison, Pierre Bernard, Laura Willett, Intact Financial
Cindy Forbes, Margaret Eve Childe, Maria McGowan, Herman Ko, Manulife
Diana Keegan, Anna Warm, MetLife | **Eberhard Faust** (retired), Munich Re
Junaid Seria, Yun Wai-Song, SCOR | **Martin Weymann**, Swiss Re
Z. Ming Li, John Campbell, Kei Kato, Tokio Marine | **Dennis Noordhoek**, The Geneva Association

The Geneva Association

The Geneva Association was created in 1973 and is the only global association of insurance companies; our members are insurance and reinsurance Chief Executive Officers (CEOs). Based on rigorous research conducted in collaboration with our members, academic institutions and multilateral organisations, our mission is to identify and investigate key trends that are likely to shape or impact the insurance industry in the future, highlighting what is at stake for the industry; develop recommendations for the industry and for policymakers; provide a platform to our members, policymakers, academics, multilateral and non-governmental organisations to discuss these trends and recommendations; reach out to global opinion leaders and influential organisations to highlight the positive contributions of insurance to better understanding risks and to building resilient and prosperous economies and societies, and thus a more sustainable world.

Acknowledgements

The Task Force would like to thank the members of the Geneva Association Climate Change and Emerging Environmental Topics Working Group and the Public Policy and Regulation Working Group for their review and feedback. We extend our special thanks also to: Chris Boss and Maeve Sherry (Aviva); Liesbeth van der Kruit and Gijs Kloek (Achmea); Edward Barron (AIG); Simone Ruiz-Vergote and Andreas Funke (Allianz); Patricia Plas, Celine Soubranne and Madeleine-Sophie Deroche (AXA); Laura Willet (Intact Financial); Hidehiko Sogano and Jiro Kamiko (Dai-ichi Life); Diana Keegan (MetLife); Panos Charissiadis (Munich Re); Guillaume Ominetti (SCOR); Urs Halbeisen and Marion Lienhard, Stefan Roth, Tobias Wassmann, Lutz Wilhelmy (Swiss Re). Finally, we appreciate the helpful comments of Christophe Courbage and Kai-Uwe Schanz (The Geneva Association).

Photo credits:
Cover page— Elena11 and Fit Ztudio / Shutterstock.com

Geneva Association publications:
Pamela Corn, Director Communications
Hannah Dean, Editor and Content Manager
Petr Neugebauer, Digital Media Manager

Suggested citation:
The Geneva Association. 2021. *Climate Change Risk Assessment for the Insurance Industry*. February. Authors: Maryam Golnaraghi and the Geneva Association Task Force on Climate Change Risk Assessment for the Insurance Industry.

www.genevaassociation.org

Contents

Foreword 5

1. Executive summary 6

2. Context 10

3. Terminology 13

4. How does climate change impact the insurance industry? 15
   - 4.1 Framing climate change risks and relevant time horizons for decision-making 15
   - 4.2 Implications of climate change risk for P&C and life re/insurers – Liability side 18
     - P&C re/insurers 18
       - Physical risk 19
       - Transition risk 20
     - Life re/insurers 22
       - Physical risk over the short term 22
       - Transition risk over the short term 22
       - Physical and transition risk over the long term 22
   - 4.3 Implications of climate change risk for P&C and life re/insurers – Asset side 23
     - Physical risk 23
     - Transition risk 23
   - 4.4 Key questions re/insurers ask when embarking on climate change risk assessments 24

5. Approaches to climate change risk assessment 25
   - 5.1 Quantitative tools 26
   - 5.2 Qualitative tools 27

6. Summary and conclusions 28

References 30

Annexes

Annex 1: Climate change-related activities of regulatory authorities 33

Annex 2: P&C and life insurance business models 35

Abstract

The Financial Stability Board's (FSB) Task Force on Climate-Related Financial Disclosure (TCFD) has raised the need for decision-relevant, clear, consistent and comparable climate information for stakeholder groups to inform investing. The insurance industry is well positioned to take the lead in advancing the forefront of methodologies and tools that produce meaningful and decision-useful information: risk is the raison d'être of the industry, and risk assessment is already deeply embedded in companies' risk management, underwriting and investment processes. Building on a history of physical climate risk modelling, and through the platform of The Geneva Association, the insurance industry is taking steps to strengthen further its global collaboration across P&C and life re/insurers to advance methodologies and tools for climate risk assessment and scenario analysis for both sides of the balance sheet. This report – the first in a series of three – offers a holistic decision-making framework for P&C and life re/insurers, for both the liability and asset sides of the balance sheet, taking into consideration all aspects of climate change risk (i.e. physical and transition risks) by line of business (LoB) and over distinct time horizons. This analysis offers a foundation for the Geneva Association Task Force's work to drive future developments in this space.

Foreword

Tragically, the effects of climate change are becoming more palpable and harder to ignore. Persistently warming temperatures and sea-level rise. Compromised ocean ecosystems. Gigantic wildfires in Australia and California and a record hurricane season in the Atlantic. The societal impacts are worldwide, and individuals and institutions must fully commit now to confronting the climate crisis.

For their part, insurers are already contributing significantly to the transition to a low-carbon economy. On the liabilities side, more insurers are factoring climate risk into their underwriting decisions. On the asset side, many companies have investment strategies that support climate mitigation. An important next step is to develop and hone climate risk assessment methodologies and tools.

There are many calls for collaboration within and across industries to tackle this. And that is precisely the aim of the Geneva Association task force: to bring the global insurance industry to the same table to develop effective approaches to climate risk assessment.

However, working in industry silos is not enough. Cooperation with regulators, rating agencies, and the scientific community is critical to deciding the most viable ways forward. Our initiative is closely engaging those stakeholders as well.

This first report of the task force sets out a climate risk assessment framework for both P&C and life insurers, urging companies to start with a simplified approach. They should focus on two time horizons – short term (2020–2030) and long term (2030–2050) – and the potential implications of physical and transition risks for both sides of the balance sheet.

As underwriters, insurers are at the forefront of understanding and preventing risk. As asset managers, they can steer massive amounts of capital to climate-resilient investments. Insurers are obvious, strong leaders on global climate action, and our industry-led initiative reinforces that they are willing and eager to forge ahead.

Jad Ariss
Managing Director

1. Executive summary

There is now widespread global recognition of climate change science and the associated socio-economic impacts as set out by the United Nations Intergovernmental Panel on Climate Change (IPCC).[1] While governments have submitted their Nationally Determined Contributions (NDCs) to mitigate the impacts of climate change,[2] the development of public policies for an orderly transition to a low-carbon future has been stubbornly slow. Progress has however been made through the financial sector in developing a framework for disclosures of climate change risks, through the Financial Stability Board (FSB) Task Force for Climate Related Financial Disclosure (TCFD). With the aim to inform investing in a climate sensitive way, among other recommendations, the TCFD seeks clarity around how companies identify, assess and manage climate change risk.[3,4]

Risk is the raison d'être of the insurance industry, and risk assessment is already deeply embedded in organisations' risk management and underwriting processes. P&C re/insurers are well prepared for the catastrophic impact of weather-related extremes today and are robustly capitalised to 'weather the storms' and be there for policyholders when disasters strike. For the past 30 years, P&C re/insurers have provided leadership in modelling and pricing natural catastrophe (NatCat) risk; conducting research and promoting risk reduction and preventive measures. Furthermore, by understanding the risks, re/insurance fosters socio-economic resilience to natural catastrophe risk, amplified by climate change. By offering innovative risk transfer solutions, re/insurers enable the entrepreneurial pathways from startup to commercialisation of the clean and green technologies of the future and incentivise reduction in greenhouse gas (GHG) emissions (e.g. green building insurance). In order to better tackle the challenges of shifting the economy to a low-carbon model, re/insurers also participate in various alliances to promote science-based methodologies, share expertise and collaborate to ensure stronger impact on the real economy.[5] As institutional investors, many P&C and life re/insurers are taking steps to integrate climate change in their investment strategies and make investment decisions that support climate mitigation.[6] Re/insurers are also actively involved in initiatives to develop sustainable finance frameworks that aim to mobilise mainstream finance to invest at scale in transitioning to a resilient low-carbon economy.

1 IPCC 2014, 2018.
2 National NDCs have been submitted to the UN Framework Convention of Climate Change (UNFCCC).
3 The TCFD has called for voluntary climate-related financial disclosures that are 'consistent, comparable, reliable, clear and efficient and provide decision-useful information to lenders, insurers and investors'.
4 TCFD 2017, 2020.
5 For example Climate Action 100+ : https://climateaction100.wpcomstaging.com/companies/ and the Net-Zero Asset Owner Alliance: https://www.unepfi.org/net-zero-alliance/
6 The Geneva Association 2018a.

Many P&C and life re/insurers are already taking steps to integrate climate change in their investment strategies and make investment decisions that support climate mitigation.

To reach the climate change goals set out in the Paris Agreement,[7] and pivot away from carbon-intensive sectors, dramatic changes in business models and everyday life are needed to impact the core and essential sectors of the world economy. Transitioning to a lower-carbon economy will entail extensive public policy, legal, technology, market and consumer behaviour changes over time.[8] Policy measures may include limiting actions that contribute to climate change, promoting adaptation or driving business-model changes in economic sectors. Climate litigation cases take many forms, for example, some of those who suffer loss or expect to suffer loss as a result of climate change-related impacts are already pursuing judicial remedies to recover damages or fund abatement efforts, while others are using litigation as a tool to leverage more ambitious climate policy and actions or to oppose them.[9] Inevitable technological innovations and disruptions for the transitioning in many sectors in the years to come will have significant impacts on organisations and their competitiveness (e.g. energy, food production, transportation, materials).[10] Other uncertainties are linked to varied and complex effects on the markets (e.g. supply and demand, products and services).

The uncertainties inherent to transition risk create challenges for re/insurers to conduct climate risk assessment across all aspects of the insurance business model.

While re/insurers start from strong foundations, these inherent uncertainties associated with transition risk (i.e. policy, legal, technology and market risks) across future time horizons of climate change bring some additional challenges to conducting meaningful, decision-useful and holistic climate risk assessment across all aspects of the insurance business model (Annex 2).

Re/insurers are initiating and/or engaging in various intra- and inter-sectoral pilot projects to develop new methodologies,[11] publishing risk reports[12] and developing proposals for appropriate decision-relevant assessments and disclosure of climate change risks, including the TCFD. For P&C re/insurers, their deep knowledge in extreme weather risk modelling has been also instrumental to raising awareness on the asset side; for example, leveraging NatCat risk modelling and expertise has led to a better grasp of the potential impacts on real estate investments. However, much more work lies ahead to converge on robust methodologies.

The Geneva Association Task Force

The Geneva Association Task Force on Climate Change Risk Assessment aims to advance and accelerate the development of holistic methodologies and tools for conducting climate risk assessment and scenario analysis. These efforts aim to shape future innovations and support re/insurers, regulators and other stakeholders in shaping innovations in this space.

Against this backdrop, in 2020, at the request of its Board of Directors, The Geneva Association (GA) established an industry-led 'Task Force on Climate Change Risk Assessment for the Insurance Industry', involving global P&C and life re/insurance companies.[13,14] The GA Task Force's aim is to advance and accelerate the development of holistic methodologies and tools for conducting meaningful and decision-relevant climate risk assessment and scenario analysis. These efforts aim to shape future

7 United Nations 2015.
8 TCFD 2017.
9 Based on research by The Geneva Association (forthcoming).
10 RethinkX 2020.
11 UNEP-FI PSI 2021, 2020; UNEP-FI 2019; UNEP-FI and Oliver Wyman 2018; ClimateWise 2019a–d.
12 CRO Forum 2018.
13 The Geneva Association is an international think tank. Its members are CEOs of the largest re/insurance companies (P&C and life), which in total manage USD 17.1 trillion in assets; employ 2.4 million people; and protect 1.8 billion people globally.
14 The Board's decision followed two Geneva Association conferences on this topic: 1) How Will Risk Modelling Shape the Future of Risk Transfer?, hosted by SCOR (9 March 2017, Paris) https://www.genevaassociation.org/how-will-risk-modelling-shape-future-risk-transfer; and 2) Advancements in the Modelling and Integration of Physical and Transition Climate Risk, hosted by Tokio Marie (11–12 July 2019, London) https://www.genevaassociation.org/climate-change-forum-2019

innovations and support re/insurers, regulators and other stakeholders in shaping innovations in this space.

This report offers a holistic decision-making framework for designing climate risk assessments for P&C and life re/insurers for both the liability and asset sides of the balance sheet. It takes into consideration all aspects of climate change risk by line of business (LoB) and for distinct time horizons.

Key findings

1. **The development of climate risk assessment methodologies and tools, such as scenario analysis, that would produce meaningful and decision-useful information is a work in progress.** Despite some actions by stakeholder groups (e.g. re/insurers, financial institutions, regulatory and standard setting bodies, international organisations, commercial data providers, consulting firms and academia), initiatives remain fragmented and considerable work lies ahead because of the quickly evolving nature of climate science as well as other factors that will influence transition efforts. Achieving consensus will take time.

2. **There are several sources of uncertainty associated with transitioning that need to be considered in a climate risk assessment.** Over the next decades, public policies, regulations, technological advancement, market conditions and other aspects of societal transition towards low-carbon economies will affect the level of climate change risk and the future risk landscape. These factors highlight some of the inherent uncertainties that must be considered and accounted for when assessing exposure to climate change risk.

3. **Climate change poses varying levels of physical and transition risk to both sides of the balance sheet (liabilities and assets) for P&C and life re/insurers.** The time horizon over which the risk manifests itself is a key factor and varies across the different lines of business and investments, which adds to the complexity of assessing climate risk impacts.

i. *P&C and life re/insurers have exposure to both physical and transition risks on the liability side.*

- *Physical risk:* P&C insurers are already experiencing an evolution in risk exposures as a result of gradual climate change. Through extensive investments in NatCat-centric research, the industry has developed a robust natural catastrophe risk management system to understand the present amount of embedded climate change. Property catastrophe portfolios are in focus, but they benefit from a short-tail liability pattern. With the majority of affected property insurance cover offered on an annual basis, P&C re/insurers have the opportunity to monitor gradual changes to the climate risk landscape and consider adjustments to pricing and/or product offerings. While this is an instrumental protection layer for P&C re/insurers, they have to watch for insurability and work on the viability of their business model over longer time horizons (2030–2050).

  For life re/insurers, the evolution in the physical risk exposure will be longer term in nature and through their underwriting. The long time horizon, over which these risks materialise, makes reliable and meaningful scenario analysis a challenging task.

- *Transition risk:* For P&C and life re/insurers, transition risk may emerge as society transitions towards lower carbon emissions and the potential impacts of climate change become clearer. More broadly, physical and transition risks are interconnected, e.g. actions to address transition risk, if taken early enough, will positively influence the severity and frequency of physical risks.

ii. *Re/insurers are exposed to both physical and transition risk on the asset side.*

Through their investment portfolios, re/insurers are exposed to both physical and transition risks. The increasing call for transparency alongside increasing regulation on sustainable finance are catalysts for increasing consideration of climate change risk and mitigation actions. When deciding on sectors and geographical allocation and investee selection, re/insurers are increasingly considering the resilience of their portfolio and mitigation actions such as divestment, best-in-class strategies and engagement.

4. **Re/insurers should engage in robust dialogue on climate change risk across the organisation** to raise risk awareness, strengthen collaboration to leverage expertise across the company and ensure adequate actions are taken where and when necessary. This report presents key questions that re/insurers are asking to focus and facilitate their work and identify the decisions and actions needed today.

5. **A combination of qualitative and quantitative approaches for assessing climate change risk over the various time horizons is required.** For example, near-term business considerations and risk management decisions for P&C re/insurance businesses require quantitative assessments, starting with physical risk. However, long-term projections (e.g. to 2050 or beyond) entail multi-dimensional uncertainty (e.g. physical, socio-economic conditions) and thus may be better assessed through qualitative approaches and serve to support raising risk awareness and the high-level, strategic steering of business and investments.

6. **Re/insurers, as risk managers and investors, play an important role in understanding the risks associated with climate change and educating stakeholders (e.g. customers, policymakers, regulators) on how climate change will impact society.** The results of re/insurers' research, risk modelling, underwriting and investments, could not only complement but also inform the broader actions that are needed by governments, policymakers, regulators, corporations and society as a whole.

Re/insurers, as risk managers and investors, play an important role in understanding the risks associated with climate change and educating stakeholders on how climate change will impact society.

2. Context

Over the last five years, actions for transitioning to a resilient low-carbon economy have been slowly gaining momentum within the public and private sectors. A pivotal point was the launch of the Financial Stability Board's Task Force on Climate-Related Financial Disclosure,[15] which raised the need for decision-relevant, clear, consistent and comparable climate information for stakeholder groups. The TCFD[16] provided principles-based guidance on climate-related financial disclosures based on climate-related risks, opportunities and scenario analysis. Growing adoption of TCFD recommendations by companies in various sectors points to the need to further develop and test industry-specific methodological approaches to climate risk assessment, including relevant scenario analysis and stress testing.[17]

Sustainable finance initiatives around the world aim to mobilise mainstream finance towards environmentally sustainable investments in order to mitigate global warming and related risks.

Sustainable finance initiatives around the world (e.g. EU Action Plan on Sustainable Finance and the European Commission Renewed Sustainable Finance Strategy,[18] Canadian Expert Panel on Sustainable Finance,[19] and the Australian Sustainable Finance Initiative[20]) aim to mobilise mainstream finance towards environmentally sustainable investments through both the public and private sectors with the ultimate objective to limit global warming and related risks. Access to high-quality, reliable and comparable climate change risk information – as per the TCFD – would help facilitate these developments.

Climate risk assessment and related disclosures are gaining momentum among financial services and insurance regulators and standard setting bodies, such as the International Association of Insurance Supervisors (IAIS) together with the Sustainable Insurance Forum (SIF), the Network for Greening the Financial System (NGFS), the European Insurance and Occupational Pension Authorities (EIOPA), the Prudential Regulation Authority (PRA) at the Bank of England (BoE), the French supervisory authority (ACPR), the central bank and financial regulatory authority in Singapore (MAS), The Australian Prudential Regulation Authority (APRA),

15 TCFD 2016.
16 TCFD 2017.
17 TCFD 2018, 2019.
18 For more information: https://ec.europa.eu/info/consultations/finance-2020-sustainable-finance-strategy_en
19 For more information: https://www.canada.ca/en/department-finance/news/2019/06/expert-panel-on-sustainable-finance-delivers-final-report-finance-minister-joins-international-climate-coalition.html
20 For more information: https://www.sustainablefinance.org.au/

the National Association of Insurance Commissioners (NAIC) and various state insurance regulators and the Commodities Future Trading Commission (CFTC) in the U.S. and Canada's Office of the Superintendent of Financial Institutions (OSFI) and Bank of Canada (Annex 1).

In parallel, international rating agencies such as Moody's and Standard & Poor's are investing in building their in-house capacities in climate risk analytics and increasingly considering climate change risk in their company, municipal and sovereign credit rating practices.[21,22]

The insurance industry is already taking action to address the climate change challenge.[23] For over three decades, P&C re/insurers have invested in climate risk research, analysis and pricing, as part of their NatCat modelling(Box 1).[24] P&C re/insurers have been instrumental in raising climate risk awareness, promoting risk reduction and preventive measures and innovating risk transfer solutions to build socio-economic resilience to physical climate risks (e.g. extreme weather events) in a changing climate.[25] Through their product offerings, re/insurers are also incentivising reduction in greenhouse gas emissions and enabling entrepreneurial pathways for the commercialisation of clean, green and carbon capture and storage technologies. As institutional investors, P&C and life re/insurers are considering portfolio strategies that increasingly integrate climate change considerations, investing in bonds (e.g. green, resilient, transition and catastrophe bonds) and establishing alliances (e.g. Climate

Box 1: Modelling the risk of extreme weather events in property insurance – Status quo

Since 1980 the insurance industry has been monitoring and maintaining databases of losses from natural disasters and how these have evolved with respect to frequency and severity, with an increase of insured losses from extreme weather by an order of magnitude over five decades, inflation adjusted. The largest drivers of the observed increase in NatCat losses are exposure-related, e.g. economic growth, property-value concentrations, migration to coast lines, urban sprawl in hazardous areas and damages to vulnerable infrastructure.

The success of property catastrophe insurance modelling also draws from the nearly universal one-year-coverage scope, allowing the industry to remain in lock-step with an evolving risk landscape, linked to changes to exposure, natural climate variability over decades or underlying impacts of anthropogenic climate change on physical risks. While explicit attribution of already-present physical climate change for most perils is still elusive with the current state of science, the industry models successfully track a rapid change in the risk landscape in aggregation of all trends, hazard and exposure alike.

Over the last few years, by using its quantitative exposure monitoring and NatCat risk modelling capabilities, the P&C re/insurance industry has managed to successfully address this rapid increase in insured loss potential, from changes to both hazard and exposure, and was able to withstand losses from several major events – Hurricanes Katrina, Rita and Wilma in 2005, the series of tropical cyclones in 2017, 2018 and 2019 in the U.S. and Japan – illustrating successful risk management practices on the back of probabilistic quantitative NatCat modelling.

The industry strives to evolve the forefront of NatCat modelling to derive decision-useful quantitative information to inform today's high-level portfolio strategy decisions, including stronger attribution to individual risk trends like climate change. Today's NatCat models are designed to provide decision-useful output for the blend of hazard, exposure, vulnerability and insurance-cover specifics that are present today. The latter three factors have been the dominant drivers for key natural perils exposure in the past five decades. While highly useful for today's and next year's portfolio management, catastrophe models are limited in providing decision-useful quantitative information over a longer term, impeding progress toward a forward-looking climate change and exposure/vulnerability landscape. Understanding and anticipating the dominant drivers next to climate change will be paramount for conditioning these models for more distant futures.[26]

21 For more information about S&P ratings and the latest report cards for companies from different sectors see: https://www.spglobal.com/ratings/en/products-benefits/products/esg-in-credit-ratings#sector-report-cards.
22 Moody's 2018, 2019; Standard & Poor's 2018, 2020.
23 The Geneva Association 2018a. Author: Maryam Golnaraghi.
24 The Geneva Association 2018b. Authors: Maryam Golnaraghi et al.
25 The Geneva Association 2016; The Geneva Association 2018a; The Geneva Association 2020a. Authors: Maryam Golnaraghi et al.; The Geneva Association 2020b. Authors: Carolyn Kousky and Maryam Golnaraghi; The Geneva Association 2020c. Author: Swenja Surminksi et al.; The Geneva Association 2020d. Authors: Swenja Surminski et al.; The Geneva Association 2020e. Authors: Neil Duffy et al.; The Geneva Association 2020f. Authors: Maryam Golnaraghi et al.
26 Catastrophe modelling efforts are also underway to address insurance protection gaps in both developed and developing nations, through stronger private and public cooperation (The Geneva Association 2018b and 2020a-f and Insurance Development Forum 2020).

Action 100+, the Net-Zero Asset Manager Alliance) for investing at scale in resilient low-carbon business models.

Through their product and service offerings, insurers are building socio-economic resilience to extreme weather events, incentivising reduction in greenhouse gas emissions and enabling entrepreneurial pathways for commercialising clean, green and carbon capture and storage technologies.

However, while quantitative and probabilistic NatCat risk modelling has become an industry best practice and a core part of property re/insurers' operations, developing methodologies and tools for holistic climate change risk modelling and scenario analysis, for both sides of the balance sheet, go significantly beyond these efforts and require further development.

While at different stages in the process, P&C and life re/insurers globally are undertaking activities across their organisations to assess their exposure to climate change risks. Insurer experiences have highlighted the many challenges related to conducting climate change risk assessments, for example:

- How to holistically consider physical and transition risks and their linkages
- Determining appropriate time horizons
- Defining and executing meaningful and decision-relevant scenarios
- Addressing gaps in data, methodologies and tools
- Dealing with numerous other inherent uncertainties

Strong industry-level collaboration and engagement with other stakeholders are needed for the cross-fertilisation of ideas to advance climate risk assessment for both sides of the balance sheet.

At this stage, re/insurers are gaining expertise, raising risk awareness through risk assessment exercises and facilitating intra- and inter-organisational dialogues. This expertise enables decision-useful analysis that results in industry actions today and avoids analysis paralysis. Over time, with scientific progress and increasing experience, the issues to consider and expectations of all stakeholders will evolve. As part of this journey, strong industry-level collaboration with other stakeholders is needed for cross-fertilisation of ideas and concepts to advance climate risk assessment for both sides of the balance sheet.

Against this backdrop, in 2020, The Geneva Association's industry-led 'Task Force on Climate Change Risk Assessment for the Insurance Industry' (hereafter referred to as 'the GA Task Force') was established to leverage stronger global collaboration and engagement with other stakeholders, to provide a more holistic, industry-level perspective for climate risk assessment, and forward-looking scenario analysis for P&C and life re/insurers for both sides of the balance sheet.

This report offers a holistic decision-making framework for designing climate risk assessments for P&C and life re/insurers, for both the liability and asset sides of the balance sheet, for all aspects of climate change risk (i.e. physical and transition risks), by LoB and for distinct time horizons.

In a second step, the Task Force will analyse the trends, approaches and challenges related to the regulatory landscape and explore opportunities for multi-stakeholder collaboration to advance methodologies and tools for climate risk assessment and scenario analysis.

The Task Force will then take a deep technical dive to push the forefront of scenario design and methodologies and tools for meaningful and decision-useful scenario analysis and stress testing.

Section 3 of this report provides an overview of key definitions. In section 4 we describe how climate change impacts re/insurers (P&C and life) on both sides of the balance sheet, with a focus on physical and transition risks, type of decisions and relevant time horizons. Section 5 offers an overview of tools and approaches to conduct climate risk assessment, which will be further expanded in future reports of this series. Recommendations are provided in section 6.

3. Terminology

In this report, the terms 'climate risk' and 'climate change risk' are not used interchangeably.

Climate risk refers to the (extreme) weather-related risk that P&C re/insurers underwrite at any given time.

Climate change risk is based on the TCFD's[27] definitions, broadly accepted and including transition risk and physical risk.

- **Physical risk** is defined as the potential negative financial impacts that could arise from direct physical effects, such as the destruction of property and infrastructure, and indirect impacts, such as business or supply chain interruptions, due to the increasing severity and frequency of extreme weather events (acute risks) and long-term shifts in climate patterns (chronic risks) caused by climate change.

- **Transition risk** is defined as the risks which could result from the process of transitioning towards a low-carbon economy. The TCFD notes that transitioning to a lower-carbon economy may entail extensive policy, legal, technology and market changes to address mitigation and adaptation requirements related to climate change.[28] Depending on the nature, speed, and focus of these changes, transition risks may pose varying levels of financial and reputational risk to organisations.

  According to the TCFD,[29] transition risk also includes climate litigation or legal risk, i.e. climate-related litigation claims brought before the courts by property owners, municipalities, states, insurers, shareholders and public-interest organisations. Reasons for such litigation include the failure to mitigate the impacts of climate change, failure to adapt to climate change and insufficient disclosure around material financial risks. As the value of loss and damage arising from climate change grows, litigation risk is also likely to increase.[30]

Climate risk assessment refers to assessing climate change risks and 'climate risk management', or managing climate change risks.

Climate change scenario analysis has been identified as one of the key priority areas for climate risk management.[31] Box 2 provides the definitions of scenario analysis, stress testing and sensitivity analysis that are used in this report.

27 TCFD 2017.
28 Ibid.
29 Ibid.
30 The Geneva Association is conducting a separate study looking at the evolving landscape of global climate litigation landscape and related sources of climate litigation and risks, using a broader definition than the TCFD's and covering more cases.
31 Carney 2019; TCFD 2017.

While these broad categories are helpful for contextualising climate change risk, a number of underlying facets must be considered when assessing the potential impacts over the short- to medium- and long-term time frames (e.g. next 5–10 years, next 30 years).

Box 2: Definitions of scenario analysis, stress test and sensitivity analysis

Scenario analysis has been a well-established tool in risk analysis for the forward-looking assessment of risks and opportunities. It is 'a process for identifying and assessing the potential implications of a range of plausible future states under conditions of uncertainty'. Scenario analysis can be quantitative, qualitative or a mix of both.

A stress test is a projection of the financial condition of a firm or economy under a specific set of severely adverse conditions. This may be the result of several risk factors over multiple periods of time or one risk factor that is short in duration. Stress testing is always quantitative.

A sensitivity analysis is the 'effect of a set of alternative assumptions regarding a future environment'. A scenario used for sensitivity testing usually represents a relatively small change in these risk factors or their likelihood of occurrence. Sensitivity analysis is predominantly quantitative but can also be qualitative.

Source: OECD 2020

For example, while often discussed as distinct exposures, it is important to acknowledge the interconnection between transition and physical risks. Specifically, if society (e.g. policymakers, corporations in carbon-intensive sectors, investors, consumers, etc.) is able to accelerate the transition by taking actions to reduce carbon emissions and thereby global warming, it may reduce the extent to which acute and chronic physical risks materialise. Conversely, an absence of action by society is likely to lead to more severe global warming and physical risks. Unfortunately, it will take decades for the consequences of today's actions to become evident.

The use of forward-looking scenario analysis for climate risk assessment, an explicit recommendation of the TCFD, is being considered.[32] Scenario analysis is essential for assessing emerging risks, in this case related to climate change in the face of significant uncertainties, and employs the following approaches:

1. **Quantitative scenario analysis**, which focuses on understanding the potential impact of a pathway of action, or inaction, by society to address climate change risk from a dollar and/or percentage perspective; for example, by how much would asset values decline? By how much would liability values increase? However, quantifying the impacts of climate change can be challenging, particularly over the long term, given the inherent uncertainty of key drivers including the timing and breadth of policy action and technological developments, second-order impacts to economic variables and other relevant changes to economic and social conditions.

2. **Qualitative scenario analysis**, which also aims to understand the potential impact of a transition pathway; however, rather than measuring the impact from a dollar or percentage perspective, qualitative scenario analysis focuses on formulating the potential consequences of a transition pathway (e.g. assumed government mitigation/adaptation measures, technology and market developments), including the business implications and actions that may be needed.

Forward-looking scenario analysis is essential for assessing emerging risks, such as for climate change in the face of significant uncertainties.

These will be further elaborated in section 5.

32 TCFD 2017.

4. How does climate change impact the insurance industry?

4.1 Framing climate change risks and relevant time horizons for decision-making

Many of the risks re/insurers shield their policyholders from have remained broadly the same over time; for example, the need for financial protection in the case of premature death and the need for protection against physical damage to assets. However, the ever-changing nature of the world introduces challenges, such as climate change, that must be accounted for when assessing the expected frequency and severity of the existing spectrum of risks.[33]

When assessing climate change risk, re/insurers need to consider a number of critical factors, namely physical and transition risks and relevant time horizons for their decision-making. Table 1 provides an overview of different types of risks that can be considered under physical risk (i.e. chronic and acute risks) and transition risk (i.e. policy risk, litigation or legal risk, market risk and technological risk) and their relation to re/insurers' risk landscape over two time horizons: 1) the short- to medium-term, or 'business-planning', time horizon (suggested as 2020–2030) and 2) the long-term, or 'strategic-planning', time horizon (suggested as 2030–2050). In order to target decision-useful analytics for action today, time horizons beyond 2050 have been purposely excluded. More details on these time horizons are provided in the sections on implications for P&C insurers and life insurers, on both the liability and investment sides of the balance sheet.

33 CRO Forum 2018; Lloyd's of London 2020a,b.

Table 1: An overview of physical and transition risks and relevant time horizons for re/insurers' decision-making

	Physical risk		
	• Can be driven by events or longer-term shifts in climate patterns. • Currently a gradual change: small annual increments compounding over years with a low probability of a sudden change.		
	Chronic risk	Acute risk	
Overview	• Progressive shifts in climate patterns, such as sea-level rise and droughts; cascading effects on food production, water security, migration.	• Changes in the nature of extreme weather events, such as wildfires, flooding, storms.	
Risk landscape over the business-planning horizon: 2020–2030 (short term)	• The impacts are already present though the rate of annual change is slow, e.g. mean global temperatures are elevated by 1-degree Celsius over pre-industrial levels, sea-level rise is adversely affecting low lying coasts today, etc.	• Attributing the role of climate change in current extreme events is a difficult, ongoing subject of scientific study. • For major perils, such as hurricanes, a response to anthropogenic climate change can be implied, but evidence of signal is strongly masked by natural climate variability and other man-made changes to the risk landscape. • For secondary perils like wildfire and local flooding, attribution is already much clearer. • Due to slow gradual change, the climate state of 2030 will not differ significantly from today.	
Risk landscape over the strategic-planning horizon: 2030–2050 (long term)	• Unmitigated, the negative impacts are expected to increase significantly, including more and prolonged heat waves and droughts, inundation of coastal real estate, disrupted food production and water scarcity, disruption of ecosystems and loss of biodiversity, the spread of diseases and other health impacts, geopolitical consequences.	• The severity and frequency of perils will change, and in many areas of the world likely increase, e.g. sea-level rise will worsen storm surge risk and cyclone severity; increase in the number and extent of wildfires and local flooding.	

Source: The Geneva Association

Over the coming decades, policy, regulatory and technological advancement, as well as market conditions and other aspects of societal transitioning towards low-carbon economies, are expected to affect the level of transition and physical climate change risks. The pace of these developments must be aligned with the time horizon of the offered insurance coverage and line of business, when considering how a climate change risk may impact re/insurers. For example, with climate change already upon us – e.g. mean global temperatures are elevated by 1-degree Celsius compared to pre-industrial times, and sea-level rise is already adversely impacting some low-lying coastal areas[35]

34 Using TCFD definition for litigation or legal risk.
35 IPCC 2018.

Transition risk				
	• May entail policy, legal, technology and market changes to address mitigation and adaptation requirements related to climate change.			
	Policy risk	Litigation or legal risk[34]	Market risk	Technological risk
	• Includes policy efforts to limit emissions or promote climate-friendly adaptation.	• May arise from insureds' causal contributions to climate change or failure to mitigate the impacts of or adapt to climate change. • May challenge insureds' role in society (duty of care/ human rights cases) or force a review of their projects or technologies.	• Includes the impact a changing climate may have on the supply and demand of goods and services.	• Includes the potential for new technology to disrupt or displace existing systems.
	• Public perception supports meaningful near-term policy action; however, action may be inconsistent across the globe and benefits from action may take time to accrue but could have an acute impact on investment portfolios.	• Likely to increase due to increases in the value of losses and damages from climate change; the scrutiny of action, or inaction, to address climate change; cases that can be used as precedent; substantial policy change in this timeframe.	• Transportation and energy generation are among the markets that will likely experience near-term impacts. • Valuation of assets in investment portfolios may become more volatile and/or experience pressure as carbon-intensive sectors become less productive and/or viable.	
	• The impact will be highly dependent on the extent of action taken in the short term. • Actions taken in the long term would also take time to accrue but could have an acute impact on asset portfolios.	• The extent of policy action taken (or not) will likely guide how the risk emerges and evolves. • Knock-on effects of climate litigation against governments could shift the dial in certain jurisdictions for corporate clients, directly affecting the corporate strategies, business models and operational decision-making of entire sectors.	• The impact will depend on the timing of transition for various sectors and asset classes, which will be informed by all aspects of transition risk (i.e. policy, legal, market, technological). • In the absence of successful mitigation in the longer term, it is likely that geoengineering solutions will be pursued, with potentially unintended consequences.	

– the insurance industry is monitoring where and by how much the underlying risk landscape has already changed, and to what extent these changes may affect their book of business over the short term (2020–2030) and long term (2030–2050).

When considering the potential effects of climate change on longer-duration lines of business (e.g. mortality protection, retirement savings), beyond understanding the direct impact of climate change on physical risks assumed through underwriting, it is important to establish assumptions for societal progress in combating climate change and how climate change may impact other key drivers (e.g. economic growth, financial market performance). For example, climate change is not expected to have a material impact on mortality or life insurance coverage over the short term. However, it may become more relevant over longer-time horizons (e.g. beyond 2050), especially when considered in parallel with the effects it may have on health, economic growth, financial markets and certain asset classes. Furthermore, the potential impact of prolonged exposure to more severe

events on life re/insurers and certain longer duration lines of P&C re/insurance business must also be considered.

4.2 Implications of climate change risk for P&C and life re/ insurers – Liability side

From the insurance industry's perspective, climate change is not a distinct risk. It is changing the frequency and the severity of the risks that re/insurers have covered for more than a century (e.g. coverage for property damage, premature death) or have assumed as part of their ALM practices (e.g. the risk of credit defaults within their asset portfolios). In other words, climate change is not a new risk class in the risk assessment practices of re/insurers. It is a change factor, whilst an important one, amongst many others, affecting both the liability and investment sides of the balance sheet. This section looks at physical and transition risks for the liability side of P&C and life re/insurers, respectively.

Climate change is not a new risk class in the risk assessment practices of re/insurers. It is an important change factor, amongst many others, affecting both the liability and investment side of the balance sheet.

P&C re/insurers

Table 2 further details the implications of climate change risk (physical and transition risks) on P&C re/insurers' liability decision-making over the two time horizons: short to medium term (2020–2030) and long term (2030–2050). For physical risks, in addition to direct risks associated with changes in the frequency and severity of extreme events (e.g. hurricanes, wildfires, storms), considerations linked to a changing climate system's tipping points (e.g. changing climate zones, changing

Table 2: Climate change risk and the decision landscape for P&C re/insurers – Liability side

	Physical risk		
	Chronic risk	Acute risk	
Risk landscape over the business-planning horizon: 2020–2030 (short term)	• Climate change alone is not yet impacting the insurability of NatCat risk, except for certain wildfire zones. • Climate change is an additional modifier of the well-known and successfully-managed natural catastrophe risk. Thus, climate change is implicitly embedded in current pricing, risk management and claims experience. • Limited data makes it difficult to isolate what impact climate change will have versus other loss drivers, including natural variability, and increasing and more concentrated asset values in high-risk zones like cities and coastal areas. • As the risk landscape is constantly evolving on multiple fronts, climate change included, a sustainable product offering needs to address today's risk versus an outdated assessment.		
Risk landscape over the strategic-planning horizon: 2030–2050 (long term)	• Climate change effects will likely manifest in a worsening claims experience for weather-related perils, requiring the industry to adjust its risk assessment and pricing dynamically and in a forward-looking mode (e.g. what used to be a 1-in-200-years event might become a 1-in-100-years event).[36] • Insuring some risks/geographies will gradually become less affordable (e.g. home coverage in exposed coastal areas) unless adaptation measures reduce risk levels and prevent new risks. • The insurance business model will not be able to address risk with a certainty of loss, e.g. property on storm surge-exposed coastlines or close to rivers. Insurability will require adaptation measures so that insurance covers the random negative deviation from an expected outcome rather than the expected outcome. • Secondary effects will be added; for example, a change or loss in biodiversity affects ecosystems and their natural protection levels, or changed temperature regimes and access to water affect urban settlements, production and supply chains, potentially leading to forced migration. • While not the most likely outcome from a 2020 insights perspective, rapid intensification of climate change and/ or exceeding tipping points[37] could have a dramatic impact on both chronic and acute risk, where risk adaptation and mitigation become cornerstones to maintain insurability.		

Source: The Geneva Association

36 But not necessarily a worsening of profitability, where premium goes at pace with the cost of risk.
37 For example this may result from a subsiding Gulf stream, linked to the changing ocean circulation caused by climate change.

ocean circulation, impacts on trade winds, jet stream and gulf stream) and a myriad of other indirect effects – such as biodiversity loss – are also reflected. On the transition risk side, the table highlights considerations for political, litigation, market and technological risks related to liability side.

Physical risk

P&C re/insurers have been successfully dealing with extreme losses from natural catastrophes – specifically, weather-related risks – for decades, using well-established and proven risk management practices and governance.[38] While the link between anthropogenic climate change and its broad effects on the frequency and severity of weather-related perils (e.g. tropical cyclones, floods and wildfires) has been established for some time now,[39] as of today, despite ongoing progress with climate change attribution science, the level of confidence in scientific results to explicitly attribute anthropogenic climate change to specific changes in frequency and severity of weather-related extreme events remains low. In other words, further analysis, potentially over the next several decades, is needed to better differentiate specific impacts of anthropogenic climate change from natural climate variability on characteristics of weather-related extremes, from period to period.[40]

Importantly, exposure and vulnerability factors, such as population growth, urbanisation, an increasing concentration of people and assets in high-risk zones (e.g. along coastlines and flood zones), development choices and supply-chain disruptions (caused by extreme events) distort and could mask any embedded climate change signal.[41]

In the interim, P&C re/insurers view climate change as a co-contributor in a rapidly changing risk landscape alongside other risk drivers highlighted above. In such a dynamically evolving risk landscape, the actuarial practice of averaging the past to anticipate the future is not valid. It is important to reiterate that the vast majority of P&C re/insurance contracts are re/underwritten on an annual basis. This makes it easy to adjust the pricing, terms and conditions, and product offerings to progressive climate change for the key portfolio on the liability side exposed to physical climate change.

	Transition risk			
	Policy risk	Litigation risk	Market risk	Technological risk
	• The impact would depend on the timing and scope of the policy to curb carbon emissions. • Significant action could limit the viability of carbon-intensive industries, impacting associated Insurance lines of business.	• The evolving legal and regulatory environment and absence of court rulings that establish principles for climate change-related liability present a high degree of uncertainty, particularly for D&O coverage. • Professionals' duties of care for some insureds could potentially lead to claims related to physical and transition risks, impacting professional indemnity/errors and omissions (E&O) coverage.	• Market forces could limit the viability of some industries, limiting associated insurance. • Exposure through reputational risk (by association in providing coverage to certain companies and industries).	• Progress in carbon removal and renewable energy presents opportunities; however, prototypical technology is often subject to volatility in results.
	• Long-term impacts will align with those in the short term. • Action will occur across all fronts – policy, legal, market and technological – but the potential impacts are difficult to assess given uncertainties regarding the timing, scope, etc. of change. • Considering the inherent uncertainty and interconnection with physical risks, multiple pathways must be contemplated.			

38 The Geneva Association 2018b.
39 IPCC 2014, 2018.
40 This remains a challenging question to quantify amongst all other changing human-driven socio-economic changes.
41 The Geneva Association 2018b, 2020a–f.

With the majority of affected property insurance cover offered on an annual basis, P&C re/insurers have the opportunity to monitor gradual changes to the climate risk landscape and consider adjustments to pricing and/or product offerings.

Transition risk

For P&C re/insurers, the impact of transition risk will be driven by less predictable external forces such as public policies (policy risk), court rulings (litigation risk), consumer/societal pressures (market risk) and technological advances (technological risk) (Table 2). From a policy perspective, actions to reduce carbon emissions could change the scope of business re/insurers are willing or able to underwrite or the price at which they are willing to offer coverage.[42,43] For example, the ability to offer some lines of business such as surety (insurer guarantees performance of a contractual obligation) and credit (insurer guarantees payment of credit extended to a party) to carbon-intensive sectors could be significantly affected if public policies curb carbon emissions dramatically. While there is a clear trend towards policy action to reduce carbon emissions in a number of major economies, the implications from an insurance perspective will likely be more gradual. However, transition could be quick and therefore the potential risk of a 'cliff effect' cannot be completely discounted. Similarly, the evolving regulatory and legal environment and the absence of court rulings that establish principles for climate change-related liability create a high degree of uncertainty for how liability insurance (insurer provides protection against liabilities that arise from lawsuits) may be impacted.[44] Similar to policy risk, the impact is expected to be gradual; however, effects are already starting to materialise in certain jurisdictions.

The growing expectation that the private sector will take proactive actions to reduce its contributions to carbon emissions or to combat climate change risk (i.e. market risk) must also be accounted for. For example, as carbon-intensive sectors reduce or suspend their operations in the face of market and public policy pressure, the opportunities to offer these businesses insurance protection will diminish. At the same time, re/insurers themselves are facing market pressure to take proactive action; for example, to no longer underwrite risks for carbon-intensive business (reducing insurance liability exposure) and to no longer invest in them (reduce insurance asset portfolio exposure). It is also important to note that as risk managers, underwriters and investors, the insurance industry is already contributing significantly to building socio-economic resilience to extreme events and climate change risks and the transition to a low-carbon economy.[45]

As carbon-intensive sectors reduce or suspend their operations in the face of market and public policy pressure, the opportunities to offer these businesses insurance protection will diminish.

While the shift away from carbon-intensive businesses may present some challenges, there are growing opportunities through technological innovations and commercialisation in areas such as carbon capture and storage, renewable energy generation and electrification of transportation, among others. Broadly speaking, businesses advancing these initiatives will require many of the same insurance coverages as carbon-intensive sectors and serve as potential underwriting and investment opportunities.

Re/insurers are also considering the expected long-term (2030–2050) impacts climate change will have for business strategy and growth purposes. Similar to the practices employed for other risks, re/insurers, in their climate risk assessment efforts, need to consider a wide range of pathways for how climate change risk may emerge. A key element within each pathway is how the magnitude and pace of action (or inaction) to address transition risk may influence the trajectory of physical risks.

From the transition risk perspective, the long-term implications for P&C re/insurers are consistent with the

42 Technically, insurance prices are based on risk (along with a number of other factors) and can provide governments, businesses and individuals with reasonably accurate signals as to the impacts and characteristics of the hazards they face. Prices commensurate with underlying risks tend to encourage re/insureds to adopt mitigation measures which reduce vulnerability across society (The Geneva Association 2016).

43 The Geneva Association 2016, 2018a.

44 The Geneva Association is undertaking a study to explore the evolving landscape of climate change litigation and implications for the insurance industry.

45 The Geneva Association 2018a.

short-term implications noted above. They consist of uncertainties associated with transition risk (i.e. policy, legal, market and technological risks), the interplay between transition efforts and physical risk, and the effect of climate change on broader factors such as economic growth, migration and geopolitical conflict, among other issues.

The interlinkages of transition and physical risk need to be considered. Broadly speaking and assuming that climate change mitigation actions are insufficient, climate change will introduce longer-term shifts in climate patterns and present chronic risks that impact the geographic locations and subsequently impact pricing and premiums at which P&C re/insurers can offer insurance protection. For example, coastal areas will increasingly experience consistent flooding as the sea level rises and agricultural regions will gradually experience changes (e.g. more prolonged and severe droughts) that impact productivity. Thus, unless actions are taken by governments, businesses and people to reduce and/or prevent the risks, insurance coverage may become prohibitively expensive for the consumer and investments may be negatively impacted.[46] The willingness and ability of the market to accept the elevated premiums re/insurers may need to charge to cover increased risks is a factor that must be considered, as it negatively affects the economic resilience enabled by risk transfer through re/insurance.

There are very few segments, if any, of a P&C re/insurer's portfolio that would warrant immediate re-underwriting or re-strategising in view of a long-term outlook (2030–2050), given the short average duration of liabilities underwritten. This provides a high degree of flexibility for implementing adjustments when necessary.

Table 3: Climate change risk and decision landscape for life re/insurers – Liability side

	Physical risk		Transition risk			
	Chronic risk	Acute risk	Policy risk	Litigation risk	Market risk	Technological risk
Risk landscape over the business-planning horizon: 2020–2030 (short term)	• Limited data makes it difficult to isolate what impact climate change will have versus other drivers. • While natural catastrophes may increase, the mortality impact has historically been small, owing to early warning and emergency preparedness measures. • Diversification of the type and location of risks assumed also serves to reduce exposure to extreme events.		• Transition risk is generally not expected to have an impact on underwriting but there is potential for assets within the investment portfolio to experience effects (see Table 4 for further details on implications for investments). • From a market risk perspective, re/insurers may be directly exposed through reputational risk (e.g. stigmatised by the market for supporting carbon-intensive industries).			
Risk landscape over the strategic-planning horizon: 2030–2050 (long term)	• Prolonged exposure to a warming environment could cause increased cardiovascular and respiratory illnesses, agricultural impacts that adversely affect diet and nutrition, increased spread of infectious disease and more. • While the impact on claims from policies already on the books may become more pronounced, it could take more time before it reaches a level of statistical significance relative to the overall size of an insurer's exposures. • The potential impacts of second-order effects, such as potential declines in economic growth, population migration, geopolitical conflict, etc. should be considered and could increase materiality.		• Long-term implications are like those in the short term. • The interaction between transition and physical risks, which will be highly dependent upon the pace and degree of action to address the various aspects of transition risk, will become more relevant. • Second order effects such as potential declines in economic growth, population migration and geopolitical conflict must also be considered.			

Source: The Geneva Association

46 The Geneva Association 2020a–f.

Life re/insurers

From a liability perspective, the climate change challenges for life re/insurers vary considerably from those of P&C re/insurers given different time horizons and the nature of the risks underwritten.[47] Table 3 highlights the implications of physical and transition risk for life re/insurers' decisions over different time horizons for the liability side.

Physical risk over the short term

Given the longer-time horizon of the risks assumed by life re/insurers, the physical risk of climate change is generally not expected to have a material or discernible impact over the short term (2020–2030). For example, to the extent climate change drives an increase in the frequency or severity of natural catastrophes over the short term, experience – in view of the impact climate change has already had over several decades – suggests that the related mortality impact is likely to be small relative to a re/insurer's overall book of business. Furthermore, existing risk management practices, such as promoting a diversification of the type and location of assumed risks, help reduce concentrated exposures and therefore limit the potential for outsized mortality losses from natural catastrophes.

The physical risk of climate change is generally not expected to have a material or discernible impact on life re/insurers over the short term.

The impacts of increased physical risks from climate change could be more pronounced for the asset side of life insurance portfolios, depending on the extent to which they are invested in physical assets, such as real estate, in geographically-impacted areas. However, such losses may be tempered by the underlying asset's insurance coverage.

The impacts of increased physical risks from climate change on the asset side of life insurance portfolios will depend on the extent to which they are invested in physical assets.

Transition risk over the short term

The expected implications of transition risk for life re/insurers in the short term is unlikely to be impacted significantly (e.g. the frequency of deaths is unlikely to increase). However, there is potential for assets within the investment portfolio to be impacted; for example, a mandate for use of renewable energy sources could result in a decline in the value of investment in fossil fuel companies.

Assessments should also account for the potential impacts of second-order 'knock-on' effects, such as declines in economic growth, population migration, geopolitical conflict and shifts towards low-carbon business models.

Physical and transition risk over the long term

Over the long term (2030–2050), the impacts of both physical and transition climate change risks are more uncertain for life re/insurers. For example, they could cause a rise in mortality through increased cardiovascular and respiratory illnesses, agricultural impacts that adversely affect diet and nutrition and the increased spread of infectious and vector-born diseases,[48] or reduction in mortality linked to reduced air pollution from transitioning to a low-carbon economy, with some segments of society being more adversely impacted than others (e.g. wealthier populations are likely to be less severely impacted).[49] It is important, when considering climate change's potential effects on mortality rates and related claims – and an insurer's overall financial picture - to also account for changes in longevity trends and impacts on other lines of business. An assessment of how climate change may impact the life insurance industry should also account for the potential impacts of second-order effects, such as potential declines in economic growth, population migration, geopolitical conflict and shifts towards low-carbon business models, which will highly depend on the pace and degree of action to address the various aspects of transition risk (i.e. policy, legal, market and technological risks). However, research on the impacts of climate change on life exposures – and whether the impacts are statistically significant in light of the long-term nature of life re/insurers business – needs to be further developed.

47 IFoA 2019a,b
48 Campbell-Lendrum, et. al 2015.
49 IPCC 2018, 2019.

4.3 Implications of climate change risk for P&C and life re/insurers – Asset side

On the investment side for both P&C and life re/insurers, climate change is already having an impact in multiple ways. Table 4 highlights how physical and transition risks impact investment-related decisions over the short-term (2020-2030) and long-term (2030–2050) time horizons. From a valuation perspective, investors are beginning to account for the effects that transitioning to lower-carbon economies may have on the long-term earning potential of carbon-intensive sectors (e.g. energy companies and utilities, transportation, automotive, chemicals and manufacturing). Investors are also increasingly considering the impact of climate change when making investment acquisition and disposition decisions. Direct assets like real estate are being analysed through climate change adaptation and mitigation lenses. For example, P&C re/insurers can leverage their NatCat risk modelling expertise to gauge potential impacts on their investments.

Physical risk

Investments portfolios are exposed to physical risk, either directly for real assets (e.g. buildings, infrastructure) or indirectly through investments in companies (e.g. equity, debt) that are exposed to those risks. Assessing the exposure is multi-faceted as it is impacted by a range of factors such as geographical location, potential for insurance to offset losses (e.g. property insurance covering real estate investments), time horizon and action or inaction from a transition risk perspective. To be comprehensive, a re/insurer would need to analyse the exposure of an asset by assessing its entire value chain, which would be subject to huge gaps in data availability and robust methodologies.

> Market pressure to reduce support for carbon-intensive sectors is expected to steadily increase and present a growing reputational risk for re/insurers and other investors.

Transition risk

The degree to which transition risk impacts a re/insurer's investment portfolios will be driven by the speed and magnitude of developments across the different facets of the transition risk spectrum. For example, significant, abrupt action by policymakers could impose constraining

Table 4: Climate change risk and decision landscape for P&C and life re/insurers – Asset side

	Physical risk		Transition risk			
	Chronic risk	Acute risk	Policy risk	Litigation risk	Market risk	Technological risk
Risk landscape over the business-planning time horizon: 2020–2030 (short term)	• Insurers are exposed directly through investments in real assets (e.g. buildings, infrastructure) and indirectly through investments in companies (e.g. equity, debt) which are exposed to those risks. • While assets may be increasingly impacted by more frequent or severe natural catastrophes the losses may be offset by insurance protection (e.g. property insurance on real estate).		• The degree to which transition risk impacts re/insurer investment portfolios will be driven by the speed and magnitude of developments across the different facets of this spectrum. • Significant actions or developments could lead to abrupt losses in investment value and drive more expeditious action on the part of re/insurers.			
Risk landscape over the strategic-planning horizon: 2030–2050 (long term)	• As the effects of climate change accelerate, certain investments and sectors may become less attractive (stranded assets), e.g. real estate in coastal communities or stakes in fossil fuel companies if renewable fuels become viable on a mass scale. • Renewable energy and greening of other key sectors along with investment in resilient and green infrastructure are anticipated to grow significantly. • New technologies (clean, green and carbon capture and storage) will continue to emerge and bring new opportunities. • Other considerations.					

Source: The Geneva Association

regulations on carbon-intensive sectors.[50] Landmark court rulings against carbon-intensive sectors or major technological breakthroughs in the renewable fuel space are other examples of transitional developments that could have a material impact on the degree to which re/insurer investment portfolios may be impacted.[51] Meanwhile, market pressure to reduce support for carbon-intensive sectors is expected to steadily increase and present a growing reputational risk for re/insurers and other investors.

The asset class of the investment and time horizon are other factors that must be considered. For stock/equity investments, which do not have maturity dates, a permanent loss in investment value could arise. For debt/fixed-income investments, the investor may still be able to receive a significant portion, if not all, of the interest and principle payments due to them as long as the issuer (i.e. the carbon-intensive company) does not default before they come due.

In light of these risks, re/insurers are increasingly taking action to increase the resilience of their investment portfolios; for example, by identifying companies within carbon-intensive sectors that are best positioned to navigate the transition, establishing timelines to eliminate investments in carbon-intensive sectors and reassessing the geographic location of investments in real assets, among other considerations.

Re/insurers are taking action to increase the resilience of their investment portfolios, such as identifying companies that are best positioned to navigate the transition, considering geographic location and setting timelines to eliminate investments in carbon-intensive sectors.

4.4 Key questions re/insurers ask when embarking on climate change risk assessments

As part of their climate risk assessment initiatives, re/insurers are engaging in robust dialogue on various dimensions of climate change risk and time horizons within their respective organisations. Key questions they are using to focus and facilitate this work include:

1. What are the impacts of climate change (physical and transition risks) across the company's lines of business? Are these impacts adequately embedded in pricing, reserving and capital allocation decisions?
    - Are there lines of business where the gradually-accumulating impact of physical climate change risk (e.g. changing frequency and severity of extreme events to sustained higher temperature and rising sea level) over future decades necessitates taking action today?
    - Which existing lines of business and operations are sensitive to transition risk? For those identified, which actions are needed today?
    - Is the accumulating impact of transition risk being accounted for in strategic business decisions?
2. What does climate change risk mean for the company's investment strategy and decisions? Which assets could be affected by climate-related risks both transition and physical risks?
3. How could the impacts (on both sides of the balance sheet) be mitigated by actions taken by the public and private sector as well as the company itself?

The relevance and prioritisation of the elements presented in Tables 2, 3 and 4 will vary across re/insurance companies, depending on their specific risk profiles. Similarly, the appropriateness of the approach will vary depending on factors such as the re/insurer's objective, business mix and level of experience and expertise with assessing climate change risk.

50 This may happen through climate litigation against governments with the goal to impact public policies for carbon-intensive sectors (The Geneva Association forthcoming).
51 The Geneva Association (forthcoming).

5. Approaches to climate change risk assessment

Re/insurers are exploring the range of methodologies and tools that could best support and enable their climate change risk assessment and scenario analysis efforts. Scenario analysis allows for a systematic process for making strategic decisions in the face of significant uncertainties. The analysis of climate risks requires a forward-looking approach and needs to be designed with concrete objectives in mind. Furthermore, the interpretation of the output needs to take into consideration the inherent uncertainties associated with how the transition will evolve.

> Re/insurers are exploring the range of methodologies and tools that would produce meaningful and decision-useful climate change risk assessment with a forward-looking approach.

At this stage, the aim is to promote increased awareness of the risk, the importance of investing in developing assessment capabilities and experimenting with different approaches and engaging in dialogue to promote cross-learning. It is important to leverage these experiences to further innovate and push the frontiers of methodologies and tools that could produce meaningful and decision-relevant risk information.

> Climate risk analysis needs to be designed with concrete, decision-based objectives and time horizons. The interpretation of the output should consider inherent uncertainties associated with the transition.

Except for a limited number of instances, a push for detailed quantitative exercises at this stage remains premature and unlikely to yield decision-useful information, particularly for long-term horizons. To the extent that quantitative approaches are being pursued by the industry or advanced by regulators, it is critical that the aforementioned uncertainties inherent in assessing climate change risk, particularly over longer-term horizons, be adequately recognised when interpreting the results.

Decisions on 'which tool is best to assess the unique exposures of a re/insurer' are typically a function of the time horizon of the assessment, which in turn is a function of the nature of the insurance coverage being provided (e.g. annual

renewable versus long-duration business). In addition to providing alignment with the nature of the insurance coverage provided, delineating an assessment of climate change's potential effects over the short term (2020–2030) and long term (2030–2050) is an effective way to recognise the role and uncertainty that policy, regulatory, technological advancement, and other aspects of transitioning towards low-carbon economies may have over the coming decades. For example, near-term business considerations and risk-management decisions for P&C re/insurers presuppose – at least partially – quantitative assessments (starting with risks of weather extreme). However, long-term projections (e.g. to 2050 or beyond) are subject to the aforementioned uncertainties (e.g. physical, transition including socio-economic and market conditions). Thus, these may be better assessed through qualitative approaches that aim to understand the change drivers of pathways, where each pathway is characterised by a set of plausible assumptions for key variables including those that are of the greatest uncertainty.

The purpose of the information must also be considered. For example, a quantitative assessment would likely be employed to aid in decision-making regarding price-setting and the allocation of capital over the short term, while qualitative assessment may be employed to facilitate discussion on longer-term strategic planning; for example, a property portfolio underwriting strategy, and raising risk awareness within the company about the angles to monitor for change.

Though a number of re/insurance companies have started conducting both qualitative and quantitative risk assessment exercises, the industry is still in the experimentation and innovation phase. However, initiatives are underway to foster industry-level collaboration and engagement, cross-learning and the development of robust approaches and ultimately, a set of decision-useful analysis tools to support a more holistic approach to climate risk assessment.

The following sections provide an overview of the two primary approaches for assessing climate change risk – quantitative and qualitative assessment tools – taking into consideration time horizons and inherent uncertainties.

5.1 Quantitative tools

Quantitative approaches are intended to deliver a measure of the financial condition of the re/insurer under a pre-determined set of assumptions. Generally, quantitative tools and outputs can only provide meaningful information to support near-term underwriting and investment decisions when all key business and economic boundary conditions can be reflected and forecasted reasonably well. As discussed, this is rarely the case for climate change risk.

Generally, quantitative approaches can only provide meaningful information to support near-term underwriting and investment decisions when all key business and economic boundary conditions can be reflected and forecasted reasonably well.

While it is difficult to isolate the near-term impacts of physical climate change (i.e. on the frequency and severity of natural catastrophes), an assessment should nonetheless aim to obtain insight into how much climate change has already materialised, and if it is adequately incorporated into the models and assumptions used for product pricing, risk governance and capital management. Extreme weather events are well captured by today's state-of-the-art NatCat models in frequency and severity in regions with mature insurance markets, but with limited explicit reflection of climate change impacts on event occurrence. These models could be leveraged to quantify the impacts of climate risk and its sensitivity to gradual changes for the short term (2020–2030), where not yet embedded in parametrisation.[52]

A quantitative approach – for example, a stress test – could be used by P&C re/insurers to explore the effects of a quick transition on in-force liabilities, new business projections and investment holdings in the short term.

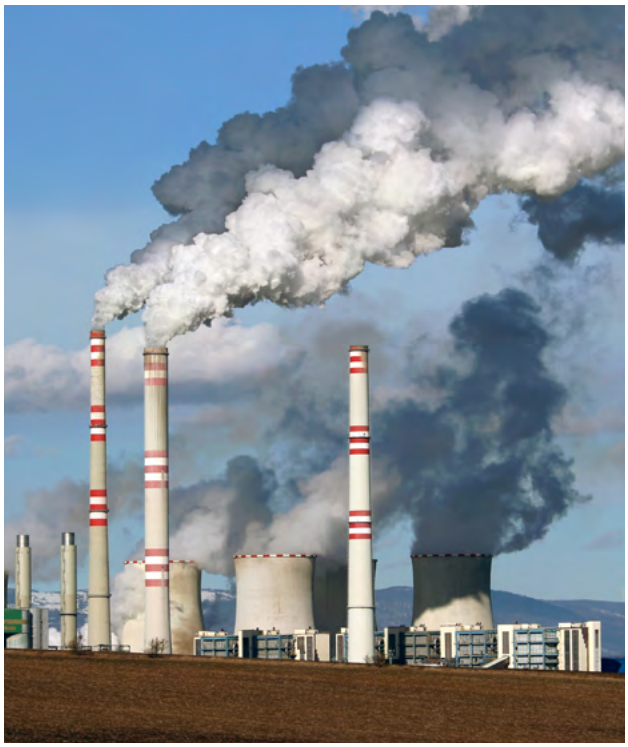
On the other hand, a quantitative approach, for example a stress test, could be used by P&C re/insurers to explore the effects of a quick transition to a low-carbon economy (e.g. sudden policy change that significantly increases carbon pricing, major court rulings, technological breakthroughs) on in-force liabilities, new business projections and/or investment holdings over the short

52 The Geneva Association 2018b.

term. However, these quantitative approaches need to be further developed to derive robust and meaningful outcomes over time.

For life re/insurers, quantitative assessments can be a useful tool for exploring the potential effects of transition risk to their investment portfolios (i.e. exploring the impact of developments similar to those noted above for P&C re/insurers) and informing actions that may be warranted. Depending on the asset mix of the portfolio, an assessment of the impact of physical risks in the short term may also be useful; for example, if the re/insurer has considerable real estate holdings in a storm-prone geography, there may be value in assessing the effects of more frequent and/or severe storms over the short term. For both P&C and life re/insurers, adding climate change risk into the investment credit risk assessment process is increasingly becoming a normal part of their risk management practices.

However, when looking at long-time horizons, the uncertainties inherent in climate change risk can present a challenge for establishing a sufficiently detailed and holistic scenario to guide the exercise. Marrying the results in a holistic manner across the different pillars of an enterprise (e.g. lines of business, liabilities versus investments) presents another challenge. As a result, while the challenges of such an endeavour may be beneficial for stimulating discussion on the subject, the decision-usefulness and meaningfulness of the results produced is likely to be highly limited and would need to be interpreted as such by the firm or other stakeholder groups (e.g. regulators).



5.2 Qualitative tools

As opposed to a quantitative assessment, such as a stress test, a qualitative assessment would focus on understanding what the future world may look like for the organisation, based on a set of assumptions that support a potential path for the emergence of climate change risk. With the less rigid nature of qualitative assessments, re/insurers could more readily consider a variety of transition pathways and implications of changes in the socio-economic environment on business strategy. They also allow greater flexibility for considering the potential correlations and interrelationships and understanding the key drivers of the risk. For example, the gradual but slow evolution of physical climate change risk presents heterogeneous and highly uncertain outcomes when considered over a long-term horizon (2030–2050). Qualitative scenario building and evaluation could reveal key change agents and feedback loops, supporting early strategic perspectives on the positioning of an insurance portfolio and related investment decisions. Similar benefits are realised when comparing the use of qualitative versus quantitative approaches for life re/insurance exposures where the effects of second-order variables (potential declines in economic growth, population migration, geopolitical conflict, etc.) may be more material than the expected impact to mortality rates.

Qualitative assessments are less rigid in nature and a great starting point for re/insurers and other stakeholders to explore exposures to climate change risk on both short- and long-term horizons for both the sides of the balance sheet.

More broadly, qualitative assessments offer a great starting point for re/insurers and other stakeholders that are beginning to explore exposures to climate change risk on both short- and long-term horizons for both the liability and asset sides of the balance sheet. Such an exercise can be invaluable for facilitating dialogue and raising awareness of climate change risk across the enterprise, which is the most important first step. In time, as more experience and knowledge is acquired, these assessments can grow in complexity and their ability to generate decision useful insights.

6. Summary and conclusions

In this report, we have offered a holistic, decision-making framework for P&C and life re/insurers to design and carry out climate risk assessment. The framework addresses types of risk (physical and transition risk), short- and long-term time horizons and both sides of the balance sheet. Our findings also cover key challenges and uncertainties that need to be considered.

Our findings lead us to the following preliminary conclusions for re/insurance companies and other stakeholders (e.g. regulators, rating agencies):

1. The **development of methodologies and tools** that would produce meaningful and decision-useful information is a **work in progress**. These methodologies and tools need to be further developed, tested and evaluated to converge on robust solutions. Achieving consensus also takes time. Strengthened collaborations and proactive engagement across the insurance industry and between the industry and the regulatory community, rating agencies, the scientific community and other experts could significantly advance methodologies that produce meaningful and decision-relevant climate risk assessments and help shape future regulatory developments in this area.

2. The design of a climate risk assessment approach must consider the potential for the **inherent uncertainties** associated with the transitioning related to public policy, technology, markets, and consumer behaviour to undermine the credibility and decision usefulness of data.

3. A **combination of qualitative and quantitative approaches** for assessing climate change risk over the various time horizons is required. When considering the short term, a quantitative approach might lead to decision-relevant insights on certain elements of the balance sheet. Over longer-time horizons however, a qualitative approach, exploring changing boundary conditions beyond a climate change stress, will likely generate more decision-useful insights.

4. Climate change risks vary across the insurance industry and by line of business. Tables 1, 2, 3 and 4 in this report provide more details on how **physical and transition risks** impact P&C and life re/insurers on short- and long-term time horizons on both sides of the balance sheet. However, this will also depend on the company's objectives and its specific business and investment portfolio mix.

5. Climate risk assessment needs to be performed holistically across the company to ensure consistency, while recognising the different challenges in assessing climate change risks, taking into consideration the potential implications of

both physical and transition risks on both sides of the balance sheet. **Cross-company engagement** also allows for leveraging internal expertise and enhancing company-wide understanding of the potential severity, interlinkages and implications of climate change risk. Companies embarking on this journey should start from the two time horizons with a limited set of scenarios (mostly qualitative, particularly for the long-term horizon). As more experience and knowledge is acquired, these assessments can grow in complexity.

6. Re/insurers, as risk managers and investors, play an important role in understanding the risks associated with climate change and **educating stakeholders** (e.g. customers, policymakers, regulators) on how climate change will impact society. The results of re/insurers' research, risk modelling, underwriting and investments, could not only complement but also inform the broader actions that are needed by governments, policymakers, regulators, corporations and society as a whole.

The Task Force's next steps include analysing the approaches, trends and challenges related to the financial and insurance regulatory landscape. This will be followed by a technical 'deep dive' to develop methodologies and tools for scenario analysis and stress testing for the insurance industry, with the aim of galvanising multi-stakeholder collaboration to converge on solutions.

References

Campbell-Lendrum, D., L. Manga, M. Bagayoko, and J. Sommerfeld. 2015. *Climate Change and Vector-Borne Diseases: What are the implications for public health research and policy?* Philos Trans R Soc Lond B Biol Sci. 2015 Apr 5; 370(1665): 20130552. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4342958/

Carney, M. 2019. *A New Horizon.* https://www.bankofengland.co.uk/speech/2019/mark-carney-speech-at-european-commission-high-level-conference-brussels

Climate Financial Risk Forum. 2020. *CFRF Guide.* https://www.fca.org.uk/transparency/climate-financial-risk-forum

ClimateWise. 2019a. *Physical Risk Framework: Understanding the Impacts of Climate Change on Real Estate Lending and Investment Portfolios - Summary for Decision Makers.* https://www.cisl.cam.ac.uk/resources/publication-pdfs/physical-risk-framework-report-summary.pdf

ClimateWise. 2019b. *Physical Risk Framework: Understanding the Impacts of Climate Change on Real Estate Lending and Investment Portfolios - Full Report.* https://www.cisl.cam.ac.uk/resources/publication-pdfs/cisl-climate-wise-physical-risk-framework-report.pdf.

ClimateWise. 2019c. *Transition Risk Framework: Managing the Impacts of the Low Carbon Transition on Infrastructure Investments Public Report.* https://www.cisl.cam.ac.uk/resources/publication-pdfs/cisl-climate-wise-transition-risk-framework-report.pdf.

ClimateWise. 2019d. *Transition Risk Framework: Managing the Impacts of the Low Carbon Transition on Infrastructure Investments Step-by-Step Guide.* https://www.cisl.cam.ac.uk/resources/publication-pdfs/transition-risk-framework-report-step-by-step.pdf.

CRO Forum. 2018. *The Heat Is On: Insurability and Resilience in a Changing Climate.* https://www.thecroforum.org/wp-content/uploads/2019/01/CROF-ERI-2019-The-heat-is-on-Position-paper-1.pdf

IFoA. 2019a. *A Practical Guide to Climate Change for Life Actuaries.* Authors: David Ford, Bradley Ashton, Kyle Audley, Marjan Qazvini, Yixuan Yuan and Yvonne McLintoc. https://www.actuaries.org.uk/system/files/field/document/A%20Practical%20Guide%20to%20Climate%20Change%20%20for%20Life%20actuaries%20-%20Oct%20v7a.pdf

IFoA. 2019b. *A User Guide to Climate-related Financial Disclosures.* https://www.actuaries.org.uk/system/files/field/document/J27006_IEMA_TCFD_Guide_V4.pdf

Insurance Development Forum. 2020. *The Development Impact of Risk Analytics.* https://microinsurancenetwork.org/groups/idf-report-development-impact-risk-analytics

IPCC. 2014. *IPCC Fifth Assessment Synthesis Report*. https://www.ipcc.ch/report/ar5/syr/

IPCC. 2018. *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. V. Masson-Delmotte, P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor and T. Waterfield (eds.) https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf

IPCC. 2019. *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems.* P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi and J. Malley (eds.) https://www.ipcc.ch/site/assets/uploads/2019/11/SRCCL-Full-Report-Compiled-191128.pdf

Lloyd's of London and Vivid Economic. 2020a. *Below 2oC: Insurance for a Low Carbon Economy.* https://www.lloyds.com/news-and-risk-insight/risk-reports/library/society-and-security/below-2c

Lloyd's of London and Vivid Economics. 2020b. *Below 2oC: Insurance for a Low Carbon Economy: Sector Deep Dive.* https://www.lloyds.com/news-and-risk-insight/risk-reports/library/society-and-security/below-2c

Moody's Investor Service. 2019. *The Impact of Environmental, Social and Governance Risks on Insurance Ratings.* July.

Moody's Investor Service. 2018. *Climate Change Risks Outweigh Opportunities for P&C Re/insurers.* March.

OECD. 2020. Climate Change: *Assumptions, Uncertainties and Surprises: Draft Background Note. Prepared for the First of a New Series of OECD Workshops on Climate Science, Policy, Regulation and Practice.* August.

The Geneva Association. 2021 (forthcoming). *Climate Change Litigation – Part 1: The Evolving Global Landscape.* Authors: Maryam Golnaraghi, M. Setzer, J. N. Brook, W. Lawrence and L. Williams.

The Geneva Association. 2020a. *Building Flood Resilience in a Changing Climate: Insights from the United States, England and Germany.* Authors: Maryam Golnaraghi, Swenja Surminski and Carolyn Kousky. June. https://www.enevaassociation.org/research-topics/building-floodresilience

The Geneva Association. 2020b. *Flood Risk Management in the United States.* Authors: Carolyn Kousky and Maryam Golnaraghi. June. https://www.genevaassociation.org/researchtopics/flood-risk-management-united-states

The Geneva Association. 2020c. *Flood Risk Management in England.* Authors: Swenja Surminski, Sara Mehryar and Maryam Golnaraghi. June. https://www.genevaassociation.org/research-topics/flood-risk-management-england

The Geneva Association. 2020d. *Flood Risk Management in Germany.* Authors: Swenja Surminski, Viktor Roezer and Maryam Golnaraghi. June. https://www.genevaassociation.org/research-topics/flood-risk-management-germany

The Geneva Association. 2020e. *Flood Risk Management in Australia.* Authors: Neil Duffy, Andrew Dyer and Maryam Golnaraghi. December. https://www.genevaassociation.org/research-topics/climate-change-and-emerging-environmental-topics/flood-risk-management-australia

The Geneva Association. 2020f. *Flood Risk Management in Canada.* Authors: Maryam Golnaraghi, Jason Thistlethwaite, Daniel Henstra, Craig Stewart. December. https://www.genevaassociation.org/research-topics/climate-change-and-emerging-environmental-topics/flood-risk-management-canada.

The Geneva Association. 2018a. *Climate Change and the Insurance Industry: Taking Actions as Risk Managers and Investors.* Author: Maryam Golnaraghi. January. https://www.genevaassociation.org/research-topics/extreme-eventsand-climate-risk/climate-change-and-insurance-industrytaking-action

The Geneva Association. 2018b. *Managing Physical Climate Risk: Leveraging Innovations in Catastrophe Risk Modelling.* Authors: Maryam Golnaraghi, Paul Nunn, Robert Muir-Wood, Jayanta Guin, Dickie Whitaker, Julia Slingo, Ghassem Asrar, Ian Branagan, Gerry Lemcke, Claire Souch, Michel Jean, Alexandre Allmann, Molly Jahn, David N. Bresch, Patrick Khalil and Michael Beck. November. https://www.genevaassociation.org/research-topics/extremeevents-and-climate-risk/managing-physical-climaterisk%E2%80%94leveraging

The Geneva Association. 2016. *The Nature and Role of Capital in Insurance.* November. https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/the-nature-and-role-of-capital-in-insurance_0.pdf

The Geneva Association. 2016. *An Integrated Approach to Managing Extreme Events and Climate Risks.* Authors: Maryam Golnaraghi, Swenja Surminski and Kai-Uwe Schanz. September. https://www.genevaassociation.org/media/952146/20160908_ecoben20_final.pdf

Standard & Poor's Global Ratings. 2020. *ESG Industry Report Card: EMEA Insurance.* February.

Standard & Poor's Global Ratings. 2018. *How Environmental, Social, And Governance Factors Help Shape The Ratings On Governments, Insurers, And Financial Institutions.* October.

TCFD. 2020. *Financial Stability Board, Bank of International Settlements.* https://www.fsb-tcfd.org/about/#

TCFD. 2019. *TCFD 2019 Status Report.* June https://www.fsb-tcfd.org/publications/tcfd-2019-status-report/

TCFD. 2018. *TCFD: 2018 Status Report.* September. https://www.fsb-tcfd.org/publications/tcfd-2018-status-report/

TCFD. 2017. *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures and Related Annexes.* June. https://www.fsb-tcfd.org/publications/final-recommendations-report/

TCFD. 2016. *Phase I Report of the Task Force on Climate-Related Financial Disclosure.* March. https://www.fsb-tcfd.org/wp-content/uploads/2016/03/Phase_I_Report_v15.pdf

UNEP-FI PSI. 2021. *Insuring the Climate Transition: Enhancing the insurance industry's assessment of climate change futures.* January. https://www.unepfi.org/psi/wp-content/uploads/2021/01/PSI-TCFD-final-report.pdf

UNEP-FI PSI. 2020. *Using Hindsight and foresight: Enhancing the Insurance Industry's Assessment of Climate Change Futures – A Progress Update.* September. https://www.unepfi.org/publications/psi-tcfd-pilot-progress-update/

UNEP-FI. 2019. *Changing Course: A comprehensive investor guide to scenario-based methods for climate risk assessment, in response to the TCFD.* https://www.unepfi.org/wordpress/wp-content/uploads/2019/05/TCFD-Changing-Course-Oct-19.pdf

UNEP-FI and Oliver Wyman. 2018. *Extending our Horizons.* https://www.unepfi.org/wordpress/wp-content/uploads/2018/04/EXTENDING-OUR-HORIZONS.pdf.

United Nations. 2015. *The Paris Agreement.* https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Annex 1: Climate change-related activities of regulatory authorities

Stakeholder	Type	Action
International Association of Insurance Supervisors (IAIS) and Sustainable Insurance Forum (SIF)	International standard-setter	• (2020) Draft issues paper on the implementation of the TCFD recommendations: http://bit.ly/IAIS-2020 • (2018) Draft issues paper on climate change risks to the insurance sector: http://bit.ly/IAIS-2018 • (2020 – to be developed) Application paper on climate risk in the insurance sector, including practical examples and case studies on how to apply the ICPs from a climate risk perspective. Public roadmap: http://bit.ly/IAISroadmap
Network for Greening of the Financial System (NGFS)	Platform of central banks and supervisors	• About: https://www.ngfs.net/en/about-us/governance/origin-and-purpose • The macroeconomic and financial stability impacts of climate change - research priorities: https://www.ngfs.net/en/macroeconomic-and-financial-stability-impacts-climate-change-research-priorities • Guide to climate scenario analysis for central banks and supervisors: https://www.ngfs.net/en/guide-climate-scenario-analysis-central-banks-and-supervisors • Status report on financial institutions' practices with respect to risk differential between green, non-green and brown financial assets and potential risk differential: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_status_report.pdf • Guide for supervisors: integrating climate-related and environmental risks into prudential supervision: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_for_supervisors.pdf
EIOPA	Supervisory authority	• Second discussion paper on methodological principles of insurance stress testing (including a stress test framework on climate change): https://www.eiopa.europa.eu/content/second-discussion-paper-methodological-principles-insurance-stress-testing_en • EIOPA work in the area of sustainable finance: https://www.eiopa.europa.eu/browse/sustainable-finance_en • Integration of climate change risk in Solvency II: https://www.eiopa.europa.eu/content/eiopa-launches-discussion-paper-methodology-integrating-climate-change-standard-formula_en
BaFin (Germany)	Financial supervisory authority	• Guidance on sustainability risks: https://www.bafin.de/SharedDocs/Downloads/EN/Merkblatt/dl_mb_Nachhaltigkeitsrisiken_en.pdf?__blob=publicationFile&v=5 • Article on how insurers measure climate risks: https://www.bafin.de/SharedDocs/Veroeffentlichungen/EN/Fachartikel/2019/fa_bj_1910_Nachhaltigkeitsrisiken_VA_en.html
ACPR (France)	Prudential supervision and resolution authority	• Scenarios and main assumptions of the ACPR pilot climate exercise: https://acpr.banque-france.fr/en/scenarios-and-main-assumptions-acpr-pilot-climate-exercise
PRA/Bank of England (U.K.)	Prudential regulation authority	• Overview of the Bank's work on climate change: https://www.bankofengland.co.uk/climate-change

Stakeholder	Type	Action
De Nederlandsche Bank (Netherlands)	Central bank, supervisory authority and resolution authority	• DNB has launched the sustainable finance platform; overview of work on climate change can be found here: https://www.dnb.nl/en/about-dnb/co-operation/platform-voor-duurzame-financiering/climate-risks/index.jsp • Overview of expectations of the DNB towards insurers on taking into account climate risks: https://www.toezicht.dnb.nl/en/3/50-237997.jsp
FINMA (Switzerland)	Financial markets regulator	• Overview as to how FINMA addresses climate risks in the financial sector: https://www.finma.ch/en/news/2020/06/20200626-mm-sustainable-finance/
APRA (Australia)	Financial supervisory authority	• APRA is developing a climate vulnerability assessment: https://www.apra.gov.au/news-and-publications/apra-outlines-plans-for-climate-risk-prudential-guidance-and-vulnerability
MAS (Singapore)	Central bank and financial regulatory authority	• No specific climate risk-related requirements on insurers yet • MAS is consulting on environmental risk management guidelines for financial institutions: http://bit.ly/MASrelease
National Association of Insurance Commissioners (U.S.)	U.S. standard-setting and regulatory support organisation created and governed by the state insurance commissioners	• NAIC's climate risk and resilience working group: https://content.naic.org/cmte_c_climate.htm
Office of the Insurance Commissioner Washington State (U.S.)	State insurance regulator	• The Insurance Commissioner's work on climate risk and insurance: https://www.insurance.wa.gov/insurance-commissioners-work-climate-risk-and-insurance
Office of the Superintendent of Financial Institutions (Canada)	Independent federal government agency that regulates and supervises more than 400 federally-regulated financial institutions and 1,200 pension plans	• A prudential perspective on the risks of a changing climate: https://www.osfi-bsif.gc.ca/Eng/osfi-bsif/med/sp-ds/Pages/jr20200207.aspx
Japan Financial Services Agency	Integrated financial regulator	• Launching the TCFD consortium of Japan: https://www.fsa.go.jp/en/news/2019/20190521.html
Commodity Future Trading Commission (CFTC) (U.S.)	U.S. financial regulatory body	• Managing climate risk in the U.S. financial system: http://bit.ly/CFTC-report

Annex 2:
P&C and life Insurance business models

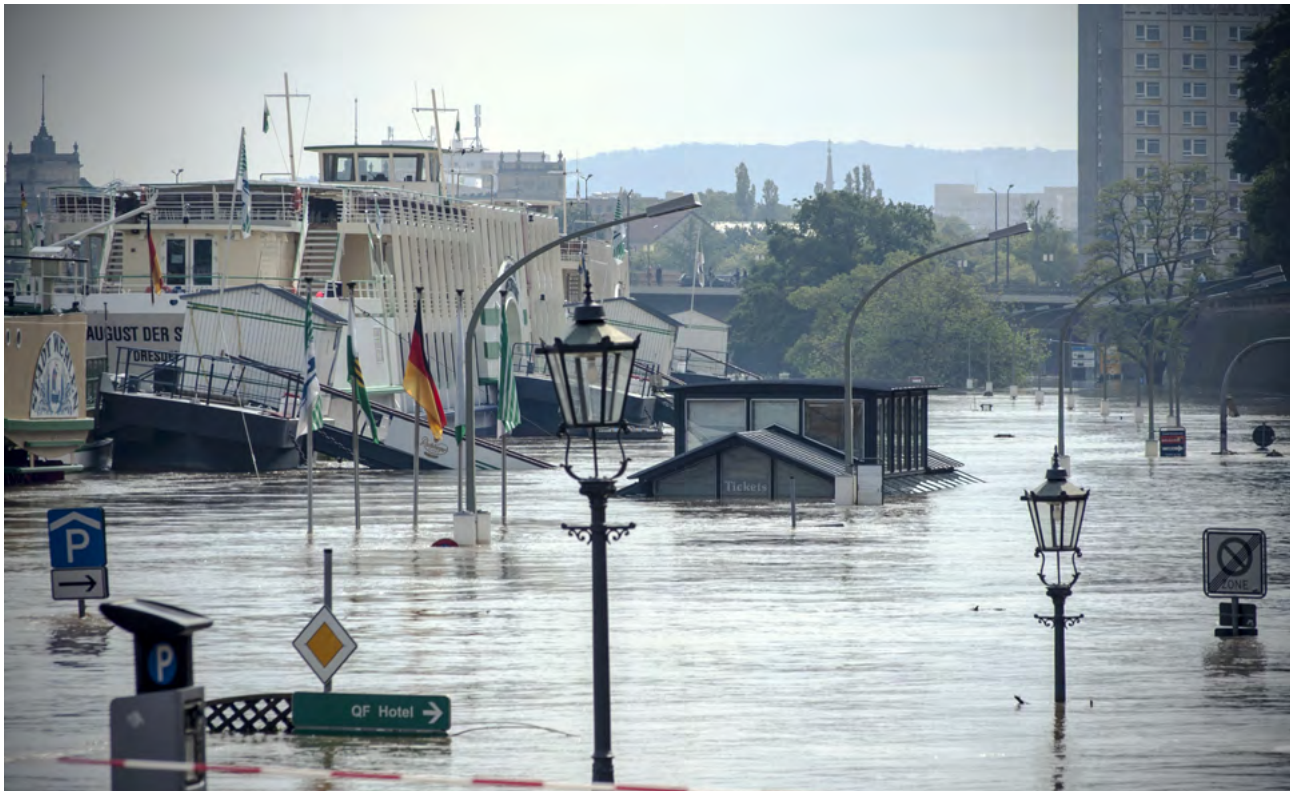
Re/insurers help stakeholders manage their exposure to the financial consequences of a broad range of low-frequency and high-severity events (or risks), which is an essential pillar for sustaining the prosperity of the global economy and societies. In addition, the premiums re/insurers receive in exchange for providing risk protection are used to fund significant investments in financial markets that are equally vital for promoting economic advancements and can positively impact the transitioning to a low-carbon economy. For centuries, managing risk for adverse and extreme events has been a cornerstone of the industry's sustainability, along with its robust ability to react and adapt its business model as risks and societal needs evolve.

2.1 Liability side

The insurance industry can be broadly divided into three categories which are defined by the type of risks they assume:

Life re/insurance companies provide protection against the financial risks of dying early, sustaining disability or injury or, in the case of retirement, outliving one's savings. The risks assumed by life re/insurers are typically long term in nature and thus, the ability for re/insurers to fulfil their obligations to customers is predicated on having a deep understanding of how the risk exposure will manifest over time.

P&C (also known as non-life or general) re/insurance companies provide protection against the financial risks that various adverse events may have on the assets of a customer (e.g. households, businesses). The risks covered



Flood in Germany, Dresden city

by P&C re/insurers are broad and vary across customer groups. For example, individuals may obtain coverage to address risks related to their ownership or use of motor vehicles, homes or other assets. Businesses may obtain coverage to address risks related to their commercial property, potential business interruptions, industry-specific perils (e.g. marine, aviation, transport) or other exposures. The majority of this cover, in particular property catastrophe, is offered on an annual basis with an option to renew at the end of the coverage period. However, there are some lines of business that address risks that may manifest over a longer time horizon.

Health re/insurance companies provide support for medical expenses. Presented as a distinct category here, in some markets health insurance is classified as part of the life or P&C insurance industry. Furthermore, in many markets, health protection is provided to individuals through their employer.[53]

The ability to provide re/insurance coverage is founded on significant research by the industry to understand historical experience and trends of risks (e.g. mortality, morbidity, natural catastrophe, etc.) as well as emerging or future developments that may influence their frequency and severity. This allows re/insurers to confidently establish a cost for providing the coverage and the approach for managing the risks it has assumed for the duration of the contract. A re/insurer's risk management approach is often rooted in an ability:

- To pool risks to leverage diversification benefits
- To match cash flows received in the form of premiums and investment returns with the payments it must make to contract holders, if a covered risk materialises (a process known as Asset Liability Management or ALM)
- To withstand instances where actual experience deviates unfavourably from what was expected
- To refresh expectations for the future as new information and data becomes available

2.2. Investment side

The premiums re/insurers collect are used to purchase investments (such as corporate and government binds or equity), which are a key element of the re/insurance business model. The return on the investments plays an important role in supporting the business' profitability, which is fundamental to the sustainability of the business and the ability to fulfil its obligations to policyholders.

The investment function of re/insurance companies is deeply linked to its liabilities, i.e. the risks that have been assumed. Re/insurers aim to acquire assets that mirror relevant characteristics of their liabilities to the largest extent possible, especially with respect to the timing of cash flows through ALM. In addition to liabilities, ALM strategies factor in the need to remain solvent, pay policyholders, and provide adequate financial return to investors.

Life re/insurers are typically 'buy-and-hold' investors seeking to generate predictable and stable cash flows to match the long-term and generally predictable liability cash flows that they must pay when claims occur. Given these preferences, the majority of investments within a life re/insurer's investment portfolio are typically allocated to high-quality fixed income investments (i.e. bonds). In sync with the asset-liability match, the duration of these investments is considerably longer than for general (non-life) re/insurers.[54]

P&C re/insurers are typically geared towards short-term and liquid investments in order to support quick and efficient payment to policyholders when a claim occurs. This is driven by the short-term nature of most business issued by P&C re/insurers.

53 While we have identified it as a distinct sector, this GA report series does not explore the potential impact climate change may have on the health insurance industry.

54 The Geneva Association 2016.

This report by the Geneva Association Task Force on Climate Change Risk Assessment for the Insurance Industry offers a holistic, decision-making framework for climate risk assessment and scenario analysis for P&C and life re/insurers. The analysis considers all physical and transition climate change risks for the liability and asset sides of the balance sheet, by line of business and over distinct time horizons and serves as a foundation for the Task Force's work to drive future developments in this space.

The Geneva Association

International Association for the Study of Insurance Economics
Talstrasse 70, Zurich, Switzerland
Tel: +41 44 200 49 00

www.genevaassociation.org