

Anchoring Climate Change Risk Assessment in Core Business Decisions in Insurance

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Third report of the Geneva Association task force on climate change risk assessment for the insurance industry

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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 and other stakeholders to discuss these trends and recommendations; and 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.

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Abstract

This report builds on the first two reports by the Geneva Association task force on climate change risk assessment. Aimed at the board of directors and executive management of P&C and life re/insurers as well as regulatory and supervisory bodies, the third report offers insight into how to anchor climate change risk assessment in core business decision-making processes using an exploratory, iterative and adaptive process, while leveraging resources, experiences, data and tools across the company. It provides guidance on how to design and utilise business use cases to frame and drive the assessment towards a holistic approach, taking into consideration both sides of the balance sheet. In addition, the report provides an overview of the evolving regulatory and supervisory approaches since 2021 in alignment with GA task force recommendations. Based on the findings of our recent survey, we also share new insights from regulatory bodies on their priorities and related questions for re/insurers across jurisdictions to guide their climate change risk assessment efforts.

Table of abbreviations

ACPR	Autorité de Contrôle Prudentiel et de Résolution
APRA	Australian Prudential Regulation Authority
BoC	Bank of Canada
BoE	Bank of England
CBES	Climate Biennial Exploratory Scenarios
CFRF	Climate Financial Risk Forum
DNB	De Nederlandsche Bank – Central Bank of Netherlands
EIOPA	European Insurance and Occupational Pensions Authority
ESG	Environmental-Social-Governance
FCA	Financial Conduct Authority
FINMA	Swiss Financial Market Supervisory Authority
FSB	Financial Stability Board
GA	The Geneva Association
IAIS	International Association of Insurance Supervisors
IEA	International Energy Agency
IFRS	International Financial Reporting Standards
IIASA	International Institute for Applied Systems Analysis
IPCC	Intergovernmental Panel on Climate Change
ISSB	International Sustainability Standards Board
JFSA	Japan Financial Services Agency
MAS	Monetary Authority of Singapore
NAIC	National Association of Insurance Commissioners
NatCat	Natural catastrophe
NGFS	Network for Greening the Financial System
NYDFS	New York State Department of Financial Services
ORSA	Own risk and solvency assessment
OSFI	Office of the Superintendent of Financial Institutions
P&C	Property & Casualty
PCAF	Partnership for Carbon Accounting Financials
PRA	Prudential Regulation Authority
SEC	U.S. Securities and Exchange Commission
TCFD	Task Force on Climate-related Financial Disclosures
UNEP-FI	United Nations Environment Programme Finance Initiative
UNEP-PSI	United Nations Environment Programme Principles for Sustainable Insurance



1. Executive summary

Since the publication of the first two reports by the Geneva Association (GA) task force on climate change risk assessment, we have witnessed important developments on the climate science, policy, technology, litigation and regulatory fronts, with implications for companies' efforts to assess the impacts of climate change-related risks and opportunities on their business model. Importantly, in this report we distinguish between the terms 'climate risk' and 'climate change risk'. Our focus is on the latter and includes physical, transition and litigation risks with a view to the future (e.g. in the next five years, by 2030, by 2050).¹ A few developments are highlighted here:

- The Intergovernmental Panel on Climate Change's Sixth Assessment Report (IPCC AR6) was released, providing the latest science on climate change mitigation and adaptation, updating climate change scenarios and stressing the need for more immediate and large-scale reductions of greenhouse gas (GHG) emissions to meet the Paris Agreement.
- Despite some incremental progress, the updated Nationally Determined Contributions (NDCs) presented by member states and the negotiations at the Glasgow 26th Conference of the Parties (COP26) still fall significantly short of aligning low-carbon transitions to a temperature increase of 1.5°C and even 2°C. In light of the large gap between the published NDCs and expected decarbonisation targets in 2030 established by scientists, policy risk remains elevated.
- On the other hand, discussions at COP26 pointed to a number of large-scale public and private sector alliances already working to accelerate the development and scale-up of new climate technologies for decarbonising major GHG-emitting sectors.
- Mandatory regulatory requirements for climate change risk disclosure are imminent. Furthermore, following the COP26 announcement by the International Financial Reporting Standards Foundation (IFRS) about the establishment of its International Sustainability Standards Board (ISSB), the development of global baseline standards for sustainability reporting, with a focus on climate change, is underway.

Mandatory regulatory requirements for climate change risk disclosure are imminent.

¹ Specifically, *climate risk* refers to the extreme weather-related risks that Property & Casualty insurance and reinsurance companies (P&C re/insurers) underwrite at any given time with annual contracts.

- The landscape of climate litigation risk is evolving fast. Studies by The Geneva Association released in 2021 have brought clarity to the global nature of this risk and its underpinning drivers. This ground-breaking research has offered a classification of the sources of climate litigation against corporations (insureds and investees of re/insurers) and governments, as well as the implications for the insurance industry on both sides of the balance sheet.

Against this backdrop, this report offers:

- Insights into the evolution of regulatory objectives and approaches along with the implications for re/insurers' climate change risk assessment and disclosure efforts;
- Strategic guidance to re/insurer boards and executive management on the governance, accountability and build-up of their internal capacities for not only framing and producing decision-useful forward-looking climate change risk information with a holistic approach, but also leveraging experiences and resources by utilising expertise, data and tools across the firm with both sides of the balance sheet taken into account;
- Guidance on how to frame and implement climate change risk assessment and scenario analysis, with business use cases to capture interlinkages and decision feedback loops.

It will take time to develop and converge on best-practice climate change risk assessment with a holistic approach which considers physical, transition and litigation risks and their interactions.

Key messages:

1. **The development of decision-relevant climate change risk assessment with a holistic approach requires an exploratory, iterative and adaptive process that will take time.** A holistic approach considers physical, transition and litigation risks and their interactions at different time horizons in the short and long term. It considers both sides of the balance sheet, as well as interactions across business functions and decision feedback loops to assess the materiality of risks and develop potential actions to address them.

Importantly, some re/insurers that have advanced further in this iterative process have found it beneficial

to anchor the assessment in overarching decision areas that link both sides of the balance sheet. While re/insurers in all business lines have started exploring the materiality of physical and transition climate change risks on each side of the balance sheet, for life & health re/insurers in particular, more research is required to assess the attributions and materiality of climate change to their underwriting exposures – including longevity, mortality and morbidity – over various time horizons. As research in this field progresses, the ability both to assess life & health re/insurer liability exposures and perform more holistic assessments will improve.

2. **An analysis of regulatory developments since June 2021 and a survey conducted by The Geneva Association reveal that the regulatory and supervisory priorities and approaches are increasingly aligned with earlier GA task force recommendations** related to climate change risk assessment and scenario analysis.
3. **Responses from 11 regulatory bodies to a Geneva Association Survey shed light on the regulatory objectives and priorities that can help guide climate change risk assessment exercises within and across jurisdictions.** Our analysis has revealed the top four regulatory priorities: policyholder protection, the insurer's financial health, corporate governance and strategy, and the insurability/affordability of insurance solutions. Other topics in order of priority are: financial stability, raising risk awareness, addressing data/risk assessment services and environmental stewardship. Critical questions related to these priorities have been identified in this report.
4. **Company boards and executive management need to consider the following four key issues to drive the process towards a more holistic approach that would produce decision-useful information:**
 - Board oversight and executive management buy-in for company-wide engagement, along with appropriate resource allocation to build these capabilities, are important;

Climate change risk assessment requires a company-wide mandate with clear accountability. Central to this process is the development of overarching decision-relevant questions that need to be addressed by the board and the executive management.

- The coordination and execution of climate change risk assessment require an internally established, company-specific mandate with clear accountability;
- Central to this process is the development of overarching decision-relevant questions for the board and the C-suite (a list based on the GA survey of regulatory and standard-setting bodies is included);
- Company-relevant business use cases should be designed and utilised to guide the iterations of climate change risk assessment.

5. A 10-step template provided in this report can help companies design business use cases to frame the analysis, engage experts from relevant business functions across the balance sheet, and mine and utilise the same data and tools across the company.

It is important to start simple by exploring the impacts of each climate change risk type, on each side of the balance sheet, considering short- and long-term time horizons. With each iteration, companies can build up the level of complexity by assessing the interactions of physical, transition and litigation risks and exploring how these risks are manifested within and across business functions. Of note:

- This process should consider internal business functions and their interactions as well as external drivers that impact issues relevant to the business use case, by risk type and time horizon;
- Materiality analysis is at the heart of climate change risk assessment, allowing focus on the areas most impacted by climate change risks and identifying priorities for a deeper dive and resource allocation;
- As part of the design and implementation of business use cases, the company should seek to identify metrics to measure and monitor the risks and track the impacts of the measures taken to manage them;
- This resource-intensive process will take time and present challenges that will need to be addressed, ranging from overtime and the availability of data for the given region to internal experience and expertise, and the availability of best practices.

In this report, we offer three examples of business use cases to demonstrate these points.

6. The use of forward-looking scenario analysis needs to be further explored, depending on the issue being considered. Scenario analysis is a tool for conducting a forward-looking assessment of risks and opportunities, where the company can systematically explore individual or combined factors and make strategic decisions in the face of significant uncertainties. Scenario analysis may be used for a range of applications, for example:

- Testing the resilience of a company's business model to climate change-related risks;
- Assessing the implications of possible actions a company can take;
- Stress-testing the company's business model under extremely adverse conditions.

If scenario analysis is relevant to the assessment, the company can explore the type of scenarios that may be applicable by first building on a range of qualitative 'What if?' questions to guide the discussions. Over time, this iterative exploration should also consider areas where *quantitative* methods may be viable. Quantitative approaches are in their infancy given the evolving nature of climate change science and the radical uncertainties associated with the transition over the long-term horizon.

In this report, we offer more insights into several benchmark scenarios, such as those produced by the Network for Greening of Financial System (NGFS) and the IPCC, that are currently among the most utilised in the financial sector. We offer more details about their shortcomings and how they might be enhanced by the company for scenario analysis.

7. Through strong industry collaboration, re/insurers should conduct an analysis of existing data challenges, gaps and needs, and define priority areas and requirements for the future development of tools. More work is required by re/insurers and regulatory bodies to identify gaps in data, to converge on best practices and build a robust toolbox for forward-looking climate change risk analyses. Since 2021, several organisations have offered an assessment of the gaps in climate change risk data and tools in the current landscape, with a focus on certain applications or segments in the financial sector. The journey towards a holistic approach could lead re/insurers to address such gaps over time, not least in emissions data, asset locations and supply chain data.

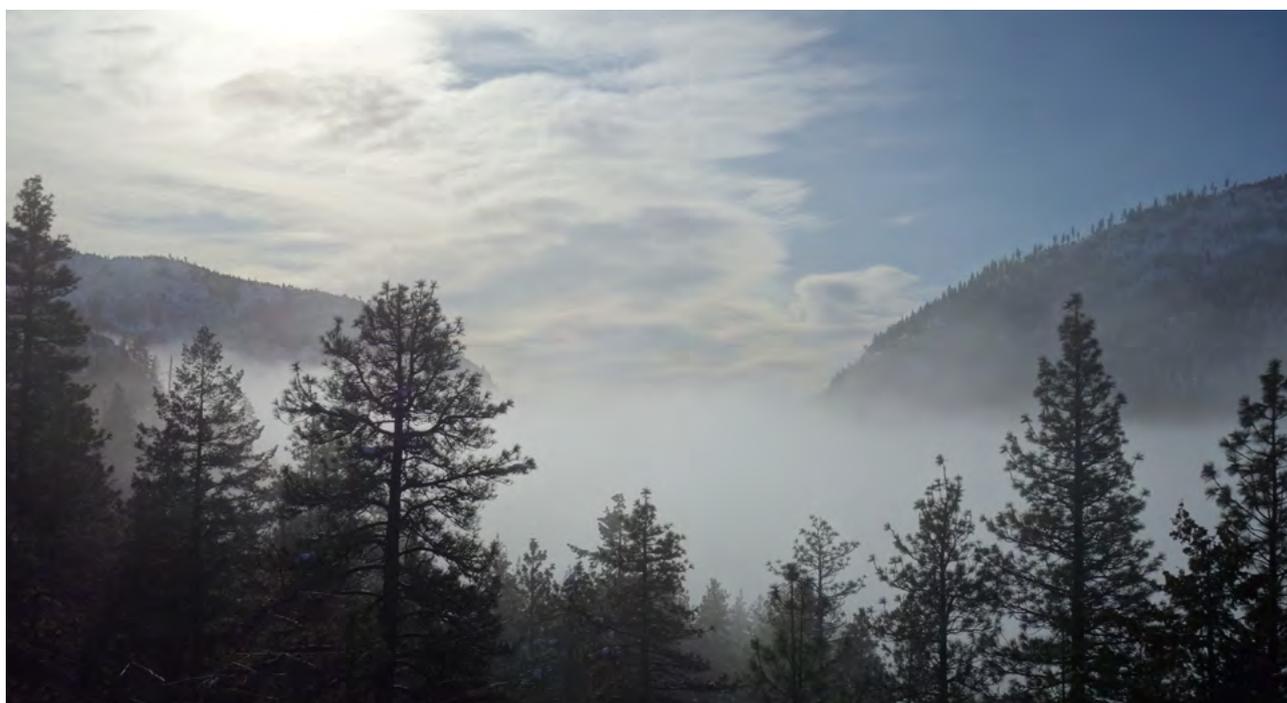
More work is required by re/insurers and regulatory bodies to identify gaps in data and develop the analytical tools to conduct forward-looking climate risk assessment.

Note that life & health re/insurers still face challenges when it comes to identifying the types of data that would allow the extraction of climate change attribution and liability exposures.

- 8. Importantly, company leadership should seek to harmonise and align their net-zero target-setting activities using 'inside-out' analysis with efforts to assess the resilience of their business model to climate change risks using 'outside-in' approaches**

for developing viable targets, transition strategy and plans. In fact, a growing number of critics are calling out the misalignment of net-zero pledges with what the companies can actually deliver and the possibility of greenwashing, which could lead to potential reputational and climate litigation risks or even regulatory action.

- 9. Robust intra- and inter-sectoral collaboration is the only way to expedite the development and convergence of good practices, meaningful baseline requirements for decision-useful climate change risk assessments and disclosures that would allow for cross-company comparisons.** To this end, we acknowledge and deeply appreciate the growing proactive collaboration and engagement across the insurance industry and with key regulatory and standard-setting bodies in the financial sector.





2. Context

In 2020, The Geneva Association (GA) launched its task force on climate change risk assessment with the aim of advancing and accelerating the development of holistic methodologies and tools for conducting forward-looking climate change risk assessment. These efforts have intended not only to support primary insurance and reinsurance companies and regulatory bodies with innovation in this area, but also to demonstrate the benefits of industry-level collaboration to help expedite the development and convergence of best practices.

There is a need to develop methodologies for holistic climate change risk modelling and scenario analysis for both sides of the balance sheet.

In its first two reports,² the GA task force highlighted the complexities associated with the development of forward-looking climate change risk assessment methodologies and tools. It stressed the need to develop methodologies for holistic climate change risk modelling and scenario analysis for both sides of the balance sheet, using a combination of qualitative and quantitative approaches. The GA task force also highlighted the implications of physical and transition risks for the insurance industry, with a focus on the challenges of quantitative scenario analysis approaches. The conclusion was that the prescriptive quantitative regulatory exercises to date, which were conducted to raise awareness, have outlived their purpose. More specifically, these resource-intensive exercises do not provide decision-useful information given the significant uncertainties associated with the transition to a carbon-neutral economy (e.g. uncertainties associated with public policy, market and technology risks). Finally, the GA task force called on regulatory bodies to clarify their regulatory objectives and explain how their exercises would deliver decision-useful information. It also stressed the need for convergence on baseline regulatory requirements for analysis and reporting across jurisdictions. To this end, it encouraged stronger collaboration between regulatory bodies within and across jurisdictions, as well as with the insurance industry, to enable the sharing of lessons learned and access to broader expertise, in the aim of expediting the convergence of best practices.

Since June 2021, there have been several developments on the policy, technology, regulatory and scientific fronts, with implications for companies' climate change risk assessment.

² The Geneva Association 2021a,b. Authors: Maryam Golnaraghi et al.

At the highly anticipated COP26,³ which brought together delegations from 192 member states and served as the largest UN-convened gathering of private sector leaders, a number of critical events were held as part of or on the periphery of the formal negotiations. Importantly, four key developments are highlighted:⁴

- The future of national public policies and sectoral regulations remains highly uncertain, despite incremental progress, as national ambitions are falling short in limiting the temperature increase to 1.5°C (governments are expected to submit more ambitious Nationally Determined Contributions or NDCs before COP27 in November 2023);
- Public- and private-sector efforts are gaining momentum for the large-scale deployment of new technologies for the energy and other sectors' low-carbon transition;⁵
- Regulatory actions related to mandatory disclosures and capital requirements for climate change risks are imminent;
- The development of an international baseline for sustainability-related financial disclosure, with a focus on climate, is underway following the announcement at COP26 of the International Sustainability Standards Board (ISSB), established by the International Financial Reporting Standards Foundation (IFRS). The work of ISSB builds on the recommendations of the Financial Stability Board's Task Force on Climate-Related Financial Disclosures (FSB-TCFD).⁶

The latest regulatory and supervisory developments point to the need for robust climate change risk governance within a company.

The latest regulatory and supervisory developments point to the need for robust climate change risk governance within a company. There is increasing recognition of the need for a combined qualitative and quantitative approach to climate change risk assessment (to be detailed in this report). The latest TCFD recommendations stress the need for more holistic climate change risk assessment which covers each side of the balance sheet.⁷ While the importance of multi-scenario analysis to cover different types of transition pathways and physical impacts is emphasised, TCFD recognises the important role of qualitative scenario analysis, especially when quantitative tools and data remain limited.⁸

In 2022, the FSB has also begun consultations on supervisory and regulatory approaches for assessing the transmission of climate change-related risks (physical, transition and litigation) across sectors and jurisdictions to explore potential sources of systemic risk. Furthermore, the first drafts of the ISSB standards – *General Requirements for Disclosure of Sustainability-related Financial Information (IFRS S1)* and *Climate-related Disclosures (IFRS S2)* – were published for consultation.⁹ Finally, with the goal to harmonise corporate reporting standards across jurisdictions, ISSB has launched a new working group comprised of global regulators and policymakers from the United States, the European Union and China.¹⁰

International rating agencies are also advancing their climate change risk analytics capabilities and requirements. At the time of this writing, these agencies consider climate change primarily as part of companies' ESG factors in their credit ratings.¹¹ While rating agencies recognise scenario analysis to be a useful tool, forward-looking scenario analysis is not yet required by re/insurers.¹²

Over the last 12 months, several organisations, industry platforms and working groups have offered a wide range of technical guidance and insight on the methodologies, tools and data for climate change risk analysis, which will be briefly covered in this report. Importantly, while a lot

3 COP26 was held in Glasgow from 31 October to 13 November 2021.

4 The Geneva Association 2021e. Author: Maryam Golnaraghi.

5 Golnaraghi 2022.

6 IFRS 2022a,b.

7 TCFD 2021.

8 The updated 2021 TCFD recommendations still fall short of the need to capture the interlinkages across the balance sheet; determine how to anchor climate change risk assessment in a company's core decision-making processes; and strengthen the link with regulatory requirements. The recommendations also do not address potential sources of double materiality misalignment between inside-out and outside-in effects, based on scenario analysis.

9 In March 2022, IFRS-ISSB Exposure Drafts of General and Climate Related Disclosure Standards were released for comments due on 29 July 2022. For more information: IFRS-ISSB delivers proposals that create a comprehensive global baseline of sustainability disclosures.

10 The new working group was announced on 27 April 2022 and includes representatives from the Chinese Ministry of Finance, European Commission, US Securities and Exchange Commission, UK Financial Conduct Authority and European Financial Reporting Advisory Group. For more information: <https://www.ifrs.org/news-and-events/news/2022/04/issb-establishes-working-group-to-enhance-compatibility-between-global-baseline-and-jurisdictional-initiatives/>

11 Based on discussions with S&P Global Ratings and Moody's Investors Service.

12 Ibid.

has been done, there are still many gaps in data, tools and methodologies that need to be addressed in the years to come.

Beyond the work of its task force, The Geneva Association has conducted in-depth research on the sources of climate litigation against corporations and governments, and the implications for re/insurers.^{13, 14}

It is also worth noting that the scientific understanding of climate change is evolving. The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR6)¹⁵ points to these advancements and the need for firms to both stay abreast of the latest scientific developments and develop the expertise to properly interpret the findings. The IPCC AR6 also provides more clarity on 1.5°C warming trajectories by 2030, namely the impacts of climate change on physical risk and enhanced transition pathways; and the implications of adaptation and mitigation measures, with a strong focus on the win-win benefits of nature-based solutions.¹⁶

Against this backdrop, this third and final report of the GA task force focuses on how climate change impacts the company's business model ('outside-in' analysis)¹⁷ with a goal to develop internal capabilities towards a more holistic approach to climate change risk assessment over time. A holistic approach considers physical, transition and litigation risks, and their interactions, at different time horizons (e.g. short- and long-term). It also considers both sides of the balance sheet, as well as interactions across business functions and decision feedback loops associated with the company's business model.

In this report, we offer insight and guidance related to the:

- Evolving approaches of regulatory and supervisory bodies, and alignment of their priorities with the earlier recommendations of the GA task force;
- Assessment of regulatory objectives and key questions for re/insurers across jurisdictions, building on our survey of regulatory and supervisory bodies, to clarify and help align climate change risk assessment efforts;
- Path for company boards of directors, executive management and experts to anchor climate change risk assessment in business decision-making processes, using an exploratory, iterative and adaptive process, all while leveraging resources, experiences, data and tools across the company;
- Design and utilisation of business use cases to frame the assessment and develop internal capabilities;
- Current status of scenario analysis and related data, the tools needed and the implications for re/insurers;
- Recommendations for re/insurers and regulatory and supervisory bodies, as they look ahead.

Climate change risk includes physical, transition and litigation risks with a view to how they evolve and interact in the future.

In this report, the terms 'climate risk' and 'climate change risk' are not used interchangeably. Specifically, climate risk refers to the (extreme) weather-related risks that P&C re/insurers underwrite at any given time. Climate change risk includes physical, transition and litigation risks with a view to how they evolve and interact in the future (e.g. in the next five years, to 2030, to 2050, to 2100).¹⁸ The contents of this report are based on the extensive deliberations of the GA task force,¹⁹ an in-depth literature review and a roundtable with 16 financial regulatory and supervisory bodies, followed by a survey to identify their regulatory objectives and key questions for re/insurers.

13 The Geneva Association 2021c,d. Authors: Maryam Golnaraghi et al.

14 The Geneva Association 2022. Author: Maryam Golnaraghi.

15 IPCC 2021, 2022a,b.

16 A forthcoming report by The Geneva Association will further explore the role of nature-based solutions.

17 European Commission 2019. *Outside-in* analysis is focused on how climate change-related risks and opportunities impact the company. This is focused on assessing the resilience of a company's core business model to climate change risks, taking into consideration physical, transition and litigation risks and their interactions, business and strategic time horizons, jurisdictions, sectors and various external drivers impacting the company, such as various future scenarios.

18 For definitions, see The Geneva Association 2021a,c.

19 The GA task force includes 53 experts from 18 insurance and reinsurance companies (P&C and Life) from North America, Europe and Japan.



3. The evolving regulatory landscape for climate change risk assessment

An analysis of regulatory developments since June 2021²⁰ reveals that the regulatory and supervisory priorities and approaches are evolving and in increasing alignment with the earlier recommendations of the GA task force. Key trends are detailed in this section.

3.1 Regulatory developments since June 2021

Between June 2021 and May 2022, certain regulators launched new initiatives and published guidelines. A synthesis of these developments reveals the need for regulatory bodies to:²¹

- Acknowledge the limitations of current tools, models and data for long-term quantitative scenario analysis (as evidence, the 2021 Bank of England Climate Biennial Exploratory Scenarios experiment concluded that projections of climate change losses are uncertain; the view that scenario analysis is still in its infancy, with notable data gaps;²² and the increasing recognition among some regulatory bodies that quantitative approaches can and should be complemented with qualitative assessments, especially over a longer time horizon²³);
- Stress the need to consider multiple scenarios representing different plausible pathways of transition or physical risks, and expand benchmark scenarios (typically NGFS) with sectoral and geographical granularity considerations;
- Recognise the principle of proportionality, with expectations linked to the size and organisational complexity of the company;
- Stress the importance of materiality in supervisory expectations for quantitative assessments as well as robust governance of climate change risks, with a need for transparency, particularly in relation to re/insurer investments in carbon-intensive sectors.²⁴

20 Since the publication of the second report of the GA task force: The Geneva Association 2021b.

21 ACPR 2022; APRA 2021a,b; BoE-PRA 2021; BoE 2021; EIOPA 2022; JFSA 2021,2022; NYDFS 2022; BoC-OFSI 2022; SEC 2022.

22 BoE-CBES 2022.

23 For example, EIOPA 2022 acknowledges that current quantitative forward-looking exercises are exploratory in nature and part of a learning process.

24 Yahoo 2022.

More specifically:

- The Bank of England (BoE), Bank of Canada-OSFI (Canada), APRA (Australia) and JFSA (Japan) have used qualitative analysis through surveys to improve their understanding of the risks faced by re/insurers and their related risk management actions;
- The ACPR (France), APRA and JFSA recognise the full spectrum of climate change risks across business lines. The New York Department of Financial Services (NYDFS) and BoE point to the need to consider both sides of the balance sheet, as well as mobilise senior management and board oversight of the whole process.

As of July 2022, there are still variations in the approaches used by regulators. Regulators agree, however, that this could impede comparisons across companies and jurisdictions as well as the ability to assess broader systemic economic and social impacts.

Importantly, the International Association of Insurance Supervisors (IAIS) is working on promoting a globally consistent supervisory response to climate change, with a focus on three areas: standards, data and scenario analysis, by providing guidance to regulatory bodies.²⁵ The Financial Stability Board (FSB) is also issuing guidance on supervisory and regulatory approaches across borders and sectors to address market fragmentation and potential sources of systemic risk.²⁶ Finally, the development of a global baseline for sustainability reporting standards with a focus on climate change, by the ISSB, aims to translate them further into harmonised inter-jurisdictional standards.²⁷

3.2 Insights into regulatory objectives and related questions for re/insurers – GA survey results

As part of its work in July 2021, the GA task force proactively engaged with 16 regulatory bodies in a roundtable discussion,²⁸ following up with a survey, concluded in early 2022, to explore shared regulatory objectives and key questions for re/insurers to guide their climate change risk assessment efforts.

The Geneva Association's survey revealed four top regulatory priorities:

- Policyholder protection
- Insurer financial health
- Corporate governance and strategy
- Insurability & affordability of insurance solutions

A total of 11 regulatory and supervisory bodies responded to the GA survey.²⁹ Table 1 provides a summary of responses and the top four regulatory priorities: policyholder protection, the insurer's financial health, corporate governance and strategy, and the insurability/affordability of insurance solutions. Other objectives include, in order of priority: financial stability, raising risk awareness, addressing data/risk assessment services and environmental stewardship. These eight priorities are referenced as P1 (Priority 1) to P8 in Table 1. We have

25 As of April 2022, the IAIS has started a series of workshops in collaboration with key stakeholders, including regulators, insurance companies and associations, to explore these issues.

26 FSB 2022.

27 Responsible Investor 2022a.

28 This regulatory roundtable was hosted by The Geneva Association on 5 July 2021 with the participation of: NGFS Secretariat, IAIS Secretariat, EIOPA, Bank of England, ACPR Banque de France, FINMA, DNB, Monetary Authority of Singapore, Japan Financial Services Agency, OSFI Canada, NAIC, US Treasury/Federal Insurance Office, New York Department of Financial Services, California Department of Insurance and Washington State Office of the Insurance Commissioner.

29 The following 11 regulatory bodies responded to the GA survey: Bank of England, ACPR Banque de France, EIOPA, FINMA, Monetary Authority of Singapore, Japan Financial Services Agency, OSFI Canada, NAIC, U.S. Treasury/Federal Insurance Office, New York Department of Financial Services and Washington State Office of the Insurance Commissioner.

further synthesised and mapped the corresponding questions that regulators consider as most relevant to re/insurer core decision frameworks (Table 2). In addition, we have made an initial attempt to group these key questions based on how they correspond to each priority identified in Table 1. These questions provide important insights to help frame climate change risk assessment exercises. While we recognise that this is a work in progress, it is our conviction that convergence on clear regulatory objectives, priorities and key questions is an important step towards finding solutions and developing baseline reporting standards.

This preliminary survey and corresponding synthesis aim to offer information that can be used by regulatory and standard-setting bodies as well as re/insurers to clarify the objectives of climate change risk assessment exercises. However, such a survey and analysis could be further expanded by international bodies, such as the IAIS and NGFS, to include all their members. This would help drive convergence on common regulatory objectives and key questions across jurisdictions, and further guide the development of global baseline standards for climate change disclosure.

Table 1: Regulatory objectives and related priorities pertaining to climate change, based on responses from 11 regulatory bodies

Regulatory objectives	Number of responses from participating regulatory bodies
Policyholder protection (P1)	10
Insurer's financial health (P2)	9
Corporate governance and strategy (P3)	6
Insurability and affordability (P4)	7
Financial stability (P5)	6
Raising risk awareness (P6)	5
Data/Analytics and risk assessment services (P7)	5
Environmental stewardship (P8)	2

Source: Based on responses to a Geneva Association survey of 11 regulatory bodies. Note: P1–P8 refers to the mutual priorities among the 11 participating regulatory bodies, ranked from highest to lowest

Table 2: Synthesis of GA survey responses and key questions mapped against re/insurer business models

Governance	Strategy	Risk management (underwriting & investment)
<p>1. How does the company consider climate change risks in its corporate governance frameworks and organisational structure? (P3)</p> <p>2. Are climate change risks understood throughout the institution? (P3, P6)</p> <p>3. Is the company ready to disclose climate change risk exposure? (P1, P3, P7, P8)</p>	<p>1. Does the company have a strategic approach towards climate change risks? (P2, P3)</p> <p>2. Has the company considered its risk appetite in relation to climate change? (P3)</p> <p>3. What are potential mitigation or management actions that the company has taken or is planning to take to address climate change risks and opportunities? (P2, P3, P4)</p> <p>4. Are climate change risks embedded in the overall strategy of the company? (P3)</p>	<p>1. How does the company perceive the insurability (affordability, accessibility and relevance of insurance products) of certain risks in light of climate change? Has it defined insurability tipping points and what needs to be done to ensure insurability? (P1, P4)</p> <p>2. How frequently does the company assess climate change risks on assets and liabilities? What is the materiality of climate change risks in these assessments on both sides of the balance sheet? (P1, P2, P3)</p> <p>3. Has the company taken steps to engage key constituencies on the topic of climate change risk and resilience, such as by encouraging policyholders to manage their risks? (P1, P6)</p>

Note: In this table, symbols P1–P8 refer to priorities 1 through 8, as identified in Table 1.

Source: Based on responses to a Geneva Association survey of 11 regulatory bodies

Capital and liquidity management	Climate change risk analytics (and scenario analysis)	Compliance and disclosure	External drivers: Government intervention
<ol style="list-style-type: none"> 1. How exposed is the company's balance sheet to the financial instability risks emanating from climate change? (P2, P5) 2. Is the company adequately capitalised through severe yet plausible climate scenarios over extended time horizons? (P1, P2, P5) 3. Does the company consider climate change risks as part of its ORSA and how do climate change risks rank among other risks? (P2, P3, P4) 	<ol style="list-style-type: none"> 1. What are the company's analytical capabilities? What are current gaps in decision-useful data and methodologies? (P7) 2. Does the company investigate climate scenarios of increasing exposure, including financial instability caused by climate change risks? How? (P2, P5, P7) 3. Does the company have models and processes in place to assess risks on the liability side? On the asset side? How does it assess the risks for specific locations? (P1, P2, P7) 	<ol style="list-style-type: none"> 1. How is the company communicating its climate change risk exposure? (P1, P6) 2. Is the company willing to provide climate-related disclosure to help raise risk awareness of investors and policyholders? (P1, P6) 	<ol style="list-style-type: none"> 1. To what extent is the viability of the company's business model dependent on government intervention (such as support of insurance risk pools or funding of climate resilience projects)? How will this change if government intervention ceases? (P1–P5) 2. What are the impacts of government intervention (policies, regulatory frameworks and investments in adaptation and mitigation measures) on the company? (P2, P3, P4) 3. How does the company perceive the role of supervisors, regulators and government? (P3)



4. Key considerations for anchoring climate change risk assessment in decision-making

4.1 Climate change is a modifier or accelerator of existing risks

From the insurance industry's perspective, climate change is not a new risk. It is one important change factor affecting both sides of the balance sheet, in effect modifying and/or accelerating known risks. It is global in nature, and while it affects all regions, it plays out differently in different parts of the world. Climate change is changing the future likelihood of a wide range of risks (e.g. frequency, severity and geographic locations of extreme weather-related events).³⁰ For example, the IPCC's Sixth Assessment Report³¹ concluded that with every additional increment of global warming, changes in extremes continue to become larger.³² Higher global warming will also increase the probability of compound events and the cascading of risks across sectors and regions, for example with simultaneous heatwaves and droughts likely more frequent. Over the last 30 years, property and casualty (P&C) re/insurers have provided leadership in natural catastrophe risk modelling and pricing using quantitative probabilistic approaches known as NatCat risk modelling.³³ **However, the development of methodologies and tools for forward-looking climate change risk modelling and scenario analysis with a holistic approach should go significantly beyond these efforts.**³⁴

4.2 Current state of climate change risk assessment in the insurance industry

Re/insurers across the globe are at different stages of assessing the impacts of climate change risks on their business model, with distinct trends by jurisdiction, line of business and size of the company. Many mid-to-large size companies have started to explore the implications of physical or transition risks on each side of the balance sheet, albeit with different levels of complexity. Overall, the investment side (for both P&C and life & health) has progressed faster with an emphasis on transition risk. P&C re/insurers have progressed with the assessment of climate change risks on the liability side, with a particular focus on physical risk. For life & health re/insurers, more research is required to evaluate the attributions and materiality of climate change to their underwriting exposures, including longevity, mortality and

30 IPCC 2021.

31 IPCC 2021, 2022a.

32 For example, an additional 0.5°C of global warming causes clearly discernible increases in the intensity and frequency of heatwaves and heavy precipitation, as well as agricultural and ecological droughts in some regions.

33 The Geneva Association 2021a. Authors: Maryam Golnaraghi et al.; and The Geneva Association 2018. Author: Maryam Golnaraghi.

34 The Geneva Association 2021a.

morbidity over various time horizons. As research in this field progresses, the ability to assess life & health liability exposures and perform more holistic assessments covering both sides of the balance sheet will improve.

Re/insurers across the globe are at different stages of assessing the impacts of climate change risks on their business model, with distinct trends by jurisdiction, line of business and size of the company.

The motivation behind starting climate change risk assessment has varied across companies, driven by each company's:

- Ambition to help shape future regulations, support the development of industry-level methodologies and/or contribute to the emergence of best practices and related disclosure standards (e.g. participation in platforms such as the GA task force on climate change risk assessment, Climate Financial Risk Forum hosted by the PRA and FCA, UN-convened net-zero alliances and the Financial Stability Board's TCFD);

- Response to regulatory exercises;
- Response to shareholder or policyholder requests;
- Exploratory internal expert-driven initiatives.

How a company embarks on its journey towards a holistic approach depends on the firm's objectives, structure, risk governance, internal processes and experiences to date with assessing materiality.³⁵ For example, a company may start with a top-down approach to assess macro-economic impacts; leverage a bottom-up approach, starting from one side of the balance sheet; and, as part of an iterative process, further explore transversal relationships across the balance sheet or use a combination of both (hybrid approach).

Importantly, some re/insurers that have gone further in this iterative process have found it beneficial to anchor the assessment in overarching decision areas that link both sides of the balance sheet. Examples include enterprise risk management and capital and liquidity management, which link the outputs back to the company's strategy and risk appetite. Furthermore, these companies emphasise the benefits of cross-company engagement and deliberations, which lead to increased climate change risk awareness, out-of-the-box thinking and the leveraging of expertise, data and tools. The analysis could also explore the implications of material risks for the company's financial and business planning.



³⁵ According to the TCFD 2021, organisations should determine materiality for climate-related issues consistently with how they determine the materiality of other information included in their annual financial filings.

4.3 Issues for the board of directors and executive management

4.3.1 Strategic importance of aligning inside-out and outside-in climate risk assessment approaches³⁶

Companies are conducting two types of climate risk assessment:

- Inside-out analysis:** This includes assessing the impact of the company's actions on the climate by setting their climate targets (e.g. net zero targets) based on a variety of science-based approaches, such as those introduced by the UN Net-Zero Asset Owner Alliance (UN NZAOA) and the Science-Based Targets initiative (SBTi).³⁷ For example, the UN-convened Net-Zero Alliances uses 1.5°C-compatible pathways, which may be far more ambitious than what companies and the real economy can deliver.³⁸ In fact, the UN NZAOA has warned that the global economy does not move as is required by science, leading to a widening gap between companies' climate targets and the real economy.³⁹ Net-zero targets need to take this widening gap into account as this misalignment could lead to other

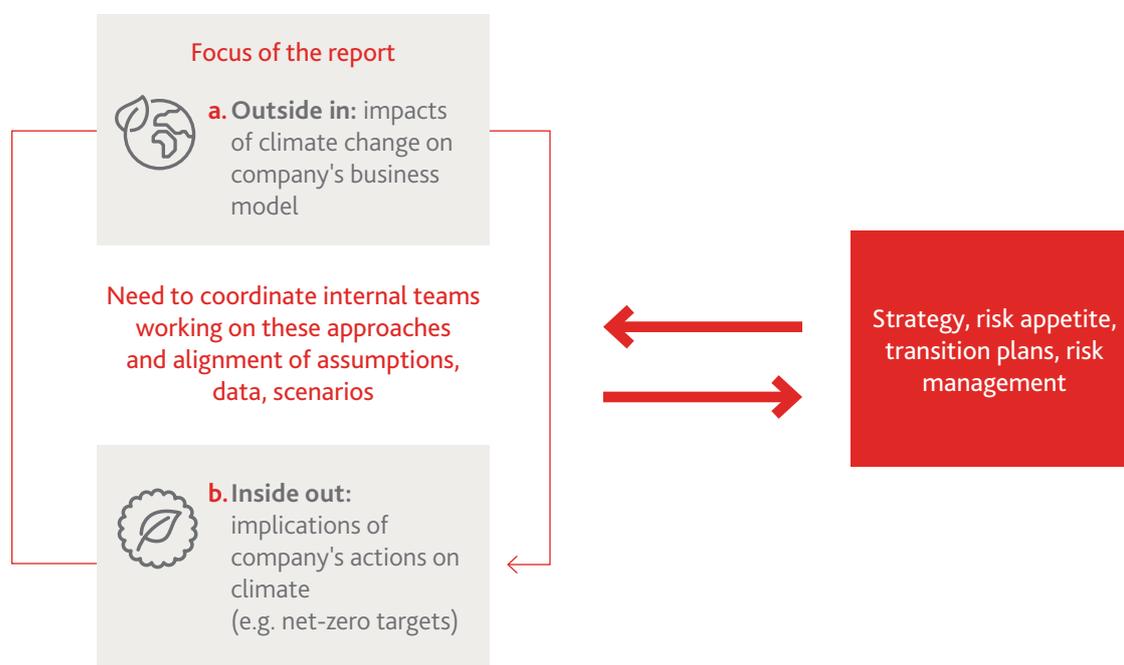
financial and non-financial risks for the company, including reputation risk. This is further exacerbated by the fact that climate science is still evolving.

- Outside-in analysis:** This involves assessing the resilience of the company's business model to climate change risks, which is the focus of this report.

The board and executive management should seek to harmonise and align inside-out with outside-in climate change risk assessment efforts to develop viable net-zero targets, strategy, transition plans and related actions.

It is important to emphasise that the development of the company's strategy, transition plan and related actions cannot be done solely using inside-out analysis. Conducting

Figure 1: Aligning outside-in and inside-out approaches



Source: The Geneva Association

36 European Commission 2019. The inside-out approach looks at how actions by the company impact climate change. This involves the establishment of net-zero targets, the translation of targets into company actions and alignment with the real economy's transition.

37 UN NZAOA 2021; SBTi 2021.

38 Net-Zero Asset Owner Alliance (<https://www.unepfi.org/net-zero-alliance/>) and Net-Zero Insurance Alliance (<https://www.unepfi.org/net-zero-insurance/>).

39 UN NZAOA 2021.



outside-in analysis is critical, enabling the company to assess not only the impacts of climate change risks and their interactions, but also the implications of the possible range of activities under different scenarios on the firm's business model. Of note, the inside-out view puts greater emphasis on 'impact' – which has a clear political component and should be grounded in materiality assumptions, which is the central objective of the outside-in analysis.

In summary, companies should seek to harmonise and align inside-out with outside-in climate change risk assessment efforts (Figure 1). In fact, a growing number of critics are calling out the misalignment of net-zero pledges by the financial sector, in light of their already committed investments in carbon-intensive sectors for the years to come.⁴⁰ Critics are also raising the possibility of greenwashing, which could lead to potential climate litigation risk. Regarding the latter, some regulators are developing KPIs to assess and monitor the existence and level of greenwashing as part of their efforts to incorporate climate change factors into their regulatory mandate.⁴¹

Critics are increasingly calling out the possibility of greenwashing, which could lead to potential climate litigation risk in the financial sector. Regulators are developing indicators to monitor greenwashing as part of their mandate.

40 Responsible Investor 2022b. A recent article expresses concern about the ambitious net-zero pledges versus the number of investments banks have already committed to carbon-intensive sectors such as oil and gas. These issues are outside the scope of this report.

41 Responsible Investor 2022c,d.

4.3.2 Four strategic considerations to drive internal processes

Irrespective of when, why or how the company started its climate change risk assessment journey and how many exercises it has completed, there are four key considerations for the board and executive management in their efforts to drive the company's capacities towards a more holistic approach (Figure 2). In short:

- Board oversight and executive management buy-in are important;
- The coordination and execution of climate change risk assessment require an internally established, company-specific mandate with clear accountability (also important to ensuring the alignment of inside-out and outside-in approaches that can be leveraged for the development of a sound net-zero

strategy, as well as policies and a viable transition plan the company can implement);

- Central to this process is the development of overarching decision-relevant questions for boards and executive management when launching their outside-in climate change risk assessment (Box 1), complemented by key regulatory and supervisory questions as important external input driving the process (Table 2);
- Company-relevant business use cases should be designed and utilised to frame the process and iterations for exploring the materiality of risks, what they mean for the company and how to address them, as described in the next section.

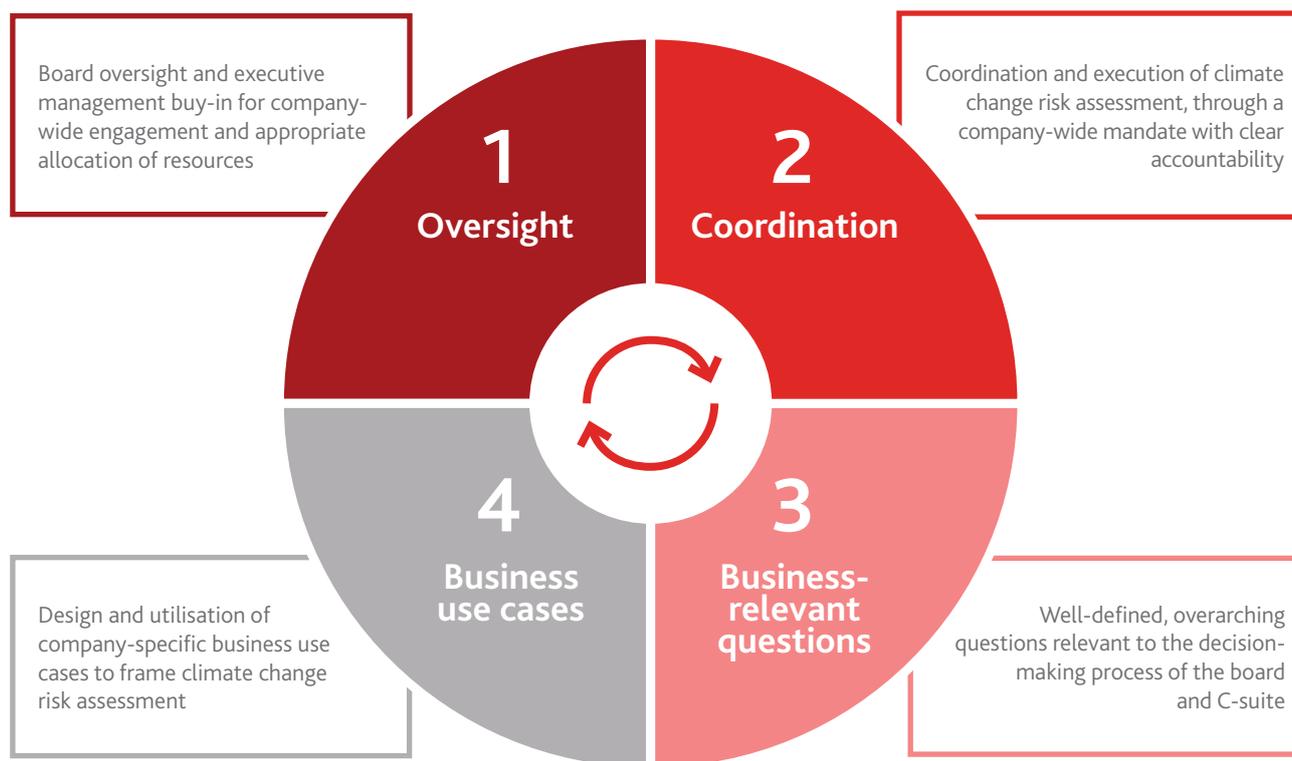
Box 1: Examples of questions that re/insurer boards and executive management need to be asking about climate change risks and opportunities⁴²

1. What is the resilience of the company's business model to climate change risks? How is the company's business model impacted by physical, transition and litigation risks? More specifically, what is the materiality of these risks and their interactions looking ahead (short- and long-term horizons)?
2. How are physical, transition and litigation risks identified, measured, monitored and managed? What actions can be taken within business functions to address these risks?
3. Does the company need to update its risk management framework to take account of these risks?
4. Does the company need to review its asset liability management (ALM) strategy with consideration for the materiality of these risks?
5. Are new data and metrics needed to assess, monitor and manage physical, transition and litigation risks?
6. How can the company encourage its key stakeholders (e.g. insureds, investees, policymakers) to take actions to reduce climate change risks? Subsequently, what are the impacts of these actions on the firm's own risks?
7. What are the range of opportunities for the company to support the adaptation to and mitigation of climate change? What are the impacts of these actions on the company's business model?
8. What are the implications of climate change for the company's governance, long-term strategy and risk appetite?
9. What training do the board, senior management and staff need to integrate the management of physical, transition and litigation risks into existing processes?

Source: The Geneva Association

⁴² These overarching questions can act as a guide to companies at the beginning of their journey. Many insurers are several iterations into the process of exploring and assessing the materiality of climate change risks on their business models. Industry-level efforts are underway through a number of platforms (e.g. The Geneva Association, CFRF, net-zero alliances) to develop best practices and alignment on these points. Note that while questions 6 and 7 relate to actions a company can take regarding its impacts on climate change (inside-out approach), these actions have impacts on the company's risks and show the extent to which outside-in and inside-out approaches are deeply interconnected.

Figure 2: Four important considerations for company boards and executive management in the development of internal processes



Source: The Geneva Association

4.4 Design and utilisation of company-specific business use cases to frame climate change risk assessment exercises

The development and utilisation of business use cases make it possible to frame the analysis, engage experts from relevant business functions, and mine and use the same data and tools across the company. Well-framed business use cases are also helpful to explore how risks may be manifested across business functions and decision feedback loops. A range of such use cases may be developed and used by the company to assess various sources of climate change risk and their effects throughout the business model.

The development and utilisation of business use cases make it possible to frame the analysis, engage experts from relevant business functions, and mine and use the same data and tools across the company.

Starting simple by investigating impacts of each climate change risk type over a short- and long-term horizon – and on each side of the balance sheet – the company can build up complexity over time through an iterative process. This could include assessing the implications of interactions of physical, transition and litigation risks; and exploring how risks are manifested across business functions and related decision feedback loops.

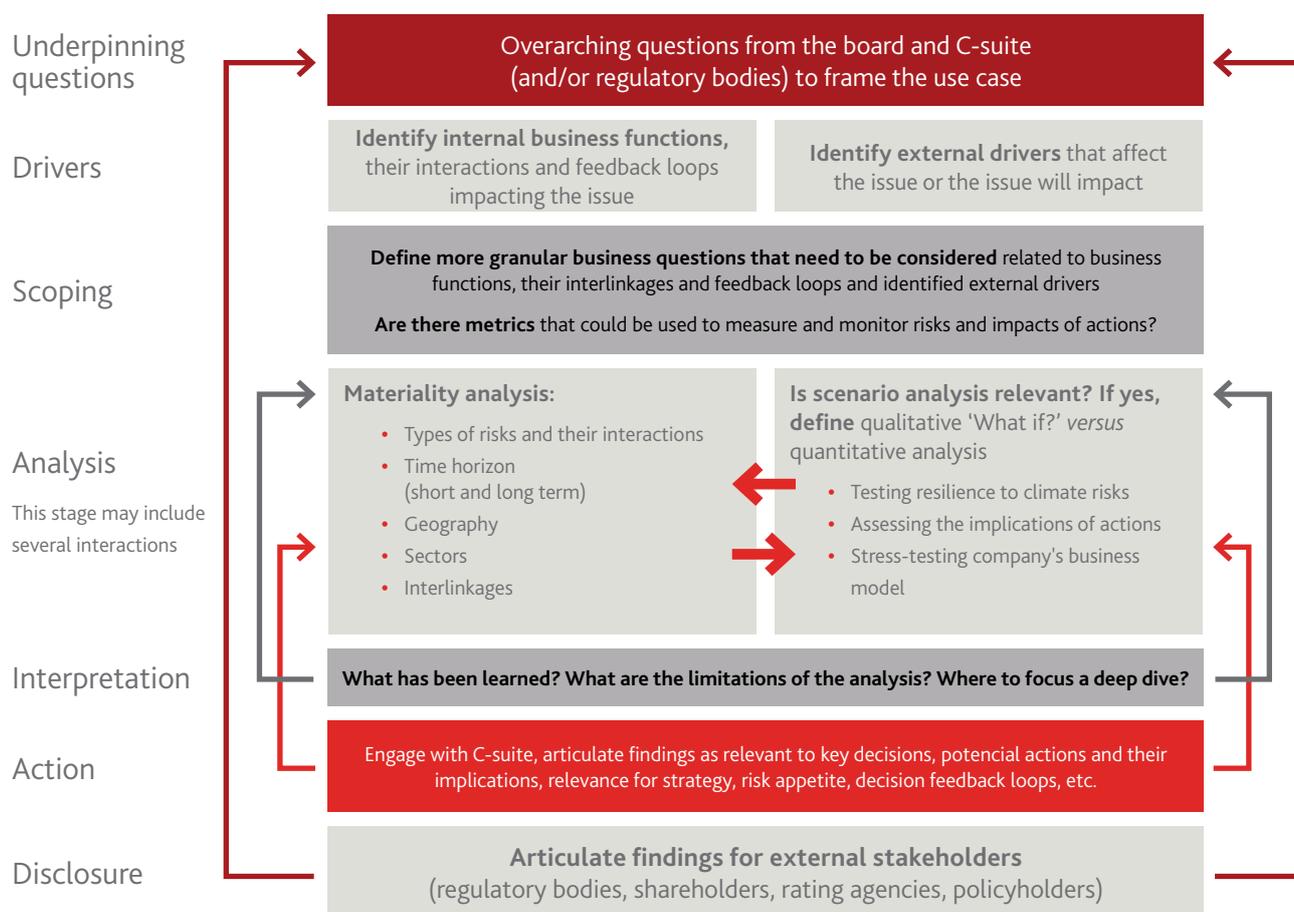
We propose a 10-step template that could be used by re/insurers for the design of business use cases (Box 2). This is also schematically shown in Figure 3 and further demonstrated using three examples.

Box 2: 10 key steps for the design of a business use case to frame climate change risk assessment

- 1. State the overall key business question(s) for the assessment** (refer to key questions from the board and C-suite in Box 1 as well as regulatory bodies in Table 2).
- 2. Identify internal business functions** that are affected or have an impact on the overarching business question:
 - Define more granular business questions related to the identified business functions and their interactions
 - Identify decision feedback loops within and across these functions to explore how these may be impacted.
- 3. Identify external drivers** that affect this issue, or that this issue could affect, such as the latest scientific knowledge about the changing characteristics of the perils, macroeconomic conditions and system-wide changes linked to government investments in mitigation and adaptation.
- 4. Set up a materiality analysis** to converge on priorities for a deeper dive, considering:
 - Risk types and their interactions (physical, transition, litigation)
 - Time horizons (short and long term, although depending on the company, some may also consider medium term)
 - State and level of confidence in climate science as related to the issues under consideration (e.g. scientific confidence about the changing characteristics of acute and chronic physical risks)
 - Who needs to be engaged in the discussions and analysis within the company, and what should be outsourced to ensure that internal and external expertise, data and tools are best leveraged
 - Opportunity cost and potential returns and benefits of the analysis.
- 5. Explore if there are any metrics that could be used to measure and monitor the risks** as well as the impacts of potential measures.
- 6. Define what scenario analysis means in the context of this use case**, and the extent to which scenario analysis can be used to measure and monitor the risks.
 - If scenario analysis is relevant, what type of qualitative and quantitative scenarios should be used? How can they be applied e.g. can the company develop a range of qualitative 'What if?' questions for discussion; can a meaningful quantitative scenario analysis be conducted; how can sectoral and regional factors be incorporated; how will the results be interpreted in light of the inherent uncertainties? (See section 4.6 and the Appendix)
 - As part of this process, it is important to explore major gaps in the data and tools that, if addressed, could help expand the company's capabilities and risk assessment toolbox.
- 7. What has been learned from the analysis?** What are the limitations of the analysis? What are the related data and tool gaps?
- 8. Which decisions should be made in light of the analysis, and what are the decision feedback loops to enhance the decisions?**
 - What actions could be taken to manage these risks and realise related opportunities?
 - Based on the materiality of risks, where is a deeper dive needed for further risk analysis?
- 9. What are the implications of the findings on the company's overall strategy and risk appetite?**
- 10. How can the findings – on the risks and potential options for actions the company can take – be articulated for key stakeholders?**
 - For the C-suite and the board?
 - For key external stakeholders e.g. regulatory and supervisory bodies, rating agencies, shareholders, policyholders?

Source: The Geneva Association

Figure 3: Schematic of the iterative process for design and utilisation of business use cases to frame climate change risk assessment



Note: Arrows in this figure imply various iterations that may be needed along the way, which should be determined by the company as part of the process.

Source: The Geneva Association

4.5 Three examples of business use cases

In order to demonstrate how to utilise the template in Box 2, we have included three examples of business use cases as a starting point for internal discussion. The design of business use cases needs to be customised to the specific situation and key issues for the company.

4.5.1 Case 1: P&C Liabilities – Implications of physical risks on ERM

This business use case builds on a P&C company's preliminary analysis of physical risk on the liability side and aims to explore the impacts of physical risk on enterprise risk management (ERM).

Case 1: P&C liabilities – Implications of physical risks on ERM

1. State the overall key business question(s) for the assessment.

Does the current ERM framework (including risk selection, underwriting guidelines and pricing) capture the physical risks of climate change adequately? Does the risk appetite need to change for material risks related to physical risks of climate change?

2. Identify the internal business functions driving this issue.

- ERM (capital adequacy, risk appetite, property exposure management)
- Underwriting
- Product development
- Operations
- Investment planning
- Shareholder information disclosures

Examples of more granular ERM and underwriting-related questions:

Examples of ERM questions:

1. Does the current ERM framework capture the physical risks of climate change adequately? If not, how can it account for any additional climate change impact, and will allocating additional capital to address the increased risk be sufficient and necessary?
2. Do we need to adjust the risk appetite to take into consideration the changes anticipated in the coming 5–10 years?
3. What sources of profit (line of business, regions, perils) could be eroded in the future due to the increasing frequency and severity of climate change risks?

Examples of underwriting questions:

1. Are there ways to reflect climate change effects by adjusting re/insurance terms and conditions, and updating internal underwriting guidelines?
2. What opportunities exist for new products that directly address climate change concerns for customers?
3. How do we reflect future changes in exposure and vulnerability in risk models?
4. Do we need new physics-based, forward-looking risk models that incorporate both climate change and natural variability?
5. What considerations should be given to developing underwriting strategies in response to long-term climate change impact?

3. Identify external drivers affecting this issue, or that this issue could affect.

External drivers influencing the listed business functions are:

- Regulatory issues
- Rating agency requirements
- Business opportunities
- Capital markets
- Industry (peer pressure)

4. Set up a materiality analysis to determine the priorities for a deeper dive.

Climate change risk assessments are intrinsically complex, and companies may need to focus on deeper climate studies on the most materially exposed portions of their portfolios, for example by:

- Evaluating the risk materiality at the intersection of exposure volumes (by geographic region and line of business) and the strength of climate change links identified in the natural perils with consequences on business operations;
- Developing scenarios for geographies where the company has offices to consider the operational risk implications (e.g. changing risk to coastal flooding at office locations, effects of extreme heat on working conditions/air conditioning requirements);
- Considering the lateral implications across the organisation, even where climate change risk assessments are primarily designed to address a particular question (for example, the potential effects of the sea level rise and increased storm surge risk on local taxes related to adapting the infrastructure, coastal real estate valuations, correlated investment asset classes and some transition effects);
- Understanding climate change science, given the significant uncertainty around the magnitude and timing of the changing physical risks caused by climate change (e.g. the timing of key tipping points in ocean atmosphere systems is especially problematic for longer-term assessments);
- Assessing the maturity of tools and quantification methodology: leveraging NatCat models to support a quantitative analysis of future climate scenarios, requires taking their main shortcomings into account i.e. uncertainties associated with exposure and vulnerability (e.g. reflecting the new building stock in 2050 and future building codes to enable adaptation to climate change in current risk models); and including certain future events in current risk model event catalogues given the unknown intensity, frequency and/or geographic extent.

5. Are there any metrics that could be used to measure and monitor the risks and impacts?

Catastrophe models provide several decision-useful quantitative risk metrics: average annual loss (AAL), occurrence/aggregate exceedance probability (OEP/AEP) curves, earnings at risk (EaR), and tail value at risk (TVaR). These metrics can be estimated representing current climate (baseline view) and future climate; and therefore used for risk management and pricing.

An example of steps in assessing portfolio exposure to physical risks of a future climate change scenario:

- Develop a baseline (or current) view of risk by analysing the company's property exposures using a catastrophe model;
- Develop climate change hazard parameter perturbations considering target time horizons and/or a target global warming scenario (e.g. consistent with 2°C temperature increase) based on latest scientific literature;
- Apply climate change shock parameters to the baseline loss model to get the climate-conditioned view of loss.

Compare and analyse the two views of risk: baseline and future climate. Estimate the risk amount in terms of AAL, EaR and TvaR.

6. What does scenario analysis mean in the context of this use case?

Quantitative scenario analysis can be useful as a tool in measuring and monitoring the risks. In the example above, the climate change-adjusted risk model could also be selectively used to assess the asset side of the balance sheet, by evaluating the potential physical risk impact to, for example, coastal real estate in the investment portfolio. However, given the inherent uncertainty associated with quantitative approaches, these will need to be supplemented by qualitative approaches.

7. What has been learned from the climate change risk analysis? What are the limitations of the analysis?

Long-term prescribed quantitative scenarios designed by regulators are not necessarily suited for all business function needs. Underwriting needs to be informed by short-term time horizons, while capital assessment and business strategy require long-term time horizons. Uncertainty in climate projections is often ignored in scenario analysis results, and efforts should be taken to frame the uncertainties. New approaches will need to be developed to more efficiently and routinely assess and explore the range of future risk levels.

8. What are the feedback loops to enhance decisions?

Examples of feedback loops include exploring how risk management under climate change is related to underwriting, product design and investment.

9. What are the implications of the findings on the company's overall strategy and risk appetite?

The insights developed as a result of such climate change risk assessment help to validate or identify challenges with underwriting plans and/or longer-term business strategies, for example:

- Product design: Underwrite renewable energy business such as solar and wind power companies through new specialised products; adapt proposal forms to better identify and credit local risk prevention measures taken, such as investment in local flood defences; ensure risk control engineers consider changing the physical risk of future site inspections and reports;
- Underwriting strategies: Consider potential changes in exposure to higher frequency events and adapt program structure participation and/or line sizes accordingly; review the design and resilience of any outward risk transfer instruments (e.g. reinsurance, retrocession, cat bonds) to expected changes in event frequency and severity due to climate change;
- Investments: Internal collaboration, engaging experts from product development, underwriting and investment functions, can help the company leverage expertise, data and tools (internal and third-party) for assessments.

10. How can the findings on the risks and options for company actions be articulated for key stakeholders?

It is important that re/insurers understand the range of uncertainty in the hazard parameters explored in their climate change risk assessments, and that this is clearly articulated to the following stakeholders when presenting the findings:

- Regulatory bodies: Perform climate change scenario analysis for mandatory regulatory submission; highlight ongoing and potentially new climate change risk analysis in the ORSA report;
- Executive suite: Review underwriting guidelines; integrate ESG into investment strategies; assess adequacy of pricing and capital models; develop new products.

4.5.2 Case 2: P&C and life investments – Transition and physical risks

This business use case considers the transition and physical risks, as well as their interactions, on investment decisions; and expands to other relevant areas such as the implications for risk appetite.

Case 2: P&C and life investments – Transition and physical risks

1. State the overall key business question(s) for the assessment.

Which climate change risks impact invested assets, and which actions should be contemplated to manage them?

Note: The main difference between life and P&C portfolios lies in the allocation of asset classes to account for differences in liability duration, cash flow visibility and liquidity needs. Regardless of internal strategic asset allocation, re/insurers generally invest across similar asset classes but may face additional constraints depending on the jurisdiction and investable universe. Life re/insurers have longer-term investment horizons linked to their liabilities.

Assets can be exposed to both physical and transition risks. For transition risks, there should be a distinction between fixed income and 'equity-like' investments. Transition risk impacts on fixed-income investments are linked to credit spreads, credit migrations, defaults, interest rates and duration, while for equity, impacts revolve around future cash flow assumptions.

2. Identify the internal business functions driving this issue.

- ERM
- Financial planning
- Sustainability
- Regulatory/government affairs
- Corporate governance
- Investments

More granular questions to consider:

- How should climate risks be incorporated into long-term investment and risk (default) assumptions?
- Does the incorporation of climate risks into long-term assumptions change asset allocation decisions?
- How should climate risks impact risk appetite? Do climate risks warrant their own risk appetite or should they be embedded in the assessment of existing risk appetite metrics?
- How do stakeholder pressure and reputational risk for non-action impact decisions?
- How should climate risks be incorporated into new product assumptions (particularly long-duration liabilities)?

3. Identify the external drivers affecting this issue, or that this issue could affect.

Transition risks are mainly driven by:

- Government policies
- Regulatory requirements
- Technological developments
- Public sentiment/reputational risk
- Rating agency developments
- Industry (peers)

... continue Case 2

4. Set up a materiality analysis to determine the priorities for a deeper dive.

A number of factors need to be considered to determine where quantitative analysis is useful and where it needs to be supplemented or replaced with qualitative analysis. While quantitative metrics will become increasingly useful, a qualitative component to issuer assessment will always be needed.

Further questions can be addressed to prioritise areas needing a deeper dive:

- Are certain sectors at risk of wholesale business model changes due to transition risk?
- Which asset classes and sectors are at risk of stranded assets?
- Will there be sectors and regions that may be removed from the investment universe due to physical risk?
- For near-term portfolio roll-off of high impact asset class/sectors, how is refinancing assessed?
- How do you address potential trade-offs between short-term returns and longer-term risks?
- What actions will you take if material risks begin to emerge in performance?
- Is climate change risk correctly priced in the market? How do re/ insurers determine when the market begins pricing in climate change risks?

Two examples of qualitative analysis that can be done using these questions for a given asset class:

Transition risk example:

Long-duration public bond issuance tends to be concentrated in public sectors such as midstream and upstream oil and gas, integrated energy and utilities, which are more susceptible to transition risks.

Given the limited investment opportunities for long-duration assets, these sectors have historically helped re/insurers execute their asset and liability matching strategies.

While they have historically presented an attractive risk/return profile, absent transition by the issuer, their attractiveness may fall in the future.

Because of the regular long term to maturity of issues in those sectors, re/insurers should now assess whether their less attractive future risk profile is still acceptable with regards to their risk appetite and risk limits. This should influence strategic plan exercises when conducting simulations on forward-looking risks and returns of various portfolio allocations.

Physical risk example:

Commercial real estate portfolios constitute a material percentage of life re/insurer investment portfolios given their long duration.

To a lesser extent, P&C re/insurers may invest in this asset class.

Depending on their geographical location and other factors, these investments can be highly susceptible to a variety of long-term physical climate change risks.

The largest impact to lenders will likely reside in tail events and nuisance flooding rather than a gradual increase in mean sea levels over decades. While risks reside at the property level (damage due to increased flooding), greater long-term risk resides at the market level due to potential population migration driven by the anticipation, insurance pricing or experience of increased flood risk.

Geographic concentration subject to market-level limits must be considered along with a robust and conservative underwriting process and flood insurance requirements in order to mitigate these risks.

5. Are there any metrics that could be used to measure and monitor the risks and impacts?

If a metric such as climate value at risk (VaR) is used, a discount rate is often applied to assess the impact on the portfolio. Given the long-dated risk profile, the discount rate can nullify the substantive impact on the portfolio holdings. As for any type of market risk, the VaR should be measured on both a standalone and diversified basis (assets and liabilities) to ensure meaningful information before rebalancing a portfolio.

As highlighted in The Geneva Association's first report, climate assessments should be both qualitative and quantitative in nature. The analysis should have both short-term (e.g. 2020–2030) and long-term (e.g. 2030–2050) time horizons – and look at the potential implications of both physical and transition risks, across them. Whatever the metrics, they should be complemented by narrative information which often provides more meaningful information to stakeholders.

6. What does scenario analysis mean in the context of this use case?

Most of the scenarios translate a climate scenario into macro-economic variables. This means that for a given scenario, stresses on rates (by country), credit spreads and equities (by sector) can be applied by maturity. The change in the valuation of assets should be analysed in light of liabilities. As interest rates apply on both sides of the balance sheet, limiting the analysis to the asset side may provide misleading information (if, for example, interest rate projections more than offset the loss of value due to credit spreads and equities; this could be the case if a transition scenario were to trigger recession).

In terms of scenario analysis, the impact on portfolios under different future climate scenarios can be analysed, looking at the impact of government policies and/or other actions resulting in a deep reduction in carbon emissions.

7. What has been learned from the climate change risk analysis? What are the limitations of the analysis?

Traditional scenario analysis risk modelling is insufficient given the time horizon over which transition risk will manifest. Despite the usefulness of scenario analysis, limitations exist within a purely quantitative scenario analysis approach. For a holistic analysis, both quantitative and qualitative analyses need to be considered.

By applying a qualitative lens, the limitations of quantitative analyses can be identified:

- Transition risk, where an analysis may shift in terms of risk and opportunity (a company may shift its strategy to focus on energy infrastructure, recognising that energy will evolve over time and the company's asset base will evolve with it, making it possible for the opportunities to outweigh the risks; qualitative analyses the company may perform in this scenario include (but not limited to) capital allocation rationale, technology investments, and an assessment of employee skills and expertise);
- Physical risk, while quantitative scenarios are useful in determining the timing and severity of potential tail events on a global scale, a qualitative overlay must be applied to fully determine company's exposure to risks, e.g. for flood risk: by pairing the NOAA scenario with a more localised qualitative analysis of the commercial real estate portfolio overlay to assess potential effects on mass migration.

8. What are the feedback loops to enhance decisions?

Examples of feedback loops:

- Risk (capital assumptions): Incorporate findings into long-term capital assumptions and expected loss assumptions embedded in product pricing;
- Investments: Consider climate risk appetite and limits and modify strategic asset allocations accordingly, perhaps with lower allocation to sectors with higher transition risk;
- Engagement/Advocacy: Could result in focusing engagement strategy on both sides of the balance sheet (with investees and clients) or policy advocacy;
- Product design: Findings could help understand alternative product pricing scenarios (Does this impact company product lines or product pricing? How is product profitability impacted by transition scenario analysis?) as well as Interlinkages of physical and transition risks: For example, if the transition risk remains low over years to come, this should create a feedback loop to consider physical risk more closely and urgently; given that re/insurers are matching currency to their liabilities, this will have implications for the geolocation of the assets as certain geographies have a higher exposure to certain types of extreme weather events).

9. What are the implications of the findings on the company's overall strategy and risk appetite?

Qualitative assessments should be linked to quantitative scenario analysis and considered in the company's overall strategy and risk appetite. Given the drawbacks to purely quantitative analysis, the qualitative assessment may be used to 1) make adjustments to improve the quantitative analysis or 2) make adjustments to a company's baseline (climate agnostic) to consider transition risk where most relevant.

This creates a direct link between the company strategy and risk appetite. Given the variety of internal and external stakeholders, a strong governance process is important and will help inform decision-making on the impact on company strategy and risk appetite.

10. How can the findings on the risks and potential options for company actions be articulated for key stakeholders?

- Investors are calling for consistent, comparable and reliable climate change risk disclosure information to help inform investment decision-making. They also are increasingly looking to drive companies to commit to decarbonising their portfolios and play a proactive role in moving towards lower-carbon economies.
- Regulatory bodies are actively engaging, with some tasked with addressing investor demands for data and others with ensuring that risks are understood and well-managed to protect policyholders.
- Like other industries, re/insurers are facing significant pressure from stakeholders to play an active role in the transition towards a net-zero economy by 2050. This requires the executive suite and board to consider additional factors when formalising the company's climate strategy, governance, risk management and metrics/targets.

Furthermore, re/insurers must consider stakeholder expectations of:

- TCFD-aligned reporting
- GHG emissions with assurance, covering scopes 1, 2 and 3
- Transition plans with assumptions, interim targets, etc. (if climate commitments are made)
- Geolocation disclosure

4.5.3 Case 3: Life & health liabilities

While life & health re/insurers require more research for underwriting to assess the attributions and materiality of climate change to longevity, mortality and morbidity, this business use case offers a starting point for a framed qualitative process to explore physical and transition risks as well as their interaction on the liability side.⁴³

Case 3: Life & health liabilities

1. State the overall key business question(s) for the assessment.

What are the impacts of physical and transition risks on the life & health insurance industry, and how can these risks be managed?

Physical climate change risks such as heatwaves, extreme weather events, water quality and scarcity, and milder winters have different impacts on: mortality, morbidity, longevity, disability incidence and duration, critical illness, medical expenses and lapse risk. It may not be readily apparent to insurers that a specific claim may be tied to climate change risk, as the cause of claim is likely linked to the human system or organ failure that ultimately leads to death. For example, death during a heatwave would likely be listed as cardio-respiratory and not identify the heatwave as the precipitating factor. On the other hand, reduced pollution from the decarbonisation of carbon-intensive sectors (e.g. energy, transportation) could have positive health effects, which may appear in the form of a lower incidence of lung cancer.

2. Identify internal business functions that are affected.

- Product development
- ERM
- Investments
- Regulatory/government affairs
- External reporting and investor relations
- Corporate governance

3. Identify external drivers affecting this issue, or that this issue could affect.

- Government climate change adaptation and mitigation policies
- Government efforts to strengthen public health systems
- Regulatory requirements
- Technological developments
- Industry (peers, clients, associations)
- Economic environment

4. Set up a materiality analysis to determine the priorities for a deeper dive.

For liabilities, the analysis could examine the following questions:

- How is climate change likely to affect longevity, mortality and health risks in the short and long term?
- Which geographies and demographic groups will be most impacted over the time horizons (in this case, we choose three time horizons)? What are the perils the geographies face?
- Which existing lines of business are sensitive to transition risks in the short and long term?

The analysis could support answers to the following questions:

- How will climate change effects influence the risks in the portfolio for the different demographic groups and geographies?
- Which products are most at risk from climate change?
- What opportunities does climate change present for companies?
- How can strategy minimise exposure to physical and transition risks?
- Does the company have operational risks, such as business continuity (office location)?

43 Botzen et al. 2020 and Longden 2019.

44 IPCC 2021; 2022a-b; The Lancet Countdown on Climate Change and Health: <https://www.thelancet.com/countdown-health-climate>; <https://www.enviromedics.org/>.

... continue Case 3

5. Are there any metrics that could be used to measure and monitor the risks?

While the implications of climate change on the liability side of life insurance are being researched, key metrics need to be identified to ensure the materiality of climate change risks is better understood.

6. What does scenario analysis mean in the context of this use case?

The company can consider different transition scenarios and implications of each on acute physical risks (e.g. extreme events) and chronic physical risks (e.g. air pollution) for different time horizons and regions in which the company operates (or would consider to expand its operations). Companies can access information about the impacts of climate change on morbidity, longevity and mortality in different regions through a number of sources (e.g. IPCC, The Lancet, Enviromedics.org).⁴⁴ The following is a hypothetical and simplified qualitative scenario analysis to demonstrate how the trends may be captured.

Table A: A hypothetical qualitative scenario analysis of acute and chronic physical climate risk in a region of interest (over three different time horizons, based on available research for a specific scenario with limited climate action to mitigate climate change)

Regional climate effects	<2030	Horizon 2030–2050	> 2050
Summer temperature	↑	↑↑	↑↑↑
Winter temperature	↑	↑↑	↑↑↑
Extreme wind events	0	0	0
Extreme flood events	0	0	↑
Extreme wildfire events	0	↑	↑
Effects on healthcare	0	0	0
Effects on food	0	0	0

Note: ↑ refers to rise, ↓ refers to drop and 0 indicates no change

This qualitative analysis may be further expanded to examine mortality and longevity trends linked to acute and chronic physical risks by age groups over the three different time horizons.

... continue Case 3: Life & health liabilities

Table B: A hypothetical qualitative analysis of trends related to impacts of acute and chronic physical risk in the region by time horizon and age group for a specific scenario

Sensitivity to climate effects	<2030			Horizon 2030–2050			> 2050			
	Age group	<40	40–65	>65	<40	40–65	>65	<40	40–65	>65
Product A Mortality										
Summer temperature		0	+	++	0	+	++	0	+	++
Winter temperature		0	-	--	0	-	--	0	-	--
Extreme wind events		0	0	0	0	0	0	0	0	0
Extreme flood events		0	0	0	0	0	0	+	+	+
Extreme wildfire events		0	0	0	0	0	0	0	0	0
Effects on healthcare		0	0	0	0	0	0	0	0	+
Effects on food		0	0	0	0	0	0	0	0	0
Product B Longevity										
Summer temperature		0	-	--	0	-	--	0	-	---
Winter temperature		0	+	++	0	+	++	0	+	+++
Extreme wind events		0	0	0	0	0	0	0	0	0
Extreme flood events		0	0	0	0	0	0	-	-	-
Extreme wildfire events		0	0	0	0	0	0	0	0	0
Effects on healthcare		0	0	0	0	0	0	0	0	-
Effects on food		0	0	0	0	0	0	0	0	0

Note: Effects can lead to an increase in risk (+/++/+++) or a decrease in risk (-/--/---). Some effects are immaterial (0).

Ultimately, by selecting different scenarios, the analysis can combine the impacts of decarbonisation measures on acute (extremes) and chronic (trends) physical climate risks that are material to conduct a sensitivity analysis.

Table C: A hypothetical qualitative analysis of trends related to the impacts of climate change mitigation action on chronic physical risks in a region

Regional transition effects	<2030	Horizon 2030–2050	> 2050
Air pollution	↓	↓↓	↓↓↓

Note: ↑ refers to rise, ↓ refers to drop.

These analyses may be extended to assess the sensitivity of insurance products to these effects. This is not addressed in this hypothetical use case.

... continue Case 3**7. What is learned from the climate change risk analysis? What are the limitations of the analysis?**

On the liability side, some countries and regions are more likely to be vulnerable to acute and chronic physical climate change impacts and the related implications of the net-zero transition. This discussion can explore the sources of uncertainty and what they mean for the analysis.

It is also challenging to grasp how climate change may be the direct source of, or contribute to, morbidity or mortality. Relevant data, methodologies and tools need to be developed to help insurers better understand how climate change risk is impacting products and pricing on the liability side of life and health insurers.

8. What are the feedback loops to enhance decisions?

Depending on the materiality of climate change risks on liabilities, examples of immediate feedback loops to consider are links to underwriting, reinsurance and Asset Liability Management modelling (ALM).

9. What are the implications of the findings on the company's overall strategy and risk appetite?

If the sensitivity to climate change is material, exposure limits for certain products, regions/countries or age groups might be necessary to reduce the effects of climate change on the company's results or solvency. A materiality assessment of the effects of climate change on life liabilities is the first step. As the effects can be radically different depending on the product, an overall assessment is needed.

Climate change can lead to both opportunities and threats. If the pricing is not sufficient in certain regions or countries, the insurer can decide not to enter or to withdraw from a certain market. But there are also opportunities as milder winters or less air pollution have a favourable effect on mortality risk. The integrated assessment of climate change risk can lead to a changed view on the attractiveness of products or regions/countries.

10. How can the findings on the risks and potential options for company actions be articulated for key stakeholders?

Such an analysis may be summarised to enable more strategic discussions related to the company's regional expansion, risk appetite and risk management approaches. However, for more detailed discussions in areas such as products and services, more in-depth data and analysis would be required.

4.6 Considerations for forward-looking scenario analysis

A 'scenario' is a plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key internal and external driving forces and relationships.

Note that scenarios are neither predictions nor forecasts but are used to provide a view of the implications of a range of developments and actions.⁴⁵

'Scenario analysis' is a tool for conducting a forward-looking assessment of risks and opportunities, where the company can systematically explore individual or combined factors and make strategic decisions in the face of significant uncertainties. Scenario analysis can be quantitative, qualitative or a mix of both. The use of scenario analysis for climate change risk assessment is an explicit recommendation of the TCFD and several regulatory bodies. Scenarios help describe key potential climate change transition pathways over short- to long-term horizons, and their analysis may be used for a range of applications, for example:

- Testing the resilience of a company's business model to climate-related risks;
- Assessing the implications of possible actions;
- Stress-testing the company's business model under extremely adverse conditions.

Regulators and financial institutions are in the early stages of experimenting with both qualitative and quantitative forward-looking scenario analysis, while methodologies, models and data continue to evolve.

Regulators and financial institutions are in the early stages of experimenting with both qualitative and quantitative forward-looking scenario analysis. **As quantitative climate scenario analysis is still in its infancy, methodologies, models and data continue to evolve.**

4.6.1 About benchmark climate change scenarios

There are several benchmark scenarios produced by a number of organisations such as the International Panel on Climate Change (IPCC), International Energy Agency (IEA) and Network for Greening of Financial System (NGFS), which are among the most utilised in the financial sector. These scenarios use different assumptions related to socio-economic factors, technological evolution, the public policy landscape, emission targets and physical risks and their interactions, which need to be carefully understood before applying them to scenario analysis in the company (the Appendix provides more detail).

- **The four families of IPCC scenarios** are designed for studying the interactions between human and climate systems, along with subsequent mitigation and adaptation strategies.
- **IEA scenarios** are designed for in-depth analyses of energy-related sectors. These scenarios are often the benchmark for energy sector pathways.
- **NGFS scenarios** are designed for studying physical and transition risks, and are the scenarios typically used in the financial sector by central banks, regulators and firms.

Benchmark scenarios currently used in the financial sector have a number of shortcomings that companies need to understand as they design and implement their forward-looking scenario analysis.

Multiple issues need to be considered when applying these benchmark scenarios. Of note:

- **These sets of scenarios are not sufficient on their own to study the climate change-related risks of a specific company.** Such benchmark scenarios can provide a useful narrative for a firm's own risk assessments, but flexibility is needed to adapt the scenarios to the business model and risk profile in order to derive decision-useful results. Ideally, the questions developed as part of the business use cases should guide the company's scenario design and analytics.

45 IPCC Glossary; NGFS 2021a-c; The Geneva Association 2021a; Nakicenovic et al. 2014; weadapt.org.

- **The models used to establish these scenarios typically do not integrate the physical impacts of climate change on macro-economic variables as a feedback loop, but instead use GHG pricing mechanisms to induce emissions reductions.**⁴⁶ This implies that climate change impacts and the associated uncertainties are not accounted for.⁴⁷ For example, variables such as GDP are exogenous and unaffected by climate change in these scenarios. The assessment of climate impacts can be made after the fact with the use of other models or damage functions, but even then, these analyses come with a high degree of uncertainty.
- **Non-climate-related events or shocks cannot be captured with these scenarios** (e.g. pandemics, geopolitical conflicts). For example, NGFS states that their methodology “does not capture the effects from extreme events, sea-level rise, non-market impacts or indirect effects e.g. through conflict.”⁴⁸ A key issue with these scenarios is how to consider shocks such as the Russian-Ukraine crisis, which beyond its short-term impacts in the energy sector will have potential long-term implications on the speed of the low-carbon energy transition in different regions.⁴⁹
- **The organisations providing the most commonly used sets of scenarios** (e.g. IPCC, NGFS) do not offer information on the likelihood of a specific scenario.
- **For the purpose of scenario analysis, different scenarios may be used together; however, this needs to be done taking into consideration the consistency of assumptions used to develop the scenarios.** For example, the socio-economic assumptions for producing different IPCC Shared Socioeconomic Pathway (SSP) scenarios can be used together with certain IPCC Representative Concentration Pathway (RCP) scenarios, where the assumptions are compatible (for more detail and references, see the Appendix).⁵⁰

Companies could consider more granular factors in designing company-specific scenarios that pertain to other stakeholder actions, which may impact their exposure and vulnerabilities.

Companies could also consider more granular factors in company-specific scenarios that pertain to other stakeholder actions, which may impact their exposure and vulnerabilities. One example would be to take into consideration the adaptation and mitigation measures of governments (national to local)⁵¹ in their jurisdictions; or to account for the strategies of their corporate clients (insureds and investees).

46 IPCC 2018.

47 The combination of physical and transition impacts as well as the cascading nature of physical risks beyond tipping points need to be studied and agreed as a methodology before integrating them into the climate change risk assessment framework, as they could lead to significant variations of the outcomes.

48 NGFS 2021a-c.

49 With Russia being a primary supplier of fossil fuel resources to European countries, the outbreak of its conflict with Ukraine has had massive impacts on energy markets first in Europe before rippling across the globe. The geopolitical tensions, imposed sanctions and divestments from Russia have led to short-term impacts on the demand, supply and prices of energy throughout the world. Additional effects could also materialise in the long run as European countries (and subsequently other world countries) rethink their long-term energy policies, strategies and investments in alternative energy systems.

50 IPCC 2022a; Rogelj et al. 2018 and CarbonBrief 2018 offer this analysis.

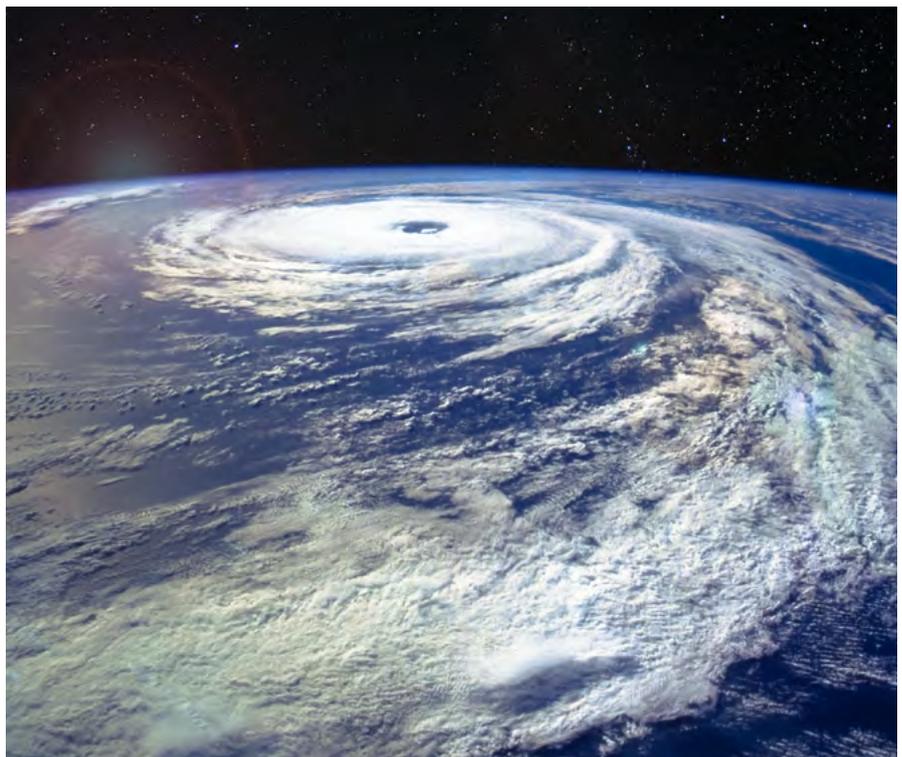
51 Two useful tools to analyse such national strategies are offered by Climate Watch (<https://www.climatewatchdata.org/>) at the global level and Climate Adapt (<https://climate-adapt.eea.europa.eu>) at the European level.



5. Status of data and tools for climate change risk assessment

A number of organisations have offered an assessment of the current climate change risk data and assessment tools for certain segments of the financial sector or for specific objectives, with some even offering recommendations on how to address these challenges (Box 3).

Deliberations of the GA task force have confirmed that despite the availability of many sources of data and tools, significant gaps continue to limit the relevance of quantitative approaches, such as long-term scenario analysis, in decisions. This conclusion is also in line with findings by other bodies such as the CFRF, FSB and UNEP-FI. More work is required by re/insurers to develop the toolbox to institutionalise these analyses in their core risk assessment and management practices.



Box 3: Examples of available tools for certain segments of the financial sector or with specific objectives

The Climate Financial Risk Forum (CFRF) published its second round of guides,⁵² building on the first iteration of publications from June 2020⁵³ and providing support to insurers, asset owners and banks on the topics of risk management, scenario analysis, disclosure, and climate data and metrics. The CFRF stresses that although forward-looking climate change risk assessment remains a difficult and exploratory process, it is necessary to inform company strategy and business decisions.

The Financial Stability Board (FSB) in July 2021 released a report addressing the availability of data for monitoring and assessing climate-related risks for financial stability for consultations.⁵⁴ The report discusses the need for data to be sufficiently granular to capture the materiality of exposures to climate risks effectively. It stresses the remaining limitations and gaps in the availability, quality and consistency of data.

The UNEP Finance Initiative (UNEP-FI) in March 2022 released a report on the climate change risk tool landscape,⁵⁵ presenting climate change risk assessment case studies of banks and investors, and retrieving the key takeaway trends, challenges and recommendations. While it is clear that data and tools are improving, the area remains a work in progress.

The Partnership for Carbon Accounting Financials (PCAF) in March 2022 released a scoping document,⁵⁶ followed by a progress report open for consultation in July 2022,⁵⁷ outlining the goals and principles for accounting for GHG emissions in underwriting portfolios of insurers, in collaboration with the Net-Zero Insurance Alliance (NZIA). This work is primarily relevant to inside-out analysis.

The International Institute for Applied Systems Analysis (IIASA) database is the IPCC AR6 Scenario Explorer,⁵⁸ compiled by IIASA and released along with the publication of the IPCC Working Group III (WGIII) report⁵⁹ as part of a cooperation agreement. The scenario ensemble contains 3,131 quantitative scenarios with data on socio-economic development, greenhouse gas emissions and sectoral transformations across energy, land use, transportation and industry.⁶⁰

The IPCC Working Group III (WGIII) annex⁶¹ details the key methods and tools available in the literature to explore mitigation strategies in a variety of sectors (i.e. energy, building, transport, industry, land use), as well as the methodology of integrated assessment models (IAMs) to capture economy-wide transformation pathways.⁶²

The European Insurance and Occupational Pensions Authority (EIOPA)⁶³ has offered methodological principles for climate change stress-testing for insurers. EIOPA gives an overview of the common modelling approaches used, with a focus on enhancing the granularity of scenarios and matching methodologies with asset classes.

Source: The Geneva Association, based on cited sources

It is undeniable that there are still many limitations and challenges with the data, tools, climate science and understanding of the inherent uncertainties associated with market, policy and technological risks, all of which limit a company's quantitative analysis. Industry-level collaboration is fundamental to expedite the identification of requirements and address gaps in the data and tools.

52 CFRF 2021a-h.

53 CFRF 2020.

54 FSB 2021.

55 UNEP-FI 2022.

56 PCAF 2022a.

57 PCAF 2022b.

58 Byers et al. 2022.

59 IPCC 2022b.

60 IPCC AR6 Scenario Explorer: <https://data.ene.iiasa.ac.at/ar6/#/login?redirect=%2Fworkspaces>.

61 IPCC 2022c.

62 IPCC 2021, 2022a,b.

63 EIOPA 2022.



6. Recommendations

An important conclusion is that the long-term and prescriptive quantitative regulatory exercises used up until now have outlived their purpose of raising awareness. The insurance industry is now at a juncture as it attempts to turn this awareness into meaningful analytics to support decisions. This requires even stronger collaboration – intra- and inter-sectoral, with regulatory and standard-setting bodies, as well as with the scientific community and climate change data providers – to leverage resources and expertise. These efforts should build on advancements in science and climate modelling; lead to the development of probabilistic forward-looking methodologies that allow the combination of climate, economic, policy and financial data in a consistent manner; and address radical uncertainties associated with the stochastic nature of the low-carbon transition over long-term horizons.⁶⁴

We explored how re/insurers could build on their to-date climate change risk assessment experience to pursue a more holistic approach, over time, using an exploratory, iterative and adaptive process. We identified key considerations for company boards and executive management, offering concrete guidance on how to design and utilise company-relevant business use cases to frame and implement decision-relevant climate change risk assessment – all while developing internal capabilities and leveraging expertise, data and tools across the company. While quantitative scenario analysis is in its infancy, we provided an update on the status of benchmark scenarios and the related data and tools to help guide companies' efforts. Finally, we shared insights into the evolving regulatory priorities and key issues for re/insurers based on direct engagement with financial regulatory and standard-setting bodies.

We have summarised our key findings in the form of recommendations for re/insurers, insurance associations and regulatory and supervisory bodies, as follows:

Re/insurers should:

- 1. Expand their climate change risk assessment exercises through an exploratory, iterative and adaptive process, leveraging their experiences to date and aspiring to a holistic approach with a view to both sides of the balance sheet.** Given the complexities of this area, it will take time and resources to develop such capabilities. To this end, companies should:

⁶⁴ Dembo 2021.

- a. Ensure a clear process for board and executive management oversight and ownership;
 - b. Designate appropriate mechanisms with a company-wide mandate to oversee the execution and report back (this could be a defined function e.g. enterprise risk management that has an overarching reach of both sides of the balance sheet, or an executive or committee designated by the board);
 - c. Start simple and build over time, considering the interlinkages of climate change risks, connections across business functions and the related decision feedback loops through which climate change risk may be transmitted;
 - d. Design and utilise company-relevant business use cases to frame the assessment process for producing decision-useful information;
 - e. Identify and engage key staff across the company to engage in the process from the start in order to leverage expertise, given that robust dialogues across business functions could lead to innovative, out-of-the-box analysis and solutions;
 - f. Assess the materiality of risks and how they are manifested within and across business functions;
 - g. Apply scenario analysis, when relevant, starting with simple 'What if?' scenarios (e.g. making assumptions about the carbon price, timing of the energy transition, implications of carbon-intensive sectors, characteristics of physical risks) and taking into account the latest developments in methodologies, models and data for forward-looking quantitative scenario analysis;
 - h. Identify areas where further training and education of the board, C-suite and staff would be needed, and invest in training programmes;
 - i. Mine and leverage data and tools available across the company and from third parties, consistently and identify gaps that need to be addressed over time.
2. **Participate in industry-level collaboration to conduct an analysis of existing data and tools, challenges, gaps and needs** to enable the insurance industry to build robust capabilities in forward-looking climate change risk assessment, and to identify priority areas and requirements for the development of future tools.
 3. **Collaborate across the industry and with regulatory and standard-setting bodies** to expedite the development of tools and methodologies for climate change risk assessment, and convergence on best practices and standards.
 4. **Actively engage in regulatory and standard-setting bodies' consultations** (e.g. IFRS-ISSB, FSB, IAIS, NGFS) to share experiences and lessons learned in the aim of advancing best practices and the development of a global baseline and related jurisdictional standards for sustainability reporting, with a focus on climate change.
 5. **Bring their company's expertise, knowledge and findings to its insureds and investees** and help them in their journey.
- International, regional and national insurance associations should:**
1. **Offer robust platforms for discussing and sharing experiences** among members in their respective jurisdictions;
 2. **Engage and collaborate not only with their respective regional, national and sub-national regulatory and supervisory bodies, but also participate in international processes** and help facilitate industry/regulatory discussions that share insights from their respective jurisdictions.
- Regulatory and standard-setting bodies should:**
1. **Further clarify their regulatory objectives and supervisory role, and engage with the industry proactively** for consultation and feedback to:
 - a. Provide more clarity on the objectives and key questions for scoping exercises that would produce decision-useful information for regulators and companies;
 - b. Explore the limitations of current forward-looking quantitative scenario analysis and stress testing, even though they are still in their infancy and it will take time to converge on the applications and approaches that would produce meaningful information;
 - c. Consider feasibility reviews based on a mix of qualitative and quantitative approaches which are anchored in the company's decision-making, taking into consideration advancements in science and evolving methodologies in this area.

- 2. Continue to strengthen coordination and collaboration mechanisms with the insurance industry and among themselves, to expedite convergence on best practices and disclosure standards for each sector and jurisdiction, such as:**
 - a. IAIS stakeholder workshops, launched in April 2022, and industry-led initiatives (e.g. the CFRF co-chaired by the FCA and the PRA);
 - b. Engagement with the IFRS-ISSB and consultations with the insurance industry.
- 3. Recognise that climate change risk assessment is a resource-intensive process, which will take time to develop.** It will be important for companies and regulatory bodies in their jurisdiction to identify best practices and address challenges collaboratively (e.g. access to data for the region, build-up of internal experience and expertise, availability of best practices).
- 4. Remain mindful and not require public disclosure of information that is proprietary and/or confidential** (e.g. ORSA).
- 5. Consider the international expansion (via the IAIS and NGFS, for example) of analysing regulatory priorities and key questions, as conducted for this report,** with the goal of bringing more clarity to mutual regulatory and supervisory objectives as well as the approaches across jurisdictions for climate change risk assessment and disclosure.

References

- ACPR. 2021. *A First Assessment of Financial Risks Stemming from Climate Change: The main results of the 2020 climate pilot exercise*. https://acpr.banque-france.fr/sites/default/files/medias/documents/20210602_as_exercice_pilote_english.pdf
- ACPR. 2022. *Climate change risk governance*. https://acpr.banque-france.fr/sites/default/files/medias/documents/20220222_climate_change_risk_governance_rapport_en.pdf
- Australian Prudential Regulation Authority (APRA). 2021a. *Information Paper – Climate vulnerability assessment*. https://www.apra.gov.au/sites/default/files/2021-09/Climate%20Vulnerability%20Assessment_1.pdf
- Australian Prudential Regulation Authority (APRA). 2021b. *Prudential Practice Guide – CPG229 climate change financial risks*. <https://www.apra.gov.au/sites/default/files/2021-11/Final%20Prudential%20Practice%20Guide%20CPG%20229%20Climate%20Change%20Financial%20Risks.pdf>
- Bank of Canada (BoC) and Office of the Superintendent of Financial Institutions (OSFI). 2022. *Using Scenario Analysis to Assess Climate Transition Risk*. <https://www.bankofcanada.ca/wp-content/uploads/2021/11/BoC-OSFI-Using-Scenario-Analysis-to-Assess-Climate-Transition-Risk.pdf>
- Bank of England (BoE). 2022. *Results of the 2021 Climate Biennial Exploratory Scenario (CBES)*. <https://www.bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario>
- Bank of England (BoE). 2021. *Guidance for Participants of the 2021 Biennial Exploratory Scenario: Financial risks from climate change*. <https://www.bankofengland.co.uk/-/media/boe/files/stress-testing/2021/the-2021-biennial-exploratory-scenario-on-the-financial-risks-from-climate-change.pdf>
- Bank of England (BoE) – Prudential Regulation Authority (PRA). 2021. *Climate-related Financial Risk Management and the Role of Capital Requirements*. Climate Change Adaptation Report 2021. <https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/publication/2021/october/climate-change-adaptation-report-2021.pdf?la=en&hash=FF4A0C618471462E10BC704D4AA58727EC8F8720>
- Botzen, W. J. W., M. L. Martinius, P. Bröde P., M.A. Folkerts, P. Ignjacevic, F. Estrada, C.N. Harmsen, H.A.M. Daanen. 2020. Economic Valuation of Climate Change-induced Mortality: Age dependent cold and heat mortality in the Netherlands. *Climatic Change* 162(2): 545–562.
- Byers et al. 2022. *AR6 Scenarios Databased* hosted by International Institute for Applied Systems Analysis (IIASA). <https://data.ene.iiasa.ac.at/ar6/#/login?redirect=%2Fworkspaces>
- California Department of Insurance – Climate Insurance Working Group. 2021. *Protecting Communities, Preserving Nature, and Building Resiliency*. <https://www.insurance.ca.gov/ccidocs/climate-insurance-report.pdf>
- CarbonBrief. 2022. *In-depth Q&A: The IPCC's sixth assessment on how to tackle climate change*. <https://www.carbonbrief.org/in-depth-qa-the-ipccs-sixth-assessment-on-how-to-tackle-climate-change>
- CarbonBrief. 2018. *Explainer: How 'Shared Socioeconomic Pathways' Explore Future Climate Change*. <https://www.carbonbrief.org/explainer-how-shared-socio-economic-pathways-explore-future-climate-change>
- CDP. 2022. *Are Companies Being Transparent in their Transition? – 2021 Climate Transition Plan Disclosure*. https://cdn.cdp.net/cdp-production/cms/reports/documents/000/006/127/original/2021_Climate_transition_plan_disclosure_FINAL.pdf?1646240437
- Climate Financial Risk Forum (CFRF). 2021a. *Climate Financial Risk Forum Guide 2021 – Climate change risk appetite statements*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-appetite-statements.pdf>

- Climate Financial Risk Forum (CFRF). 2021b. *Climate Financial Risk Forum Guide 2021 – Risk management use cases*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-risk-management-use-cases.pdf>
- Climate Financial Risk Forum (CFRF). 2021c. *Climate Financial Risk Forum Guide 2021 – Climate change risk training*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-climate-risk-training.pdf>
- Climate Financial Risk Forum (CFRF). 2021d. *Climate Financial Risk Forum Guide 2021 – Scenario analysis*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-scenario-analysis.pdf>
- Climate Financial Risk Forum (CFRF). 2021e. *Climate Financial Risk Forum Guide 2021: Case studies on climate action*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-case-studies.pdf>
- Climate Financial Risk Forum (CFRF). 2021f. *Climate Financial Risk Forum Guide 2021 – Disclosures – Managing Legal Risk*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-disclosures-legal-risk.pdf>
- Climate Financial Risk Forum (CFRF). 2021g. *Climate Financial Risk Forum Guide 2021 – Innovation*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-innovation.pdf>
- Climate Financial Risk Forum (CFRF). 2021h. *Climate Financial Risk Forum Guide 2021 – Climate data and metrics*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-data-metrics.pdf>
- Climate Financial Risk Forum (CFRF). 2020. *Climate Financial Risk Forum Guide 2020 – Risk management chapter*. <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2020-risk-management-chapter.pdf>
- ClimateWatch. 2019. World Resources Institute. <https://www.climatewatchdata.org/>
- ClimateWise. 2022. Principles for Integrated Assessment of Physical and Transition Risk. <https://www.cisl.cam.ac.uk/resources/publications/climate-tango-principles-integrating-physical-and-transition-climate-risk>
- CRREM and UNEP-FI. 2022. Managing Transition Risk in Real Estate: Aligning to the Paris Agreement. <https://www.crrem.eu/wp-content/uploads/2022/04/Managing-transition-risk-in-real-estate.pdf>
- CRO Forum. 2020. *Carbon Footprinting Methodology for Underwriting Portfolios*. <https://www.thecroforum.org/wp-content/uploads/2020/05/CRO-Carbon-Foot-Printing-Methodology.pdf>
- Dembo, R. S. 2021. *Risk Thinking in an Uncertain World*.
- Energy & Climate Intelligence Unit (ECIU) and Oxford Net Zero. 2021. *Taking Stock: A Global Assessment of Net Zero Targets*. Black, R., K. Cullen, B. Fay, T. Hale, J. Lang, S. Mahmood, and S.M. Smith. file:///C:/Users/GA.GA-NEW12.001/Downloads/ECIU-Oxford_Taking_Stock.pdf
- Energy & Climate Intelligence Unit, Data-Driven EnviroLab, NewClimate Institute, Oxford Net Zero. 2021. Net Zero Tracker. <https://zerotracker.net/>
- European Commission 2019. *Guidelines on Non-financial Reporting: Supplement on reporting climate related information*. [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019XC0620\(01\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019XC0620(01)&from=EN)
- European Environment Agency (EEA) and European Commission. Climate-ADAPT. <https://climate-adapt.eea.europa.eu/>
- European Insurance and Occupational Pensions Authority (EIOPA). 2022. *Methodological Principles of Insurance Stress Testing – Climate change component*. https://www.eiopa.europa.eu/sites/default/files/financial_stability/insurance_stress_test/methodological_principles_of_insurance_stress_testing_-_climate_change_component.pdf
- Financial Stability Board (FSB). 2022. *Supervisory and Regulatory Approaches to Climate-related Risks – Interim report*. <https://www.fsb.org/wp-content/uploads/P290422.pdf>
- FSB. 2021. *The Availability of Data with Which to Monitor and Assess Climate-related Risks to Financial Stability*. <https://www.fsb.org/wp-content/uploads/P070721-3.pdf>
- Golnaraghi, M. 2022. Decarbonising our Economy. *The Actuary Magazine*. January. <https://theactuarymagazine.org/decarbonising-our-economy/>
- Grubler, A., C. Wilson, N. Bento et al. 2018. A Low Energy Demand Scenario for Meeting the 1.5°C Target and Sustainable Development Goals without Negative Emission Technologies. *Nat Energy* 3: 515–527. <https://doi.org/10.1038/s41560-018-0172-6>

- International Financial Reporting Standards (IFRS) – International Sustainability Standards Board (ISSB). 2022a. *S1 General Requirements for Disclosure of Sustainability-related Financial Information*. <https://www.ifrs.org/content/dam/ifrs/project/general-sustainability-related-disclosures/exposure-draft-ifrs-s1-general-requirements-for-disclosure-of-sustainability-related-financial-information.pdf>
- International Financial Reporting Standards (IFRS) – International Sustainability Standards Board (ISSB). 2022b. *S2 Climate-related Disclosures*. <https://www.ifrs.org/content/dam/ifrs/project/climate-related-disclosures/issb-exposure-draft-2022-2-climate-related-disclosures.pdf>
- International Energy Agency (IEA). 2021. *World Energy Model*. <https://www.iea.org/reports/world-energy-model>
- 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*. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf
- IPCC. 2022a. *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_FinalDraft_FullReport.pdf
- IPCC. 2022b. *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf
- IPCC. 2022c. *Annex III: Scenarios and modelling methods*. (Annex of IPCC 2022b). https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_Annex-III.pdf
- IPCC. 2021. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf
- Japan Financial Services Agency (JFSA). 2021. *The JFSA's Strategy on Sustainable Finance (July 2021 – June 2022)*. <https://www.fsa.go.jp/en/news/2021/20211104/01.pdf>
- Japan Financial Services Agency (JFSA). 2022. *Fundamental Approaches to Responses to Climate Change in Financial Institutions*. <https://www.fsa.go.jp/news/r3/ginkou/20220425/01.pdf>
- Longden, T. 2019. The Impact of Temperature on Mortality across Different Climate Zones. *Climatic Change* 157(2): 221–242.
- Meinshausen et al. 2020. The Shared Socio-economic Pathway (SSP) Greenhouse Gas Concentrations and their Extensions to 2500. *Geosci. Model Dev.* 13(8): 3571–3605. <https://gmd.copernicus.org/articles/13/3571/2020/>
- Network for Greening the Financial System (NGFS). 2021a. *NGFS Climate Scenarios for Central banks and Supervisors*. https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_phase2_june2021.pdf
- Network for Greening the Financial System (NGFS). 2021b. *NGFS Climate Scenarios Database – Technical Documentation V2.2*. https://www.ngfs.net/sites/default/files/ngfs_climate_scenarios_technical_documentation_phase2_june2021.pdf
- Network for Greening the Financial System (NGFS). 2021c. *A Progress Report on Global Supervisory and Central Bank Climate Scenario Exercises*. <https://www.ngfs.net/sites/default/files/medias/documents/scenarios-in-action-a-progress-report-on-global-supervisory-and-central-bank-climate-scenario-exercises.pdf#%5B%7B%22num%22%3A90%2C%22>
- Network for Greening the Financial System (NGFS). 2020. *NGFS Climate Scenarios – For central banks and supervisors*. https://www.ngfs.net/sites/default/files/medias/documents/820184_ngfs_scenarios_final_version_v6.pdf
- New Climate Institute and Carbon Market Watch. 2022. *Corporate Climate Responsibility Monitor 2022 – Assessing the transparency and integrity of companies' emission reduction and net-zero targets*. <https://newclimate.org/wp-content/uploads/2022/02/CorporateClimateResponsibilityMonitor2022.pdf>
- New York Department of Financial Services. 2021. *Guidance for New York Domestic Insurers on Managing the Financial Risks from Climate Change*. https://www.dfs.ny.gov/system/files/documents/2021/11/dfs-insurance-climate-guidance-2021_1.pdf
- O'Neill, B.C., E.K. Ebi et al. 2017. The Roads Ahead: Narratives for shared socio-economic pathways describing world futures in the 21st century. *Global Environmental Change* 42: 169–180. <https://doi.org/10.1016/j.gloenvcha.2015.01.004>.
- O'Neill, B.C., T.R. Carter, K. Ebi et al. 2020. Achievements and Needs for the Climate Change Scenario Framework. *Nature Climate Change*. 10: 1074–1084. <https://doi.org/10.1038/s41558-020-00952-0>

- Partnership for Carbon Accounting Financials (PCAF). 2022a. *GHG Emissions Associated to Insurance and Reinsurance Underwriting Portfolios – Scoping document March 2022*. <https://carbonaccountingfinancials.com/files/2022-03/pcaf-scoping-doc-insurance-associated-emissions.pdf>
- Partnership for Carbon Accounting Financials (PCAF). 2022b. *Global GHG Accounting and Reporting Standard for the Insurance Industry*. <https://carbonaccountingfinancials.com/files/2022-07/2207-insurancstandard-03.pdf?899cf30b3c>
- Responsible Investor. 2022a. *ISSB Forms Working Group with US, EU and China on Harmonising Standards*. <https://www.responsible-investor.com/issb-forms-working-group-with-us-eu-and-china-on-harmonising-standards/>
- Responsible Investor. 2022b. *Banks Called Out for Mismatch on Climate Pledges*. https://www.responsible-investor.com/banks-called-out-for-mismatch-on-climate-pledges/?utm_source=newsletter-weekly&utm_medium=email&utm_campaign=ri-weekly-subscriber&utm_content=11-04-2022
- Responsible Investor. 2022c. *FCA Adds Greenwashing to Sustainability KPI*. https://www.responsible-investor.com/fca-adds-greenwashing-to-sustainability-kpis/?utm_source=newsletter-weekly&utm_medium=email&utm_campaign=ri-weekly-subscriber&utm_content=11-04-2022
- Responsible Investor. 2022d. *SEC Commissioners Vote for ESG Disclosure Rules to Counter Greenwashing*. https://www.responsible-investor.com/sec-commissioners-vote-for-esg-disclosure-rules-to-counter-greenwashing/?utm_source=newsletter-weekly&utm_medium=email&utm_campaign=ri-weekly-subscriber&utm_content=06-06-2022
- Riahi, Keywan, D.P. van Vuuren, E. Kriegler et al. 2016. The Shared Socioeconomic Pathways and Their Energy, Land Use, and Greenhouse Gas Emissions Implications: An overview. *Global Environmental Change*. 42: 153–168. 10.1016/j.gloenvcha.2016.05.009. <https://www.sciencedirect.com/science/article/pii/S0959378016300681>
- Rogelj et al. 2018. Scenarios Towards Limiting Global Mean Temperature Increase Below 1.5°C. *Nature Climate Change* 8: 325–332. <https://doi.org/10.1038/s41558-018-0091-3>
- Securities and Exchange Commission (SEC). 2022. *The Enhancement and Standardization of Climate-Related Disclosures for Investors – Proposed Rule No. 33-1042*. <https://www.sec.gov/rules/proposed/2022/33-11042.pdf>
- SCOR. 2022. *The Relevance of Climate Change for Life Insurance. Part 1 – The risk manager’s view*. <https://www.scor.com/en/download/>
- Standard & Poor’s Global Ratings. 2021. *Global Reinsurers Grapple with Climate Change Risks*. <https://www.spglobal.com/ratings/en/research/articles/210923-global-reinsurers-grapple-with-climate-change-risks-12116706>
- Task Force on Climate-related Financial Disclosures (TCFD). 2017. *Recommendations of the Task Force on Climate-related Financial Disclosures*. <https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf>
- Task Force on Climate-related Financial Disclosures (TCFD). 2021. *Guidance on Metrics, Targets, and Transition Plans*. https://assets.bbhub.io/company/sites/60/2021/07/2021-Metrics_Targets_Guidance-1.pdf
- Task Force on Climate-related Financial Disclosures (TCFD). 2021. *Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures*. https://assets.bbhub.io/company/sites/60/2021/07/2021-TCFD-Implementing_Guidance.pdf
- Task Force on Climate-related Financial Disclosures (TCFD). 2021. *2021 Status Report*. https://assets.bbhub.io/company/sites/60/2022/03/GPP_TCFD_Status_Report_2021_Book_v17.pdf
- The Geneva Association. 2018. *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. 2021a. *Climate Change Risk Assessment for the Insurance Industry – A holistic framing of decisions and other key considerations for both sides of the balance sheet*. Authors: Maryam Golnaraghi and the GA task force on climate change risk assessment. February. https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/climate_risk_web_final_250221.pdf
- The Geneva Association. 2021b. *Insurance Industry Perspectives on Regulatory Approaches to Climate Change Risk Assessment*. Authors: Maryam Golnaraghi and the GA task force on climate change risk assessment. June. https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/climate_regulation_web2.pdf

The Geneva Association. 2021c. *Climate Change Litigation – Insights into the evolving global landscape*. Authors: Maryam Golnaraghi, J. Setzer, N. Brook., W. Lawrence, and L. Williams. April. https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/climate_litigation_04-07-2021.pdf

The Geneva Association. 2021d. *A Classification of Climate Litigation Sources Against Companies and Governments and Implications for Insurers* (internal report). Authors: Maryam Golnaraghi, N. Brook., W. Lawrence, L. Williams, J. Setzer. September.

The Geneva Association. 2021e. What Do the Outcomes of COP26 Mean for Insurers? Author: Maryam Golnaraghi. December. <https://www.genevaassociation.org/news/articles-interest/COP26-insurers>

The Lancet Countdown on Climate Change and Health. <https://www.thelancet.com/countdown-health-climate>

United Nations Environment Programme – Principles for Sustainable Insurance Initiative (UNEP-PSI). 2021. *Insuring the climate transition – The final report on the project of UN Environment Programme’s Principles for Sustainable Insurance Initiative to pilot the TCFD recommendations*. <https://www.unepfi.org/psi/wp-content/uploads/2021/01/PSI-TCFD-final-report.pdf>

United Nations Environment Programme – Principles for Sustainable Insurance Initiative (UNEP-PSI). 2022a. *Managing Environment, Social and Governance Risks in the Life and Health Insurance Business*. https://www.unepfi.org/psi/wp-content/uploads/2022/04/LH-Guide_-Public-Consultation.pdf

United Nations Environment Programme – Financial Initiative (UNEP-FI). 2022b. *The Climate Change Risk Tool Landscape – 2022 Supplement*. <https://www.unepfi.org/wordpress/wp-content/uploads/2022/03/The-Climate-Risk-Tool-Landscape-2022-supplement.pdf>

United Nations-Convened Net Zero Asset Owner Alliance (NZAOA). 2021. *Target Setting Protocol – 2nd edition*. <https://www.unepfi.org/wordpress/wp-content/uploads/2022/01/NZAOA-Target-Setting-Protocol-Second-Edition.pdf>

University of Cambridge Institute for Sustainability Leadership (CIS) ClimateWise. 2022b. *Climate Tango: Principles for Integrating Physical and Transition Climate-risk Assessment with Sectoral Examples*. https://www.cisl.cam.ac.uk/sites/www.cisl.cam.ac.uk/files/climate_tango_jan2022.pdf

van Vuuren, D.P., E.J. Edmonds, M. Kainuma et al. 2011. The Representative Concentration Pathways: An overview. *Climatic Change* 109: 5. <https://doi.org/10.1007/s10584-011-0148-z>

World Meteorological Organisation (WMO). 2022. *Global Annual to Decadal Climate Update*. https://hadleyserver.metoffice.gov.uk/wmolc/WMO_GADCU_2022-2026.pdf

Yahoo Finance. 2022. California Insurance Commissioner on Climate Standard: 'Transparency is critical'. <https://finance.yahoo.com/video/california-insurance-commissioner-climate-standards-160934028.html?guccounter=1>

Appendix: About benchmark climate change scenarios

A brief comparison of some of the existing benchmark scenarios provided by the International Panel on Climate Change (IPCC), International Energy Agency (IEA) and the Network for Greening of Financial System (NGFS) are offered in the table. Each scenario set is developed based on certain assumptions and built for a specific purpose.

	IPCC (Illustrative Pathways (IPs)) ⁶⁵ (Established 2022, used for AR6 Working Group 3 Report)	IPCC (SSPs) ⁶⁶ (Established 2016–2017, used for SR15 2018 and AR6 2021 reports)	IPCC (P1, P2, P3, P4) ⁶⁷ (Established 2018, used for SR15 2018 report)
Purpose	<ul style="list-style-type: none"> • Pathways representing either current climate policy outcomes or further deep mitigation strategies outcomes • explore a wider variety of possible emissions futures compared to previous IPCC scenarios 	<ul style="list-style-type: none"> • Explore alternative socio-economic development patterns • Provide a common framework of socio-economic pathways for scenario analysis. 	<ul style="list-style-type: none"> • Explore 1.5°C compatible mitigation pathways • Focus on emissions reductions and Carbon Dioxide Removal (CDR), either technology- or nature-based
Target audiences	Research, governments, general audience	Research, governments, general audience	Research, governments, general audience
Methodology	<ul style="list-style-type: none"> • Scenarios selected from the AR6 database⁶⁸ • Scenarios show different societal and climate policy choices for development of future GHG emissions • Selection depended on: climate policy ambition, mitigation strategies, timing of implementation 	<ul style="list-style-type: none"> • Societal choices translated into scenarios with IAMs • Initially no mitigation targets are asked, SSPs are exploratory 	<ul style="list-style-type: none"> • Uses a combination of SSPs and RCPs, all compatible with 1.5°C • SSPs provide socio-economic assumptions, RCPs the mitigation targets
	<ul style="list-style-type: none"> • IAMs used do not account for physical impacts of climate change as a feedback loop on macroeconomic variables. • IAMs use an artificial GHG price to induce reduction in emissions. • IPCC rather inputs the pathways into climate models at a later stage to study climate impacts. 		
Addressing physical and transition climate change risks	<ul style="list-style-type: none"> • Represent transition pathways given policy assumptions • Are not used for physical risk assessment 	<ul style="list-style-type: none"> • SSPs convey different levels of physical and transition risks – But rather explore socio-economic challenges to mitigation and adaptation 	<ul style="list-style-type: none"> • No physical risks described • Convey different transitions risks towards 1.5°C
Usability	<ul style="list-style-type: none"> • Used to understand the implications of climate policies • Used to explore a wider variety of possible emissions futures than other IPCC scenarios • Not used as input into complex climate models 	<ul style="list-style-type: none"> • As input for climate models or other IAMs. • Associated with RCPs to create mitigation pathways 	<ul style="list-style-type: none"> • Informative and illustrative scenarios • Used to explore implications of 1.5°C compatible world • Has been used for inside-out alignment for target setting of companies

65 IPCC 2022b.

66 Riahi et al. 2016; Chen et al. 2021; IPCC AR6 2021; O'Neill, B.C. et al. 2017; O'Neill, B.C. et al. 2020.

67 IPCC 2018; Grubler et al. 2018; J. Rogelj et al. 2018; Schweizer et al. 2020.

68 Byers et al. 2022.

IPCC (RCPs)⁶⁹ (Established 2010–2011, used first for AR5 2014 report and then later reports)	IEA (WEO-WEM)⁷⁰	NGFS⁷¹
<ul style="list-style-type: none"> Establish emission scenarios compatible with different targets of climate forcing (i.e. emission targets) 	<ul style="list-style-type: none"> Explore energy sector pathways (technology use, development and cost) Focus either on current policies trajectory, or necessary changes to meet < 2°C targets 	<ul style="list-style-type: none"> Explore different transition pathways (orderly, disorderly) and current policies trajectory (hot house world) study of physical risks impact on economy ex-post with damage functions
<p>Research, governments, general audience</p>	<p>Research, government, private sector</p>	<p>Financial institutions, financial regulators and central banks</p>
<ul style="list-style-type: none"> IAMs find the cost-efficient pathways to meet chosen warming targets No common socio-economic assumptions. This is provided by associating RCPs to SSPs 	<ul style="list-style-type: none"> Energy sector supply & demand models Either normative: try to meet warming targets, or exploratory: looking at current policies impact 	<ul style="list-style-type: none"> IAMs explore different climate policy evolutions Damage function to study impact of physical risks on economic variables All based on SSP2 'middle-of-the-road' socio-economic assumptions
	<ul style="list-style-type: none"> Do not include physical impacts of climate change as a feedback loop 	<ul style="list-style-type: none"> NGFS models initially don't capture physical impacts of climate change Use artificial GHG prices to induce reduction in emissions
<ul style="list-style-type: none"> RCPs convey different levels of physical and transition risks But do not directly address these risks 	<ul style="list-style-type: none"> IEA scenarios only consider transition pathways in energy sectors Physical risks are not considered 	<ul style="list-style-type: none"> NGFS scenarios are explicitly made to represent different levels of transition and physical risks
<ul style="list-style-type: none"> As inputs for climate models, to study climate impacts, mitigation and adaptation measures Associated to SSPs to provide mitigation targets 	<ul style="list-style-type: none"> For energy-specific sector analysis 	<ul style="list-style-type: none"> Expandable and usable by industry (regulators and companies) Provide a range of transition and physical risks pathways for climate change risk assessment

69 Van Vuuren et al. 2011; IPCC 2014.

70 IEA 2021.

71 INGFS 2021a-c.

... continue Appendix

	IPCC (Illustrative Pathways (IPs)) ⁶⁵ (Established 2022, used for AR6 Working Group 3 Report)	IPCC (SSPs) ⁶⁶ (Established 2016–2017, used for SR15 2018 and AR6 2021 reports)	IPCC (P1, P2, P3, P4) ⁶⁷ (Established 2018, used for SR15 2018 report)
Spatial granularity	Depends on model used for the selected pathway	IAMs initially output results for 5 world regions, which can be downscaled	Same as SSPs
Sectoral granularity	Depends on model used for the selected pathway	High granularity of economic sectors, with more granularity for the energy sector	Same as SSPs
Time horizon	2100	2100	2100
Relevance to the insurance industry?	<ul style="list-style-type: none"> Comprehensive review of extensive scenario literature (including e.g. NGFS work) The pathways are representative of thousands of climate scenarios Compared to other IPCC scenarios, there is a focus on climate policy outcomes 	<ul style="list-style-type: none"> Combined with RCPs for climate change risk assessment Provide a set of consistent socio-economic assumptions 	<ul style="list-style-type: none"> P scenarios are considered best science on pathways compatible with 1.5°C Used to establish targets for net-zero portfolio alignment Used to understand the trade-off between short-term emissions reductions and long-term deployment of CDR

Source: The Geneva Association

IPCC (RCPs)⁶⁹ (Established 2010–2011, used first for AR5 2014 report and then later reports)	IEA (WEO-WEM)⁷⁰	NGFS⁷¹
5 world regions for sectors of the economy. Very high GHG emissions resolution worldwide	26 regions, some indiv. countries	11–32 regions depending on the IAM chosen. Results have been downscaled to 100 countries
12 sectors of energy, land-use, consumption	High granularity in energy-related sectors: industry has 6 sub-sectors, Buildings demand is separated into six end-uses, and transport into 9 modes	Three to eight sectors of buildings, industry, transport
2100, extended to even 2300	2050	2100
<ul style="list-style-type: none"> • Provide mitigation targets for use with SSPs • RCPs on their own can readily be used for physical risk assessment but lack proper socio-economic foundations 	<ul style="list-style-type: none"> • Possess higher-level details on the transition pathways of energy-related sectors than the other sets of scenarios. (technology development) • Cannot readily be used for physical risk assessment 	<ul style="list-style-type: none"> • Typically used in the exercises proposed by regulators • NGFS scenarios can be used to study physical and transition risks • Provide some impact data on macroeconomic variables

This third and final Geneva Association report on climate change risk assessment presents comprehensive yet practical guidance to help re/insurers implement more holistic assessment and forward-looking scenario analysis in their business models. The report reflects input from key regulatory and standard-setting bodies across jurisdictions and includes three examples of business use cases.

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