

ORSA

OPINION

on the supervision of the use of climate change
risk scenarios in ORSA

EIOPA-BoS-21-127
19 April 2021



eiopa

European Insurance and
Occupational Pensions Authority

1. Legal basis

- 1.1. The European Insurance and Occupational Pensions Authority (EIOPA) provides this Opinion on the basis of Article 29(1)(a) of Regulation (EU) No 1094/2010¹. This article mandates EIOPA to play an active role in building a common Union supervisory culture and consistent supervisory practices, as well as in ensuring uniform procedures and consistent approaches throughout the Union by providing opinions to competent authorities.
- 1.2. EIOPA delivers this Opinion on the basis of Directive 2009/138/EC (Solvency II Directive)², in particular in relation to Articles 41, 44, and 45 thereof, Commission Delegated Regulation (EU) 2015/35 (Delegated Regulation)³, in particular in relation to Articles 262 and 306 thereof, and EIOPA's Guidelines on own risk and solvency assessment.⁴
- 1.3. This Opinion is addressed to the competent authorities (CAs), as defined in point (i) of Article 4(2) of Regulation (EU) No 1094/2010.
- 1.4. The Board of Supervisors has adopted this Opinion in accordance with Article 2(7) of its Rules of Procedure⁵.

2. Context and objective

- 2.1. Climate change constitutes a serious risk for society, including insurance and reinsurance undertakings (collectively "undertakings"). The detrimental impact of global warming on natural and human systems is already visible today and without further international climate action, the global average temperature and

¹ Regulation (EU) No 1094/2010 of the European Parliament and of the Council of 24 November 2010 establishing a European Supervisory Authority (European Insurance and Occupational Pensions Authority), amending Decision No 716/2009/EC and repealing Commission Decision 2009/79/EC, OJ L 331, 15.12.2010, p. 48.

² Directive 2009/138/EC of 25 November 2009 of the European Parliament and of the Council on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II) (OJ L 335, 17.12.2009, p.1).

³ Commission Delegated Regulation (EU) 2015/35 of 10 October 2014 supplementing Directive 2009/138/EC of the European Parliament and of the Council on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II) (OJ L 12, 17 January 2015, p.1).

⁴ EIOPA's Guidelines on own risk and solvency assessment (EIOPA-BoS-14/259).

⁵ https://www.eiopa.europa.eu/sites/default/files/publications/administrative/bos-rules_of_procedure.pdf

associated physical risks will continue to increase⁶, raising underwriting risk of undertakings, impacting asset values and challenging their business strategies. The Paris Agreement on climate change requires its signatories to reduce greenhouse gas emissions with the objective to hold the global temperature increase to well below 2°C and to pursue efforts to limit it to 1.5°C compared to pre-industrial levels.⁷ Keeping the global temperature increase below 2°C would require annual reductions in carbon emissions greater than occurred in any single year in the last 100 years, including during the deepest recessions, and 70-80% of proven fossil fuel reserves to be stranded.⁸ Hence, the transition towards a zero-carbon economy, especially when unanticipated, may seriously depress investments in carbon-intensive sectors. The transition may also induce higher legal claims on companies that fail to take into account the impact on climate change, which may affect undertakings directly or indirectly through their underwriting of legal liability risks.⁹

- 2.2. The Solvency II Directive requires undertakings to consider in their system of governance, risk-management system and own risk and solvency assessment (ORSA) all risks they face in the short and long term and to which they are or could be exposed, also when these risks are not (fully) included in the calculation of the Solvency Capital Requirement (SCR). The European Commission has published a draft delegated regulation amending the Delegated Regulation, specifying that undertakings should integrate sustainability risks in their risk management and ORSA.¹⁰
- 2.3. EIOPA's Guidelines on own risk and solvency assessment state that the undertaking should ensure that its assessment of the overall solvency needs is forward-looking, including a medium term or long-term perspective as appropriate, recognising that it represents the undertaking's own assessment of its risk profile and the capital and other means needed to address these risks, given the nature, scale and complexity of the risks inherent in its business.
- 2.4. The Task Force on Climate-related Financial Disclosures (TCFD), established by the G20's Financial Stability Board, issued recommendations to encourage

⁶ IPCC: Global warming of 1.5°C, which is a 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, October 2018, <https://www.ipcc.ch/sr15/>

⁷ The EU has committed itself to climate neutrality by 2050 consistent with a maximum temperature increase of 1.5°C. The European Climate Law proposed by the Commission sets a legally binding target of net zero greenhouse gas emissions by 2050. See European Commission: Committing to climate-neutrality by 2050: Commission proposes European Climate Law and consults on the European Climate Pact, Press release of 4 March 2020, https://ec.europa.eu/commission/presscorner/detail/en/ip_20_335

⁸ The heat is on – Insurability and Resilience in a Changing Climate, Emerging Risk Initiative, Position Paper, January 2019: <https://www.thecroforum.org/wp-content/uploads/2019/01/CROF-ERI-2019-The-heat-is-on-Position-paper-1.pdf>

⁹ EIOPA's Opinion on Sustainability within Solvency II (EIOPA-BoS-19/241), 30 September 2019, https://www.eiopa.europa.eu/sites/default/files/publications/opinions/2019-09-30_opinionsustainabilitywithinsolvencyii.pdf

¹⁰ Draft Commission Delegated Regulation (EU) amending Delegated Regulation (EU) 2015/35 as regards the integration of sustainability risks in the governance of insurance and reinsurance undertakings, Ref. Ares(2020)2955224, 8 June 2020, [https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1591684709161&uri=PI_COM:Ares\(2020\)2955224](https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1591684709161&uri=PI_COM:Ares(2020)2955224)

companies to disclose climate-related information.¹¹ The European Commission's Guidelines on non-financial reporting on climate-related information (Commission Guidelines) integrate the TCFD's recommendations, providing guidance for disclosures in the five reporting areas distinguished in the Non-Financial Reporting Directive (NFRD).¹² ¹³This includes a description of the resilience of the company's business model and strategy, taking into consideration different climate-related scenarios over different time horizons, including at least a 2°C or lower scenario and a greater than 2°C scenario.¹⁴ The requirements of the NFRD apply to large listed companies, banks and insurance companies with more than 500 employees.

- 2.5. On 30 September 2019, EIOPA published its Opinion on Sustainability within Solvency II in response to a request from the European Commission, providing advice on the integration of sustainability, in particular climate-related developments, into the Solvency II framework.¹⁵ EIOPA recommended that undertakings consider climate risks beyond the one-year time horizon, which cannot be fully captured in the Solvency II capital requirements, through the system of governance, risk-management system and their ORSA. This Opinion considered that further work would be needed to define a consistent set of quantitative parameters that could be used in climate change-related scenarios that undertakings can then adopt as appropriate in their ORSA, risk management and governance practices, also recognising that other parameters will depend on the specificities of each undertaking.
- 2.6. EIOPA conducted an information request among the CAs in the EEA on the use of climate change scenarios by undertakings in the ORSA (see Annex 1). The results show that a small minority of ORSAs included in the sample assessed climate change risk using scenario analysis.¹⁶ Moreover, where undertakings performed a quantitative analysis of climate change risk, most assessments took a short-term perspective.¹⁷
- 2.7. Given that the (re)insurance industry will be impacted by climate change-related physical and transition risks, EIOPA considers it essential to foster a forward-

¹¹ Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures, 15 June 2017, <https://www.fsb-tcfd.org/publications/final-recommendations-report/>

¹² European Commission's Guidelines on non-financial reporting – Supplement on reporting climate-related information, Communication from the Commission, OJ C 209, 20.06.2019, p. 1.

¹³ Directive 2014/34/EU of 22 October 2014 of the European Parliament and of the Council amending Directive 2013/34/EU as regards disclosure on non-financial and diversity information by certain large undertakings and groups (OJ L 330, 15.11.2014, p.1).

¹⁴ Companies are encouraged to consider a 1.5°C scenario, in light of the IPCC's Special Report, referred to in footnote 6.

¹⁵ EIOPA's Opinion on Sustainability within Solvency II (EIOPA-BoS-19/241), 30 September 2019, https://www.eiopa.europa.eu/sites/default/files/publications/opinions/2019-09-30_opinionsustainabilitywithinsolvencyii.pdf

¹⁶ Less than 13% of ORSAs made reference to climate change risk scenarios, which constitutes an upper limit. In many countries this also includes ORSAs where climate change risk was assessed or mentioned, but where undertakings did not explicitly conduct an analysis using climate change risk scenarios.

¹⁷ Next to these findings in the ORSAs, a survey conducted by the Sustainable Insurance Forum (SIF) found that only around 15-20% of undertakings have made plans to, or are already taking steps to, implement the TCFD Recommendations and to deliver TCFD-aligned disclosures, even though 72% of undertakings expect that climate change will impact their business. See IAIS/SIF, Issues Paper on the Implementation of the Recommendations of the Task Force on Climate-related Financial Disclosures, February 2020, <https://www.sustainableinsuranceforum.org/iais-sif-issue-spaper-2020>

looking management of these risks, also in the long term. This Opinion sets out EIOPA's expectations to CAs on the supervision of the integration of climate change risk scenarios by undertakings in their ORSA. CAs should implement the expectations applying the risk-based and proportionate approach envisaged by the Opinion.

- 2.8. The analysis of climate change risk is a relatively new field, in particular in relation to the financial sector, including insurance. The insurance industry, but also supervisory authorities, started only recently (or still have to start) exploring the effects of climate change. Considerable progress has been made in enhancing understanding and developing approaches to measure exposures to climate change risk, but challenges remain. This Opinion recognises that the approaches to scenario analysis of climate change risk need to evolve over time, as new methodologies become available and undertakings gain experience.
- 2.9. Regulation in the EU in the area of sustainable finance is also still evolving. The European Commission announced in its communication on the European Green Deal that its Renewed Sustainable Finance Strategy will focus on a number of actions, including a better integration of climate and environmental risks into the EU prudential framework of financial institutions as well as a review of the NFRD.¹⁸ Moreover, the European Commission is reviewing the Solvency II Directive, including the potential use of ORSA in macro-prudential supervision¹⁹, which would also likely be relevant for climate change risk.
- 2.10. Depending on the regulatory developments and the methodological advancements of climate change risk (scenario) analysis, EIOPA may further develop the supervisory expectations put forward in this Opinion. The direction of travel should be an outcome with a degree of standardisation, balancing that ORSA reflects own risk and the need for some level of consistency.
- 2.11. Annex 2 contains an analysis of the costs and benefits relating to this Opinion.

3. Supervision of the use of climate change risk scenarios in ORSA

Integration of climate change risk in ORSA in the short and long term

- 3.1. CAs should require undertakings to integrate climate change risks in their system of governance, risk-management system and ORSA, similar to all risks undertakings are or could be exposed to, in line with Articles 44(2) and 45(2) of the Solvency II Directive and Article 262(1)(a) of the Delegated Regulation as well as Guidelines 7 and 8 of EIOPA's Guidelines on own risk and solvency assessment and EIOPA's Opinion on Sustainability within Solvency II. In the ORSA, undertakings should do an assessment to identify material climate change risk exposures and subject the material exposures to a risk assessment.

¹⁸ European Commission, The European Green Deal, Communication from the Commission, COM(2019) 640 final, 11 December 2019, Brussels, https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf

¹⁹ See section 11.4 of EIOPA's Opinion on the 2020 review of Solvency II (EIOPA-BoS-20/749), 17 December 2020, https://www.eiopa.europa.eu/sites/default/files/solvency_ii/eiopa-bos-20-749-opinion-2020-review-solvency-ii.pdf

- 3.2. CAs should expect undertakings to assess climate change risk in the short term. There is strong evidence that already now climate change is affecting the frequency, severity and distribution of extreme weather events and natural disasters.^{20,21} Not only physical risk, but also transition risk can arise in the short term. For example, when governments decide to introduce a carbon tax or when a sudden technological breakthrough occurs, which substantially reduce dependency on fossil energy. Financial markets may also reassess their expectations of a future transition to a low-carbon economy, resulting in price falls of carbon-intensive assets in the present.²²
- 3.3. CAs should also expect undertakings to assess the long-term risks of climate change using scenario analysis to inform the strategic planning and business strategy²³. The time horizon could be longer than the time horizons currently considered by undertakings in their ORSA, e.g. an order of magnitude of decades may be appropriate. In contrast to the usual expectation of short-term, mid-term and long-term time horizons in the ORSA, time horizons from a climate change perspective tend to be considerably longer, e.g.²⁴:
- Current climate change: “up to today” records of the impact of climate change;
 - Short-term climate change: projected view of climate change for the next 5-10 years;
 - Mid-term climate change: projected view of climate change for the next 30 years (by mid-century);
 - Long-term climate change: projected view of climate change for the next 80 years (by end of century).
- 3.4. The increasing manifestation of climate change risks in the coming years and decades may provide undertakings with strategic opportunities, but also challenge current business models, jeopardising the long-term risk profile and solvency. A higher incidence of extreme weather events and natural disasters may raise demand for insurance coverage. However, the increased cost of insurance coverage, or alternatively more restrictive terms and conditions, may constrain insurance business. Only 35% of the total losses caused by extreme weather events is currently insured across Europe.²⁵ Higher physical risk profiles due to climate change may put insurability under further pressure, jeopardising

²⁰ Climate change, impacts and vulnerability in Europe 2016 - An indicator-based report, EEA Report No 1/2017, January 2017, https://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016/at_download/file

²¹ EEA climate state and impact (CLIM) indicators, 2020, https://www.eea.europa.eu/data-and-maps/indicators#c0=30&c12-operator=or&b_start=0&c10=CLIM

²² An energy transition stress test for the financial system of the Netherlands, DNB Occasional Studies Volume 16-7, October 2018, https://www.dnb.nl/binaries/OS_Transition%20risk%20stress%20test%20versie_web_tcm46-379397.pdf

²³ Article 45(4) of the Solvency II Directive.

²⁴ Definition of climate change used in EIOPA's Discussion paper on Methodology on potential inclusion of climate change in the Nat Cat standard formula (EIOPA-BoS-20/666), 2 November 2020, <https://www.eiopa.europa.eu/sites/default/files/publications/consultations/discussion-paper-methodology-on-potential-inclusion-of-climate-change-in-nat-cat-standard-formula.pdf>

²⁵ EIOPA's Staff Discussion Paper on Protection gap for natural catastrophes (EIOPA-19/485), September 2019, https://www.eiopa.europa.eu/sites/default/files/publications/advice/eiopa-19-485_eiopa_staff_discussion_paper_protection_gap.pdf

undertakings' business continuity and risk management by limiting the availability of reinsurance. As such, undertakings are confronted with the strategic challenge and opportunity to enhance affordability and insurability, also to contribute to climate change adaptation and mitigation.

- 3.5. The materialisation of transition risk has the potential of disrupting the sectoral composition of the economy, e.g. from carbon-intensive to green sectors. This may put carbon-oriented investment strategies under pressure with assets becoming stranded. Moreover, such a shift will jeopardise the viability of business models relying on customers in carbon-intensive sectors, but also create opportunities for the development and design of new insurance products targeted at emerging economic sectors.²⁶

Definition of climate change risk

- 3.6. CAs should expect undertakings to take a broad view of climate change risk, including all risks stemming from trends or events caused by climate change. Climate change risk can broadly be categorised into two drivers of risk: transition risks and physical risks (see Table below).

Transition risks are risks that arise from the transition to a low-carbon and climate-resilient economy. They include: • Policy risks, for example as a result of energy efficiency requirements, carbon-pricing mechanisms which increase the price of fossil fuels, or policies to encourage sustainable land use. • Legal risks, for example the risk of litigation for failing to avoid or minimise adverse impacts on the climate, or failing to adapt to climate change. • Technology risks, for example if a technology with a less damaging impact on the climate replaces a technology that is more damaging to the climate. • Market sentiment risks, for example if the choices of consumers and business customers shift towards products and services that are less damaging to the climate. • Reputational risks, for example the difficulty of attracting and retaining customers, employees, business partners and investors if a company has a reputation for damaging the climate.
Physical risks are risks that arise from the physical effects of climate change. They include: • Acute physical risks, which arise from particular events, especially weather-related events such as storms, floods, fires or heatwaves that may damage production facilities and disrupt value chains. • Chronic physical risks, which arise from longer-term changes in the climate, such as temperature changes, rising sea levels, reduced water availability, biodiversity loss and changes in land and soil productivity. Source: European Commission's Guidelines on non-financial reporting – Supplement on reporting climate-related information, Communication from the Commission, OJ C 209, 20.06.2019, p. 1. Note: The wording of the transition risk driver "Market risks" in the Commission's guidelines is changed here into "Market sentiment risks" to avoid confusion with the term market risk in Solvency II.

²⁶ IAIS/SIF's Issues Paper on Climate Change Risks to the Insurance Sector, July 2018, <https://www.iaisweb.org/file/73565/sif-iais-issues-paper-on-climate-risk-to-the-insurance-sector-clean>

- 3.7. The above drivers of climate change risk can be translated into traditional prudential risk categories: underwriting risk, market risk, credit and counterparty risk, operational risk, reputational risk and strategic risk. Such a mapping with examples of transition and physical risks is included in Annex 3 for non-life insurance and in Annex 4 for life insurance, including health insurance.²⁷ The examples should not be interpreted as an exhaustive list of transition and physical risks but rather as illustrations to enhance understanding of the broad range of potential risks posed by climate change.

Materiality assessment of climate change risks

- 3.8. CAs should expect undertakings to identify material climate change risks for their business.
- 3.9. Risks are considered to be material in the context of Solvency II where ignoring the risk could influence the decision-making or the judgement of the users of the information, which in case of the ORSA would be the undertaking's administrative, management or supervisory body and its relevant staff.
- 3.10. CAs should expect undertakings to identify the materiality of exposures to climate change risks through a combination of qualitative and quantitative analyses.
- 3.11. A qualitative analysis could provide insight in the relevance of the main drivers of climate change risk in terms of traditional prudential risks, i.e. market risk, counterparty risk, underwriting risk, operational risk, reputational risk and strategic risk.²⁸ The mapping matrices included in Annex 3 and 4 could be of assistance in obtaining a holistic view of the relevant types of climate change risks.
- 3.12. A quantitative analysis could be used to assess the exposure of assets and underwriting portfolios to transition risk (for example, based on their carbon footprint) and physical risks (for example, based on their geographical location)^{29,30}.
- 3.13. In practice, the assessment of material exposures of assets and underwriting activities to physical risks necessitates an examination of the future impact of climate change on the incidence of those physical risks. For example, certain geographical locations may not be subject to flood risk now, but may be so in the future due to sea level rise. Undertakings should not prematurely conclude that physical risks are not a material issue because underwriting activities are (currently) covered by (re)insurance arrangements.
- 3.14. CAs should expect undertakings, which conclude that climate change is not a

²⁷ The mapping and illustrative examples greatly benefitted from IAIS/SIF's Issues Paper on Climate Change Risks to the Insurance Sector, July 2018, <https://www.iaisweb.org/file/73565/sif-iais-issues-paper-on-climate-risk-to-the-insurance-sector-clean> and BIS's Turning up the heat – climate change assessment in the insurance sector, FSI Insights, No 20, 6 November 2019, <https://www.bis.org/fsi/publ/insights20.pdf>

²⁸ The Commission's Guidelines recommend undertakings to disclose the characterisation of their climate-related risks in the context of traditional industry risk categories such as credit risk, market risk and operational risk.

²⁹ The Commission's Guidelines recommend undertakings to disclose the exposure of financial assets, non-financial assets and assets under management to principal climate-related risks and provide with a breakdown of those risks in physical and transition risks.

³⁰ The Commission's Guidelines recommend undertakings to disclose the amount of carbon-related underwriting exposures in terms of insurance revenues.

material risk, to provide an explanation as to how that conclusion has been reached.

Range of climate change risk scenarios

- 3.15. CAs should expect undertakings, where appropriate, to subject the identified material risks to a sufficiently wide range of stress tests or scenario analyses, including the material short and long-term risks associated with climate change.
- 3.16. A forward-looking and risk-based approach to the ORSA necessitates that undertakings consider a wide range of outcomes. A clear view of the risks and uncertainties to which the undertaking is exposed allows the management body to discuss and decide on actions to mitigate excessive risks and anticipate future management actions contingent on certain future events unfolding.
- 3.17. The uncertainties will increase with the length of the time horizon. In case of climate change, future outcomes will be determined by a multitude of external factors, like demographic and economic developments, government policy to curb carbon emissions, technological change and market sentiment. Even when these were known, there is substantial modelling uncertainty regarding the feedback of these external developments to future transition and physical risks.
- 3.18. In line with the Commission's Guidelines, CAs should expect undertakings to subject material climate change risks to at least two long-term climate scenarios, where appropriate:
- a climate change risk scenario where the global temperature increase remains below 2°C, preferably no more than 1.5°C, in line with the EU commitments; and
 - a climate change risk scenario where the global temperature increase exceeds 2°C.

Two scenarios would also allow undertakings to define a reference scenario against which the other scenario could be compared.

- 3.19. The aim of the scenario analysis is to assess and discuss the resilience and robustness of the undertaking's business strategies under different developments of climate change risks over time. Therefore, it is important that within the two scenarios, there is a sufficiently wide range of transition and physical risks, depending on the undertaking's exposure. As such, undertakings may also consider another combination of the two temperature scenarios specified in the previous paragraph more appropriate.
- 3.20. The expectation to subject climate change risks at least to two long-term climate scenarios does not apply to undertakings which concluded, and explained, that climate change risk is not material, in line with Point 3.14 of this Opinion.
- 3.21. To implement the long-term climate scenarios, undertakings may develop their own climate scenarios or build, to a more or lesser extent, on existing ones, depending on the undertakings' expertise and resources. A number of climate change scenarios containing pathways for physical and transition risks are publicly available (see also Annex 5). The Network for Greening the Financial System released a first set of climate scenarios in June 2020, aiming to make

such scenarios more accessible and relevant for the financial sector (see Annex 6).³¹

Lower precision and frequency of long-term scenario analyses

- 3.22. CAs should expect that quantitative analyses of long-term climate change scenarios aim for a lower level of precision of balance sheet projections and are conducted at a lower frequency than short-term risk assessments in ORSA.
- 3.23. Making long-term, multi-period scenario projections of the undertaking's balance sheet and income statement, introduces new challenges. For example, as a consequence of accounting for future business in the projections to assess the long-term viability and solvency of current business models and strategies. However, given the "what if" nature and its focus on key risk drivers, the long-term scenario analysis will also allow for more simplified approaches and assumptions compared to the short-term risk analysis, which requires a higher level of precision to determine overall solvency needs and compliance with the SCR.
- 3.24. Long-term climate scenarios with a wide range of physical and transition risks will also be less susceptible to short-term developments. The long-term climate scenarios as well as the assessment of the impact of those long-term scenarios on material exposures could be updated on a non-annual basis, if properly justified by an absence of new material risk exposures. Moreover, the long-term scenario analysis could be partially updated, as additional material exposures are identified or new methodologies and data become available.

Evolution of climate change risk analyses

- 3.25. CAs should expect that the scope, depth and methodologies of undertakings' quantitative (scenario) analyses of climate change risk evolve, as modelling approaches advance and undertakings gain more experience. Furthermore, CAs should expect that the speed of evolution as well as the scope and granularity of quantification is proportionate to the size, nature and complexity of undertakings' climate change risk exposures.
- 3.26. Although important progress has been made in recent years in the development of scenarios, methodologies and guidance, challenges remain in conducting (scenario) analysis of climate change risks (see Annex 5). For example, significant modelling expertise and expert judgement will be needed to translate carbon price pathways into transition impacts on assets of companies or economic sectors or to translate temperature pathways into physical impacts in relevant geographical areas. Climate scenarios available today will not contain all information on transition and physical impacts in a form and resolution relevant for the undertaking.
- 3.27. Only a minority of undertakings have already started analysing the effects of climate changes risk in the ORSA, which means that undertakings will have to build adequate capacity and gain experience. Undertakings without any prior

³¹ NGFS, Climate scenarios for central banks and supervisors, June 2020: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_final.pdf

experience can start off analysing long-term climate scenarios in a largely qualitative way. However, CAs should expect a systematic improvement of the scope and sophistication of quantitative scenario analyses, also considering the ongoing developments in the field of climate change risk analysis, and taking a risk-based and proportionate approach.

Supervisory reporting and consistent disclosure

3.28. CAs should expect undertakings to present and explain in the ORSA supervisory report the analysis of short and long-term climate change risks, including:

- an overview of all material exposures to climate change risks, an explanation how the undertaking assessed the materiality and, where relevant, an explanation if the undertaking concluded that climate change risk is not material;
- the methods and main assumptions used in the undertaking's risk assessment of material exposures, including the long-term scenario analysis;
- the quantitative and qualitative outcomes of the scenario analyses and the conclusions drawn from the results.

CAs should encourage larger undertakings to disclose climate-related information, in line with the Commission's Guidelines. This should contribute to the dissemination of comparable and reliable climate-related information, while recognising the potential benefits for undertakings in terms of enhanced dialogue with stakeholders, higher confidence of policyholders and better corporate reputation.

3.29. The analysis of climate change risks referred to in this Opinion cover many elements recommended in the Commissions' Guidelines, including how climate-related risks could affect overall solvency needs of undertakings.

3.30. CAs should expect that the information relating to climate change risk contained in the non-public ORSA supervisory report is consistent with the undertakings' public disclosure of climate-related information under the NFRD, recognising that the ORSA report and disclosures under the NFRD have different objectives.

4. Reporting requirements

4.1. CAs should collect qualitative and quantitative data enabling them to perform a supervisory review of the analysis of short and long-term climate change risks in ORSA in accordance with this Opinion. Instruments for data collection should be the regular supervisory reporting, most notably the ORSA supervisory report.

5. Monitoring by EIOPA

5.1. EIOPA will start monitoring the application of this Opinion by the CAs two years after its publication.

5.2. This Opinion will be published on EIOPA's website.

Done at Frankfurt am Main, 30 March 2021

[signed]

For the Board of Supervisors

Peter Braumüller

Vice-Chairperson

Annex 1: Summary results of the information request among CAs on the use of climate change risk scenarios in the ORSA and other documents

- 1.1. EIOPA conducted an information request among the CAs in the EEA on undertakings' use of climate change risk scenarios in their ORSA and other documents. CAs in all thirty EEA countries responded to the request. The ORSAs of in total 1682 undertakings were analysed (about three quarters of undertakings under Solvency II), representing over 80% of the non-life market in terms of gross written premiums and of the life market in terms of assets.
- 1.2. Undertakings may conduct scenario analyses of climate change risk outside of the scope of the ORSA or without mentioning it in the ORSA. To get a more complete view of the use of scenario analyses, CAs were also requested to provide information on such assessments described in other documents, like the Solvency and Financial Condition Report (SFCR), annual report or sustainability reports. Twenty-three CAs analysed other documents of in total 820 undertakings (about one third of all undertakings), covering more than half of the non-life market in terms of gross written premiums and the life market in terms of assets.
- 1.3. Only a small proportion of undertakings made use of climate change risk scenarios in their ORSA. No more than 13% of ORSAs made reference to climate change risk scenarios. This percentage constitutes an upper limit. In many countries this also includes ORSAs where climate change risk was assessed or mentioned, but where undertakings did not explicitly conduct an analysis using climate change risk scenarios. Similarly, references to climate change risk scenarios were found in no more than 10% of other documents analysed. For the same reasons, this percentage should also be interpreted as an upper limit.
- 1.4. Many undertakings recognised in their ORSA, often in the "emerging risks" section, that climate change represents a risk, especially the expected increase in physical risks for non-life insurers. However, undertakings described climate change risks in generic terms without assessing (qualitatively or quantitatively) the specific impact on the undertaking. Sometimes undertakings explained that climate change risks are not material due to their business model or because of the reinsurance arrangements in place. A number of reasons were provided for not doing further quantitative scenario analysis, including the:
 - uncertainty, but also gaps in knowledge and lack of data, about the effects of climate change on (physical) risks occurring in the future;
 - difficulty of quantifying the impacts on the undertaking due to the large number of risk drivers relating to climate change and the parameter uncertainty;
 - long-term nature of climate change risk (scenarios) compared to the 3-5 years' time horizon commonly applied by undertakings in performing the ORSA.A number of times it was mentioned that undertakings are in the process of conducting quantitative scenario analysis or intend to do so in the future.
- 1.5. Of the ORSA reports in which CAs found descriptions of climate change risk (scenario) analysis, 58% of the analyses were qualitative in nature, 20% quantitative and 22% contained both types of analyses. The qualitative analysis often comprised descriptions of the climate change risks, the possible impact on

the undertaking and the mitigating measures, like reinsurance and premiums, which tend to rise with progressive increases in the frequency and severity of physical risks. Sometimes the physical risks were further broken down with respect to the types of extreme weather events and natural disasters that are relevant for the geographical areas in which the undertaking is active. In this respect, reference was made to so-called flood maps or scenarios developed by national climate change research centres. Other CAs responded that undertakings mapped climate change risk to traditional prudential risks, like underwriting, market, credit, including reinsurance default risk, operational risk, including the risk of higher climate-related litigation, and reputational risks. It was also mentioned that undertakings, as part of their risk register, assess the probability and impact of the risks using scores ('low', 'medium' and 'high') together with the risk's immediacy in years. Undertakings described transition risk in a concise manner and in generic terms, recognising that investments in carbon-intensive sectors would be most exposed. Although no explicit assessments of the exposure to transition risk were recorded, undertakings provided quite extensive information on the mitigation of this risk. Many undertakings indicated having in place ESG or sustainability policies, including screening policies that often exclude coal-related investments and underwriting activities.

- 1.6. Most quantitative analyses found in the ORSA reports consider the increase in physical risks on non-life underwriting claims. Some analyses take a technical approach by increasing the expected claims/loss ratios on the underwriting portfolio, most others assess (a combination of) specific extreme weather events. These climate change risk analyses are hard to distinguish from regular natural catastrophe scenarios. Not many undertakings linked the shocks to climate scenarios specifying, for example, future carbon emissions and temperature pathways. A number of undertakings assessed scenarios with several types of risk factors, e.g. the occurrence of extreme weather events in combination with lower interest rates, the default of a reinsurance undertaking or a fall in asset values. Only a few undertakings explored the impact of physical risks on investment assets. Transition risk analyses ranged from simple, uniform asset stresses to more elaborate assessments, distinguishing three temperature scenarios over a timeframe of 15 years. For most other climate change risk analyses the time period considered was 1-5 years or not specified. Nearly all assessments consider the risk exposure of existing business, climate change risk analysis relating to the acquisition of new business being rare.

Examples of quantitative climate change risk analyses in ORSA

Physical risk

- Simulation of an increase in the loss ratio of 5% per year in the non-life lines of business affected by climate change, taking into account the loss-absorbency of the national insurance compensation arrangement.
- Adverse scenario consisting of a convergence over 8 years towards the average claims during the period 2016-2018, which were high due to severe floods,

relative to a central scenario consisting of a 10-year average of past claims.

- Analysis of the impact of the following key catastrophe events, both individually and in combination: European windstorm surge, Ireland flood and freeze, UK river flood, UK earthquake and European earthquake.
- Scenario of two events occurring within a week of each other: hurricane coming from the Baltic Sea and heavy rain causing flash floods.
- Scenario of windstorm followed by floods causing increase in claims relating to motor and multi-risk (fire and other damage to or loss of property) lines of business. The mapping of the physical location of the affected exposures followed a study conducted by the local insurance association, in association with academia, which mapped the sites vulnerable to floods in Portugal. The scenario assumed a 100% loss in house-contents, 10% loss of total property value and 5% loss in total value of motor vehicles.
- Scenario with a widespread increase in windstorms, leading to an increase in claims in multi-risk (fire and other damage to or loss of property) lines of business. The scenario assumed an increase in the loss ratio of 30% in the first year and 10% in the second year of the projection horizon.
- Scenario related to climate change with stresses on relevant investments and underwriting risks, considering a time horizon of five years.

Physical risk linked to specific climate scenario

- Scenarios with expected higher claims due to more frequent, severe storms, a gradual but systemic increase in negative weather events and higher mortality over a 3-5 year period. Scenarios are partly based on the Royal Netherlands Meteorological Institute (KNMI) climate change projection of increasingly intense (hail)storms and periods of drought.
- Scenario consistent with the IPCC's 8.5 Representative Concentration Pathway (RCP), increasing losses linked to flooding by 38%, sea-level submersion by 82%, and globally increase the loss ratio by 50% in certain property damage segments.

Physical risk in combination with other risk factors

- Scenario with a longer period of low risk-free interest rates, combined with an increase in the frequency and intensity of natural disasters/storms due to climate change.
- Scenario with a likelihood of 1 in 40 consisting of flood and windstorm linked to climate change in combination with the default of the largest reinsurer.
- Scenario with a series of storms occurring during a single winter, causing a significant increase in claims, following the (unrelated) failure of the reinsurer.
- Reverse stress test considering the impact of four EU windstorms in one year due to climate change, where the fourth event has no reinsurance protection remaining. The impact of those events is combined with other events like the default of a reinsurer and a financial crisis to complete the reverse stress testing.

Physical risk affecting assets

- Scenario over a 3-5 year timeframe with prolonged droughts, negatively affecting the value of residential property and, as a result, the value of the undertaking's mortgage portfolio.

Transition risk

- Scenarios with generic parameters, e.g. decline in stock prices etc., not being specifically tailored to climate-related investments.
- Assessment of the impact on investments of 1.5°C, 2°C and 3°C degrees climate scenarios over the period 2018-2033. Modelling based on work with the UN Environmental Programme Finance Initiative (UNEP FI) for stocks and bonds and in-house model for the property portfolio.
- Scenario analysing the impact of new government introducing swift legislation to ban diesel engines in major cities on new product launch. The new government, being formed in a country where a major branch is established, won the elections on the basis of commitments to mitigating climate change after significant storms and floods caused extensive damage.

- 1.7. Of the other documents in which CAs found descriptions of climate change risk (scenario) analysis, 79% of the analyses were qualitative in nature, 6% quantitative and 17% contained both types of analyses. The findings are generally consistent with the conclusions for the ORSA reports. Undertakings recognise in a qualitative manner the risks of climate change for their company and the wider insurance market. Moreover, many undertakings describe how the companies' corporate responsibility and ESG/sustainability policies contribute to a sustainable economy and, in particular, to mitigating climate change. One CA found an elaborate description of the use of climate change risk scenarios:

Example of climate change risk scenarios in other documents

One of Europe's largest insurance groups makes extensive use of climate change scenarios to better assess the variety of risks and opportunities associated with climate change. It makes use of climate scenarios from the Intergovernmental Panel on Climate Change (IPCC), International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA), among others, but also own scenarios. The scenarios' time horizons are up to 2040 and temperature pathways range from well below 2°C to as much as 4°C. Examples of analyses done within the group:

- Pilots of methods and disclosure relating to the investment portfolio by measuring alignment with a 2°C scenario, conducting physical risk analysis, as well as exploring value-at-risk metrics;
- Climate scenario and alignment analysis on listed equity and corporate bond portfolios;
- Energy and carbon performance overview of the direct real estate portfolio, including indicative science-based targets;
- Development, jointly with the UN PRI, of an ESG guide to non-life underwriting, including a risk heat map for economic sectors which also covers climate change-related risk assessments;
- Analysis of potential transition risk drivers and financial impacts on different economic sectors under 2°C and 1.5°C scenarios in different geographical regions. Outcomes were translated into heat maps and for the energy sector more detailed quantitative analysis on potential losses from stranded assets was conducted.

Annex 2: Analysis of costs and benefits

- 2.1. Solvency II requires undertakings to consider in their system of governance, risk-management system and own risk and solvency assessment (ORSA) all material risks they face in the short and long term and to which they are or could be exposed, also where these risks are not (fully) included in the calculation of the SCR.
- 2.2. The information request conducted by EIOPA shows that less than 13% of undertakings made use of climate change risk scenarios in their 2019 ORSA (see Annex 1). Moreover, undertakings that undertook a quantitative analysis of climate change risk mostly did so considering a 1-5 years horizon.
- 2.3. This Opinion provides guidance to CAs to expect from undertakings to identify potentially material climate change risks for their business and that undertakings consider both short and long-term climate change risks in their ORSAs using scenario analyses based on a proportionate and risk-based approach. This will be accompanied with costs as the risk management function and potentially other functions will require additional resources. More services will have to be sourced from external providers at additional costs, including resources needed for the development of methodologies and complex models required for the analysis of climate change risk.
- 2.4. Generally, central functions, like risk management, have a relatively higher cost impact on smaller than on larger undertakings. However, in cases where the underwriting activities of smaller undertakings are more concentrated in a few local/domestic markets, as opposed to global exposures of large undertakings, this can reduce the complexity of scenario analysis of climate change risk. Moreover, the Opinion recognises that undertakings have to gain experience and build expertise, allowing undertakings to gradually enhance sophistication of the scenario analyses. This will limit the initial costs and in the long-term will yield methodologies and models that will enable firms to deduct conclusions from observed data.
- 2.5. Finally, Solvency II already requires undertakings to identify and assess all material risks in their ORSA, which means that the Opinion is only confirming and clarifying existing EU legislation.
- 2.6. EIOPA is confident that the costs will most likely be outweighed by the benefits of undertakings considering short and long-term climate change risks in their ORSA, which will enable them to carefully manage future risks and take advantage of the opportunities that will come along. However, EIOPA recognises that the costs of developing and implementing the necessary tools to aid in climate change scenario analysis are not directly estimated and are difficult to quantify.
- 2.7. Firstly, already now, climate change is having an impact on the frequency and concentration of extreme weather events and natural disasters depending on the geographical region and the perils examined. Moreover, the transition risks associated with climate change may arise suddenly and in the short term. Capturing these risks in the ORSA will contribute to strengthening the solvency

position of undertakings and, hence, benefit the protection of policyholders.

- 2.8. Secondly, the long-term effects of climate change may have far-reaching effects on (re)insurance markets and undertakings' business models. The rise in physical risks may stimulate demand for insurance cover, but higher (re)insurance costs and premiums are also likely to constrain demand. Higher physical risks due to climate change may render more risks in more geographical locations uninsurable, limiting the availability of reinsurance and jeopardising business continuity. The transition to a low-carbon economy has the potential of disrupting economic sectors, eroding undertakings' customer base in conventional industries, but also offering opportunities for selling new types of insurance products and services. Taking into account the long-term risks and opportunities of climate change in undertakings' business strategy and strategic planning using long-term scenario analysis will contribute to ensuring the long-term solvency and viability of undertakings.
- 2.9. Lastly, the Opinion considers climate change risks from the perspective of undertakings rather than the impacts of the activities of undertakings on climate change risk, but both perspectives are to a considerable degree interlinked. Undertakings' consideration of strategies to enhance affordability and insurability of coverage against physical risks will contribute to the EU strategy on adaptation to climate change. The internalisation of short and long-term climate change risks is expected to reduce activities that negatively affect climate change and, hence, will contribute to the EU's commitment to climate neutrality in 2050.

Annex 3: Mapping of climate change risks to prudential risks – Non-life insurance

Climate change risk channel	Sub type	Underwriting risk	Market risk	Credit / Counterparty risk	Operational / Reputational / Strategic risk
Transition risk	Policy	- Economic impact of a policy-triggered transition to a low-carbon economy leads to higher claims for some lines of business, e.g. credit insurance.	- Energy efficiency regulation of commercial and residential property reduces the value of undertakings' investments in real estate that do not comply with the requirements. - Increase in carbon taxes and/or reduction in emission rights, negatively affects investments in carbon intensive sectors, like mining, energy, transport and manufacturing. - Late government intervention to achieve transition to low carbon economy disrupts the stability of the real economy and the financial sector, depressing asset values and interest rates. - Transition to low-carbon economy results in higher spreads on government bonds of countries that are economically dependent on oil & gas exploration, coal mining and/or carbon-intensive industries.	- Collateral backing of commercial and residential mortgage portfolio decline in value e.g. due to government policy with regards to the energy efficiency of real estate.	- Maritime insurance undertakings experience market contraction as policy-induced transition to a low-carbon economy leads to a fall in global shipping of oil and gas. - Transition to a low-carbon economy reduces demand for insurance products and services where undertakings' customer base is heavily exposed to conventional carbon-intensive industries.
	Legal	- Higher climate change-related claims under liability policies, like directors & officers, professional	- Price declines of investments in carbon-intensive sectors due to companies facing litigation	- Reinsurance undertaking faces claims for not considering the impact of its underwriting decisions on	- Undertakings that do not take into account the impact of their underwriting and investment decisions on

Climate change risk channel	Sub type	Underwriting risk	Market risk	Credit / Counterparty risk	Operational / Reputational / Strategic risk
		indemnity and third-party environmental policies.	for failing to avoid or minimise adverse impacts on the climate, or failing to adapt to climate change.	climate change, resulting in a lower credit standing and higher exposure of undertakings to reinsurance losses.	climate change experience direct claims for damages and litigation costs.
	Technology	- High claims on new insurance products covering green technologies because of underpricing due to lack of data.	- Advances in clean energy technology result in stranded assets of companies involved in oil & gas exploration and carbon-based power generation. - Companies or sectors invest in new low-carbon technologies but some of those prove not to be successful, depressing their asset values.	- Advances in clean energy technology result in losses on private loans to companies dependent on carbon-based power generation as well as companies developing unsuccessful clean energy technologies.	- Undertaking's strategy fails to take into account disruption of conventional industrial organisation induced by technology-driven transition to low-carbon economy with firms demanding new insurance products and services, leading to a drop in demand for its products.
	Market sentiment		- Shift in customer preferences for climate-friendly goods and services, e.g. electrical cars and transport vehicles, puts investments in producers of conventional, carbon-based goods and services under pressure.	- Shift in business preferences to occupy sustainable office and retail space lowers the value of mortgage loans on climate-unfriendly commercial property.	- Shift in customer preferences for sustainable companies diminishes demand for the undertaking's insurance products and services, as its business strategy does not sufficiently take into account the long-term impact on sustainability factors.
	Reputation		- Investments in certain companies perform poorly because of their reputation of contributing to climate change.	- Higher spreads on loans to certain companies and real estate funds that have a climate-unfriendly reputation, resulting in lower revenue for these companies and lower occupancy rates of	- Non-life underwriting in economic sectors contributing to climate change, e.g. coal-fired power infrastructure, damages the reputation of undertakings, making it difficult to attract

Climate change risk channel	Sub type	Underwriting risk	Market risk	Credit / Counterparty risk	Operational / Reputational / Strategic risk
				the real estate.	and retain customers and staff.
Physical risk	Acute	- Climate change increases the frequency and concentration of extreme weather events and natural catastrophes, e.g. heat waves, landslides, floods, wildfires and storms, resulting in higher insurance claims. - Climate change increases the frequency and concentration of extreme weather events and natural catastrophes, damaging property and resulting in higher insurance claims. - Motor and auto underwriting losses increase over time due to increased severe hailstorm events. - Aviation hull claims increase over time due to increased hailstorm and lightning strike losses. - Higher frequency/intensity of hails or floods result in higher claims on crop insurance. - Climate change increases the losses related to Non-Damage Business Interruption (NDBI) insurance by preventing firms' operations following a	- Higher credit spreads on government bonds issued by countries that are highly susceptible to acute physical risks. - Downgrade of municipal bonds issued by municipalities whose infrastructure, economy and/or revenues are impacted by extreme weather events. - Values of real estate portfolios decline due to properties being located in areas highly sensitive to the increase in extreme weather events. - Climate change-related shocks, e.g. a pandemic, negatively affecting the economy and the financial system and depressing interest rates and asset values. - Increased currency volatility of countries that are vulnerable to the rise of extreme weather events and natural disasters, increasing undertakings' foreign exchange risk.	- Higher frequency and concentration of extreme weather events and natural disasters reduces the credit standing and/or leads to defaults of reinsurance undertakings, exposing undertakings to reinsurance losses. - The availability and cost of reinsurance cover becomes prohibitive for smaller insurers in certain markets due to the increase in frequency, correlation and severity of natural disasters. - Higher frequency and severity of extreme weather events reduces the credit standing of non-life undertakings, raising their cost of capital. - Uninsured losses on commercial and residential property arising from climate change-induced physical perils negatively affect the performance of mortgage loans.	- Climate change-related increase in extreme weather events and natural disasters affecting undertakings' own assets (property, equipment, IT systems and human resources), increasing costs and potentially compromising operations. - Undertaking's risk management and pricing fails to take into account the potential non-linear character of acute physical risks, e.g. coincidence of previously un-correlated event, resulting unexpectedly claim burdens, resulting in unexpected losses. - Increasing acute physical risks, like wildfires, floods and storms, constrains insurers to underwrite property and assets. - Inappropriate strategy relating to acute physical climate risk mitigation reduces the insurer's competitiveness. - Melting arctic ice due to climate change is likely to lead to an opening up of the Northwest Passage leading to new opportunities for marine

Climate change risk channel	Sub type	Underwriting risk	Market risk	Credit / Counterparty risk	Operational / Reputational / Strategic risk
		natural disaster, even if they have not been physically impacted (for example aviation companies). - Increase of extreme events will impact the creditworthiness of firms and individuals, resulting in higher credit insurance claims			insurance.
	Chronic	- Higher frequency and severity of epidemics and pandemics due to climate change lead to higher non-life insurance claims, e.g. business interruption and credit insurance. - Increase in temperatures will negatively affect the productivity of crop farming, thereby increasing crop insurance claims that cover revenue losses. - Decreasing river water levels prevent firms from operating, resulting in higher losses related to Non-Damage Business Interruption (NDBI) insurance .	- Higher credit spreads on government bonds issued by countries that are highly susceptible to chronic physical risks. - Fall in value of real estate portfolios due to properties being located in areas highly impacted by the increase in chronic physical risks, e.g. coastal urban areas vulnerable to sea level rise. - Government prioritises water supply to households and resulting water scarcity will put pressure on non-essential business activities.	- Higher incidence of pandemics results in losses on commercial mortgages, as consumers avoid shopping malls and working from home reduces demand for office space.	- Climate change-induced sea level rise renders residential and commercial property in vulnerable areas uninsurable. - Agricultural insurance undertakings experience a market contraction as crop farming is no longer possible due to temperature increases and lower water availability and as rising ocean temperatures reduces the productivity of fish farming. - Travel insurance undertakings face a severe market contraction following a climate change-induced pandemic. - Sea level rise constrains the insurability of houses located next to the coast, resulting in lower revenues for non-life insurers.

Annex 4: Mapping of climate change risks to prudential risks – Life insurance, including health

Climate change risk channel	Sub Type	Underwriting risk	Market risk	Credit / Counterparty risk	Operational / Reputational / Strategic risk
Transition risk	Policy		- Energy efficiency regulation of commercial and residential property reduces the value of undertakings' investments in real estate that do not comply with the requirements. - Increase in carbon taxes and/or reduction in emission rights, negatively affects investments in carbon intensive sectors, like mining, energy, transport and manufacturing. - Late government intervention to achieve transition to low carbon economy disrupts the stability of the real economy and the financial sector, depressing asset values and interest rates. - Transition to low-carbon economy results in higher spreads on government bonds of countries that are economically dependent on oil & gas exploration, coal mining and/or carbon-intensive industries.	- Collateral backing of commercial and residential mortgage portfolio decline in value e.g. due to government policy with regards to the energy efficiency of real estate.	- Transition to low-carbon economy reduces demand for life insurance products, e.g. occupational pension plans, where undertakings' customer base is heavily exposed to conventional carbon-intensive industries.
	Legal		- Price declines of investments in carbon-intensive sectors due to companies facing litigation	- Reinsurance undertaking faces claims for not considering the impact of its underwriting decisions on	- Undertakings that do not take into account the impact of their investment decisions on climate change experience

Climate change risk channel	Sub Type	Underwriting risk	Market risk	Credit / Counterparty risk	Operational / Reputational / Strategic risk
			for failing to avoid or minimise adverse impacts on the climate, or failing to adapt to climate change.	climate change, resulting in a lower credit standing and higher exposure of undertakings to reinsurance losses.	direct claims for damages and litigation costs.
	Technology		- Advances in clean energy technology result in stranded assets of companies involved in oil & gas exploration and carbon-based power generation. - Companies or sectors invest in new low-carbon technologies but some of those prove not to be successful, depressing their asset values..	- Advances in clean energy technology result in losses on private loans to companies dependent on carbon-based power generation as well as companies developing unsuccessful clean energy technologies.	- Undertaking's strategy fails to take into account disruption induced by technology-driven transition to a low-carbon economy with consumers demanding new life insurance products and services, leading to a drop in demand for its products.
	Market sentiment		- Shift in customer preferences for climate-friendly goods and services, e.g. electrical cars and transport vehicles, puts investments in producers of conventional, carbon-based goods and services under pressure.	- Shift in business preferences to occupy sustainable office and retail space lowers the value of mortgage loans on climate-unfriendly commercial property.	- Shift in customer preferences for sustainable companies diminishes demand for the undertaking's insurance products and services, as its investment strategy does not sufficiently take into account the long-term impact on sustainability factors.
	Reputation		- Investments in certain companies perform poorly because of their reputation of contributing to climate change.	- Higher spreads on loans to certain companies and real estate funds that have a climate-unfriendly reputation, resulting in lower revenue for these companies and lower occupancy rates of	- Undertakings' investments in carbon-intensive industries result in reputational damage, making it difficult to attract and retain customers and staff.

Climate change risk channel	Sub Type	Underwriting risk	Market risk	Credit / Counterparty risk	Operational / Reputational / Strategic risk
				the real estate.	
Physical risk	Acute	- Climate change increases the frequency and concentration of extreme weather events and natural disasters, resulting in higher life and health insurance claims. - Higher life and insurance claims as a climate change-induced rise in heat waves increases mortality among elderly populations with pre-existing health conditions or vulnerabilities. - Higher rates of ill health (morbidity) and deaths (mortality) due to climate change-related rise in wildfires and resulting air pollution, leading to higher life and health insurance claims.	- Higher credit spreads on government bonds issued by countries that are highly susceptible to acute physical risks. - Downgrade of municipal bonds issued by municipalities whose infrastructure, economy and/or revenues are impacted by extreme weather events. - Values of real estate portfolios decline to properties being located in areas highly sensitive to the increase in extreme weather events. - Climate change-related shocks, e.g. a pandemic, negatively affecting the economy and the financial system and depressing interest rates and asset values. - Increased currency volatility of countries that are vulnerable to the rise of extreme weather events and natural disasters, increasing undertakings' foreign exchange risk.	- Higher frequency and concentration of extreme weather events and natural disasters reduces the credit standing and/or leads to defaults of reinsurance undertakings, exposing undertakings to reinsurance losses. - Uninsured losses on commercial and residential property arising from climate change-induced physical perils negatively affect the performance of mortgage loans.	- Climate change-related increase in extreme weather events and natural disasters affecting undertakings' own assets (property, equipment, IT systems and human resources), increasing costs and potentially compromising operations. - Lower economic activity due to increase in extreme weather events reduces consumer demand for life insurance policies.

Climate change risk channel	Sub Type	Underwriting risk	Market risk	Credit / Counterparty risk	Operational / Reputational / Strategic risk
	Chronic	- Chronic rise in temperatures and humidity are breeding ground for vector-borne diseases, increasing the likelihood and severity of epidemics and pandemics and causing higher life and health insurance claims. - Global warming extends the transmission season and geographical range of many infectious diseases, e.g. Lyme disease, avian influenza, meningitis, dengue fever and tropical bacterial and viral infections, leading to higher life and health underwriting claims.	- Higher credit spreads on government bonds issued by countries that are highly susceptible to chronic physical risks. - Fall in value of real estate portfolios due to properties being located in areas highly impacted by the increase in chronic physical risks, e.g. coastal urban areas vulnerable to sea level rise. - Government prioritises water supply to households and resulting water scarcity will put pressure on non-essential business activities, depressing the value of non-essential investment assets.	- Higher incidence of pandemics results in losses on commercial mortgages, as consumers avoid shopping malls and working from home reduces demand for office space. - The availability and cost of reinsurance cover for mortality and morbidity risks becomes prohibitive for smaller insurers in certain markets due to the increase in frequency of epidemics and pandemics, thereby increasing their risk profile.	- Chronic climate change-related impacts, e.g. sea level rise or rise in pandemics, affects undertakings' own assets (property, equipment, IT systems and human resources), increasing costs and potentially compromising operations. - Increasing frequency of epidemics and pandemics constrains insurers to provide life and health insurance.

Annex 5: Guidance for developing and including climate change risk scenarios in ORSA

- 5.1. This annex aims to provide direction on some challenging issues for the application of climate change risk scenarios in ORSA, instead of giving comprehensive guidance. Various guidance documents and overview papers are already available on the use of climate change scenarios and how to apply them, including:
- the technical supplement of the Task Force on Climate-related Financial Disclosures (TCFD), which discusses the use, application and analytical choices involved in scenario analysis.³² Moreover, a descriptive overview is provided of a range of publicly available climate scenarios;
 - the guide to scenario analysis from the Network for Greening the Financial System (NGFS), accompanying the release of its first set of climate scenarios;³³
 - the discussion paper of EIOPA on methodological principles for its first insurance climate change stress tests, including a discussion of approaches to derive granular impacts of transition and physical risks as well as the use of single-versus multi-period projections³⁴;
 - the paper of the Financial Stability Institute (FSI) of the Bank for International Settlements (BIS), reviewing the current state of play of climate risk assessments, including scenario analyses and stress tests, by undertakings and supervisors in the insurance sector.³⁵
- 5.2. The sections below discuss specific challenges for the application of climate change risk scenarios in ORSA, taking a long-term perspective. However, some of the topics will also be relevant for conducting short-term climate change risk analyses, most notably the modelling of transition and physical impacts at a granular level.
- 5.3. Going forward, EIOPA sees the advantages of developing and providing optional guidance for undertakings regarding climate scenario design and specifications using concrete case studies. This would serve the twin objectives of lowering implementation costs for undertakings (in particular small- and mid-sized ones) and enhancing the comparability of reported information.

Identification of climate change scenarios

- 5.4. The identification of a range of relevant climate change scenarios is the starting point of the scenario analysis. This includes the main assumptions underlying the scenarios, like demographic developments, urbanisation trends, technological change and government climate policy. The scenarios together with the underlying assumptions determine the “narrative”. The narrative deserves due

³² TCFD’s Technical Supplement – The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities, June 2017, <https://www.fsb-tcfd.org/publications/final-technical-supplement/>

³³ NGFS’s Guide to climate scenario analysis for central banks and supervisors, June 2020, https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_scenario_analysis_final.pdf

³⁴ EIOPA’s Second Discussion Paper on Methodological principles of insurance stress testing (EIOPA-BoS-20/341), 24 June 2020, https://www.eiopa.europa.eu/sites/default/files/publications/consultations/eiopa-bos-20-341_second-discussion_paper-methodological-principles-for-stress-testing.pdf

³⁵ Turning up the heat – climate change assessment in the insurance sector, FSI Insights, No 20, 6 November 2019, <https://www.bis.org/fsi/publ/insights20.pdf>

attention in order to ensure interesting and challenging scenarios that facilitate internal communication and discussion. Reverse stress-testing could also be envisaged as a tool to explore a combined physical, transition and liability risk scenario, which undertakings can use to develop their understanding of the ways in which risks can both emerge and combine, thus informing development of an appropriate suite of management responses.

- 5.5. The identification of the scenarios will depend on the undertaking's assessment of the materiality of exposures to climate change risks. For example, for some undertakings scenarios with a significant range of physical risks may be most relevant, while for other undertakings a focus on transition risks may be more appropriate. Unless undertakings decide to develop the scenarios themselves, the choice of scenarios will be constrained by the scenarios that are publicly available. For example, the NGFS published eight climate scenarios with varying assumptions on climate policy, temperature targets and technological developments. The socio-economic pathways underlying these scenarios are based on the "Middle of the Road" Shared Socioeconomic Pathway (SSP), fixing population growth and urbanisation rates.
- 5.6. The macroeconomic parameters, like GDP, price level, interest rates, to be covered in the scenarios should also be considered. The inclusion of those will largely depend on the analytical choices made with regard to the time horizon of the scenarios. Interest rates will be relevant for undertakings in both short-term and long-term projections. GDP and price levels will be important in long-term scenarios to extrapolate variables to the future.
- 5.7. Lastly, the granularity needs to be decided at which undertakings intend to assess the impact of transition and physical risks. For transition risks, this relates to the breakdown of assets by economic sectors, companies or activities, for physical risk to the geographical resolution of underwriting activities and assets, such as property. The granularity will depend on the material risk exposures identified by the undertaking. For example, the materiality assessment should identify to which climate change-related perils in which geographical areas the undertaking is exposed. However, the granularity will also depend on the modelling techniques available to assess the impacts at a given resolution.

Modelling transition and physical impacts at granular level

- 5.8. Publicly available climate scenarios tend not to contain information on transition and physical impacts at high resolutions. This means that undertakings will have to translate transition pathways, e.g. carbon prices, emission levels, GDP, into impacts on asset prices. Similarly, high-level climate pathways, e.g. temperature increases, need to be translated into physical impacts on the undertaking's underwriting activities and assets in the relevant geographical locations.

Transition impacts on assets

- 5.9. A number of academics, research institutions and supervisory authorities have put forward methodologies to estimate the impact of transition pathways on asset categories. In general, these methodologies aim to assign a carbon-sensitivity to economic sectors or activities of companies. Using these carbon sensitivities, the

impact of a given transition pathway on the aggregate economy and asset returns can be differentiated to asset prices in different sectors. Examples of these methodologies, which are discussed in more detail in EIOPA's discussion paper³⁶, include:

- the transitions stress tests of the national supervisors in France³⁷ and the Netherlands³⁸, which assess the impact on equities and corporate bonds at the sectoral level, making use of the macroeconomic model NiGEM;
- the PACTA model of the 2°Investing Initiative, which was originally developed to assess alignment of investors' portfolios with a 2° transition scenario. However, it can also be used to estimate the impact of a transition scenario on equities, corporate bonds and real estate at sectoral level.³⁹
- the CARIMA model, which can be used to assess the impact of a transition scenario on equities, corporate bonds and real estate at the sectoral level.⁴⁰
- the CLIMAFIN model, which does not only model the carbon sensitivity of economic sectors, but also the subsequent carbon sensitivity of national economies and government finances to assess the impact of transition scenarios on government bonds.⁴¹

Physical impacts on underwriting activities

- 5.10. To translate scenarios into physical impacts, the changes in temperature need to be converted into changes in frequency and severity of acute perils as well as chronic effects such as sea-level rises. These changes need to be converted into financial impacts on the undertaking's underwriting portfolio in relevant geographical areas.
- 5.11. The PRA has published a practitioner's aide for the general insurance sector to assess the financial impacts of physical climate change.⁴² The guide was developed by a cross-industry working group and contains a number of practical case studies. National climate change scenarios have been published, which can assist undertakings to translate global climate change scenarios to pathways of physical perils in individual countries.⁴³ Studies of the Commission's Joint

³⁶ EIOPA's Second Discussion Paper on Methodological principles of insurance stress testing (EIOPA-BoS-20/341), 24 June 2020.

³⁷ Scenarios and main assumptions of the ACPR pilot climate exercise, 17 July 2020, https://acpr.banque-france.fr/sites/default/files/medias/documents/20200717_main_assumptions_and_scenarios_of_the_acpr_climate_pilot_exercise.pdf

³⁸ An energy transition stress test for the financial system of the Netherlands, Occasional Studies Volume 16-7, October 2018, https://www.dnb.nl/binaries/OS_Transition%20risk%20stress%20test%20versie_web_tcm46-379397.pdf

³⁹ The 2°Investing Initiative, Storm ahead – a proposal for a climate stress-test scenario, Discussion Paper, April 2019, https://2degrees-investing.org/wp-content/uploads/2019/02/Stress-test-report_V2.pdf

⁴⁰ Görgen, M., Jacob, A., Nerlinger, M., Riordan, R., Rohleder, M., Wilkens, M., Carbon Risk, Working Paper, June 2019, <https://www.frbsf.org/economic-research/events/2019/november/economics-of-climate-change/files/Paper-6-2019-11-8-Riordan-1PM-2nd-paper.pdf>

⁴¹ Battiston, S. and Monasterolo, I., A Climate Risk Assessment of Sovereign Bonds' Portfolio Working paper, July 2020, <https://ssrn.com/abstract=3376218>

⁴² A framework for assessing financial impacts of physical climate change – A practitioner's aide for the general insurance sector, May 2019, <https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/publication/2019/a-framework-for-assessing-financial-impacts-of-physical-climate-change.pdf?la=en&hash=7DE2A5E0442752ED910CF01F36BC15AA661AD1D9>

⁴³ See for example KNMI 2014 scenarios for the Netherlands (<http://www.climatescenarios.nl/>), the NCCS 2018 scenarios for Switzerland (<https://www.nccs.admin.ch/nccs/de/home/klimawandel-und->

Research Centre also contain relevant information on the impact of physical risks in Europe (see example below).

Illustrative example: How to assess the impact of physical risks (for floods) on a non-life insurance portfolio?

In order to assess the potential impact that climate change could have on a non-life undertaking that covers flood risks, the Peseta IV study of the Commission's Joint Research Centre (JRC) on rising river flood risk in the EU could be used.⁴⁴ The JRC study derives changes in expected annual damage (EAD) from the projected changes in frequency and severity of river floods under various temperature scenarios, which are subsequently transformed into financial losses (for the entire economy).

A non-life undertaking could use the study to (a) assess how much exposure it has in regions which are strongly impacted by rising river flood risk due to climate change, and (b) to estimate changes in insured losses on its underwriting portfolio due to climate change based on the projected change of overall economic losses under the different scenarios.

For example, considering a simple example, a non-life undertaking may offer flood insurance products in Finland and Sweden.

- In Finland, the total sum insured (TSI) equals 10 and the average annual loss (AAL) equals 5;
- In Sweden the TSI equals 15 and the AAL equals 5.

The table below summarises the EAD (in EUR million, 2015 values) found in the JRC study for Finland and Sweden under present socioeconomic conditions (Base economy), future socioeconomic conditions (Economy 2050) and three temperature scenarios (1.5°C, 2°C, 3.0°C warming).

	EAD Base economy				EAD Economy 2050	
	base	1.5°C	2.0°C	3.0°C	1.5°C	2.0°C
Finland	252	292	437	659	383	558
Sweden	228	420	780	1544	582	1068

Considering that the non-life undertaking in the example has a higher exposure to Sweden than Finland, it is important for the undertaking to know that the potential climate change impact on the EAD relating to river flood is higher in Sweden than in Finland. Using the changes in EAD shown in the table above, the undertaking could also derive changes to the estimated losses, even if this would only give a rough approximation. For example, the base AAL of the undertaking in Sweden is equal to 5. Assuming that the undertaking's losses change in line with the overall economic losses in the table above, the estimated AAL in the 1.5°C temperature scenario under current socioeconomic conditions would be equal to 5.8 ($= 292 / 252 \times 5$). The table below provides the estimated AAL in all scenarios for both Finland and Sweden.

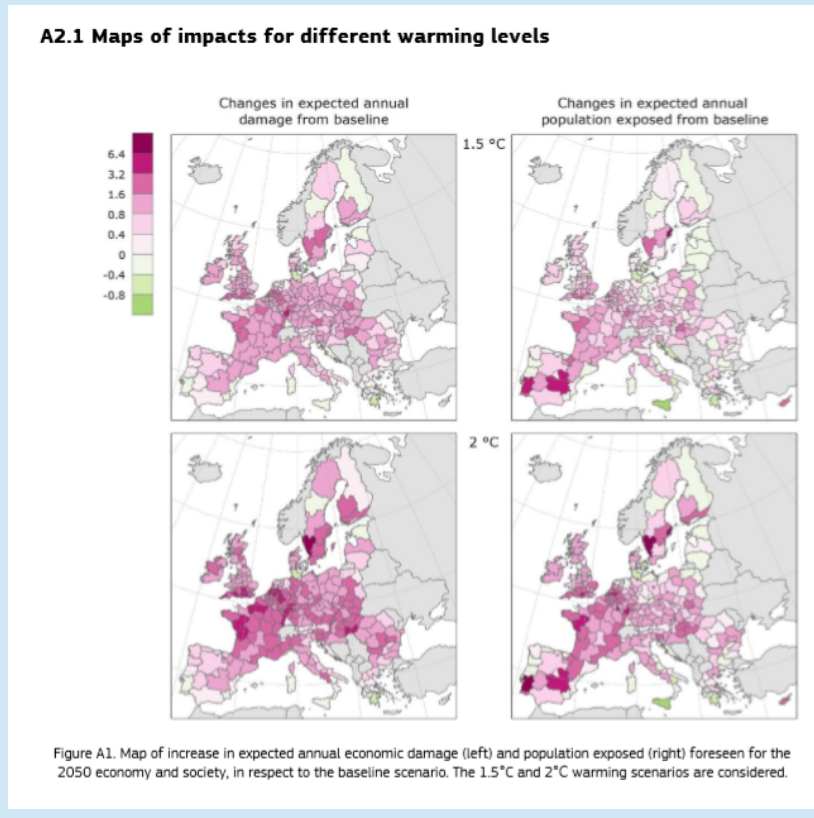
	EAD Base economy				EAD Economy 2050	
	base	1.5°C	2.0°C	3.0°C	1.5°C	2.0°C

[auswirkungen/schweizer-klimaszenarien.html](https://www.auswirkungen/schweizer-klimaszenarien.html)) and the Met Office 2018 scenarios for the UK (<https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index>).

⁴⁴ Adapting to rising river flood risk in the EU under climate change, JRC Technical Report, PESETA IV project – Task 5, 14 May 2020, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC118425/pesetaiv_task_5_river_floods_final_report_2.pdf

Finland	5	5.8	8.7	13.1	7.6	11.1
Sweden	5	9.2	17.1	33.9	12.8	23.4

A similar exercise could also be done at a more granular regional level using maps distinguishing the 281 European regions at NUTS-2 level (see Figure A1 from the JRC study below). Using the same methodology, undertakings could take the projected changes in EAD at NUTS-2 level, instead of country level, and estimate how their losses are changing at NUTS-2 level, instead of country level, analogously to the example above.



Physical impacts on assets

5.12. Translating physical risks to financial impacts on investments in companies will be challenging. Firstly, larger companies usually have activities in multiple locations and countries. Secondly, extreme weather events and natural disasters may affect financial losses in complex ways due to supply chain effects. Some commercial data providers have developed scoring models for companies⁴⁵ and real estate investment trusts (REITs)⁴⁶, ranking their sensitivity to physical risks. Estimating the impact on property looks relatively less complex. It will be more straightforward to determine the physical locations of properties. Moreover, undertakings can use similar techniques as for the assessment of physical risks

⁴⁵ Twenty Four Seven, Scenario Analysis for Physical Climate Risk, June 2019, <http://427mt.com/2019/06/18/scenario-analysis-for-physical-climate-risk-equity-markets/>

⁴⁶ Twenty Four Seven and GeoPhy, Climate Risk, Real Estate, and the Bottom Line, October 2018, http://427mt.com/wp-content/uploads/2018/10/ClimateRiskRealEstateBottomLine_427GeoPhy_Oct2018-6.pdf

relating to their property underwriting portfolio.

- 5.13. The specifications for the 2019 general insurance⁴⁷ and life insurance⁴⁸ stress test in the UK contain stresses for the impact of physical risk, but also transition risk, on the value of different asset types under a range of climate change scenarios.

Multi-period projections

- 5.14. A short-term, or at least a one-year, scenario analysis of climate change risk does not require a projection of balance sheets into the future. Undertakings can just apply the (instantaneous) scenario or stresses to the current balance sheet.
- 5.15. As a simplification, to avoid multi-period projections, it is also possible to assess transition and physical events that occur in the future relative to current balance sheets. For example, the PRA allowed for such a simplification in its first exploratory climate change part of its 2019 stress test and EIOPA proposes in its discussion paper⁴⁹ to do the same in its first exploratory climate stress test for the insurance sector.
- 5.16. Other (partial) scenario analyses are conceivable that do not require the projection of a (full) balance sheet, but preserve the long-term character of climate change scenarios, like the projection of simple ratios, e.g. the evolution of claims for different perils or geographic areas. Undertakings could also evaluate the asset side in isolation from technical provisions by showing the impact of a transition scenario on the market value of an investment portfolio over time.
- 5.17. Still, the projection of a full balance sheet provides several important benefits. Most importantly, it ensures internal consistency. Climate change scenarios often affect both sides of the balance sheet, e.g. through the channel of transition risk on the asset side and physical risk on the liability side. Also in life insurance, for example, payouts to policyholders may be directly linked to asset returns, so a transition scenario would necessarily affect both sides simultaneously. Further, in the case of one or multiple asymmetric balance sheet shocks (e.g., a shock to the liability side with no supposed change to the asset side) a full projection can be useful to ensure the feasibility of the management decisions intended to help mitigate such shocks. For example, it is of little interest to evaluate the reaction of an undertaking to both a transition risk scenario - which may include a reorientation of a portfolio towards a more sustainable sector - and a physical risk scenario - which may involve exiting a certain line of business or geographical area - without measuring the compatibility of the two under the balance sheet constraints. A complete balance sheet projection enhances undertakings' insight and reflection about the sustainability of their business model and strategy, also fostering richer and more challenging discussion in the management board.

⁴⁷ PRA's General Insurance Stress Test 2019 - Scenario Specification, Guidelines and Instructions, 18 June 2019, <https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/letter/2019/general-insurance-stress-test-2019-scenario-specification-guidelines-and-instructions.pdf>

⁴⁸ PRA's Life Insurance Stress Test 2019 - Scenario Specification, Guidelines and Instructions, 18 June 2019, <https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/letter/2019/life-insurance-stress-test-2019-scenario-specification-guidelines-and-instructions.pdf>

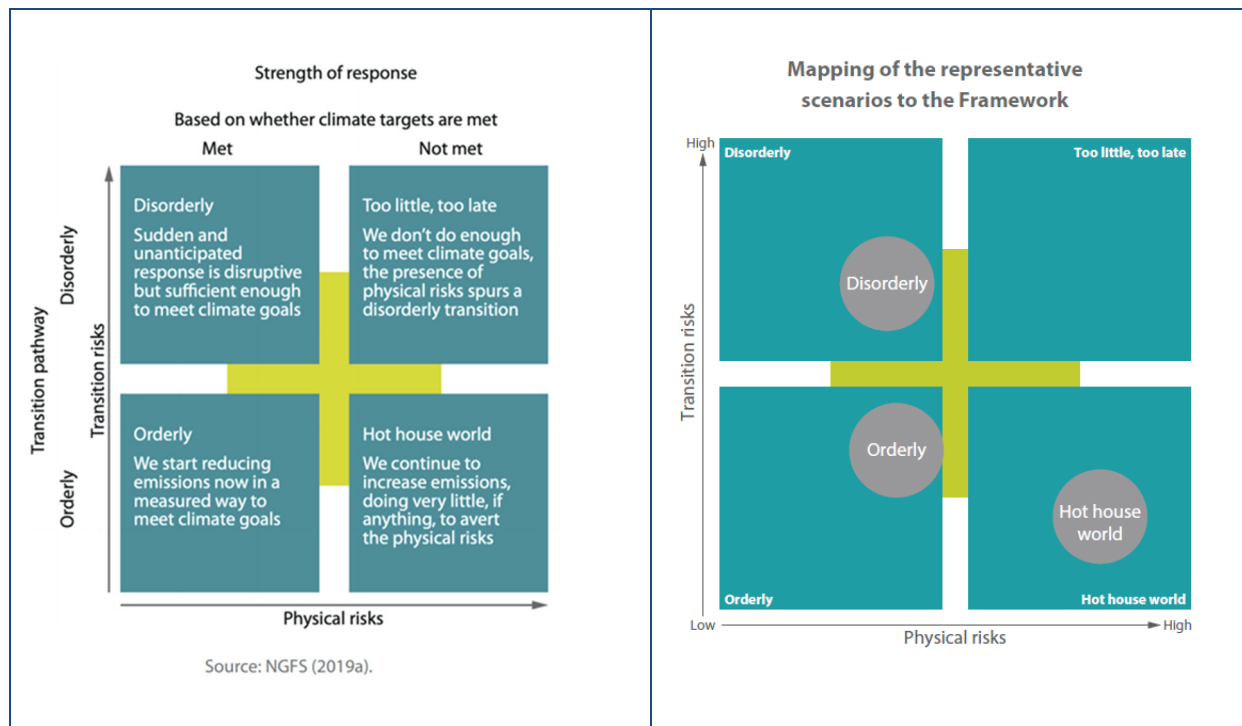
⁴⁹ EIOPA's Second Discussion Paper on Methodological principles of insurance stress testing (EIOPA-BoS-20/341), 24 June 2020.

Moreover, it would allow CAs to assess emerging risks due to compositional conflicts or inconsistencies for the market as a whole.

- 5.18. The aim of a long-term scenario analysis is to evaluate business strategies taking into account the material risk drivers relating to climate change. As such, it is not the intention to make detailed projections of all income and expense items, all balance sheet items and all SCR components. Since the long-term analysis is meant to assess business strategy in a range of 'what if' scenarios, it would, for example, be important to reflect new business in the projection of future liabilities. Similarly, capital charges for underwriting risk would be expected to increase in long-term climate change scenarios. In contrast, simple extrapolation methods should be considered for elements of the SCR that are not materially impacted. The same holds true for income-expense and balance sheet items of business lines that are not materially affected. Lastly, simplified methods should be considered for projecting the risk margin and the best estimate of technical provisions to keep the computations tractable.

Annex 6: NGFS climate scenarios

- 6.1. The Network for Greening the Financial System (NGFS)⁵⁰, in partnership with an academic consortium⁵¹, published a set of reference scenarios which generally fall into three categories: an orderly transition, a disorderly transition and a “hot house” world. Both of the transition scenarios are consistent with limiting global warming to below 2°C by 2070, while growing emissions in the “hot house” world lead to temperature rises of over 3°C by the same horizon. The three representative scenarios in each of the three quadrants are supplemented with five alternate scenarios with different assumptions on policy responses, temperature targets and technological progress.⁵²



- 6.2. Phase 1 of the scenarios contain impact variables on transition pathways (energy demand, capacity, investment and prices, carbon prices, emissions, temperature trajectories, agricultural variables and GDP) as well as on variables on chronic climate impacts (like temperature, precipitation and GDP) up to the year 2100. In a phase 2 update, the NGFS intends to:

- expand the scenario modelling to explore the further dimensions of the risks;
- improve regional coverage and sectoral granularity;
- calculate probabilistic losses from acute climate impacts;

⁵⁰ The NGFS consists of 66 central banks and supervisors as well 13 other institutions whose goals include the development of risk management tools related to climate change for broad, harmonized use within the financial system. Such tools include the modeling of distinct climate scenarios and subsequent projections of a wide range of macroeconomic and climate variables.

⁵¹ Potsdam Institute for Climate Impact Research (PIK), International Institute for Applied Systems Analysis (IIASA), University of Maryland (UMD), Climate Analytics (CA) and the Swiss Federal Institute of Technology in Zurich (ETHZ).

⁵² NGFS Climate Scenarios for central banks and supervisors: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_final.pdf

- expand the set of macroeconomic outputs;
 - improve the NGFS Climate Scenario database and portal.
- 6.3. Impact variables for the NGFS scenarios result from an ensemble of integrated assessment models, general circulation models, sectoral impact models and global macroeconomic damage functions. Currently, two distinct NGFS databases containing such variables are openly accessible:
- the NGFS Scenario Explorer⁵³ provided by IIASA, for transition pathways and data on macroeconomic impacts;
 - the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP)⁵⁴, for physical impact data.
 - technical documentation for these two databases, including information regarding how to access the platforms, is available on the NGFS website⁵⁵.
- 6.4. The Scenario Explorer allows users to pick one of 43 scenarios (all of which are classified as either orderly, disorderly or hot-house) and to choose subsequent impact variables such as energy demand, energy investment, electricity capacity, CO₂ emissions, GDP losses, land cover, crop yields (cereal, oilcrops and sugarcrops), and carbon prices. The coverage is global, although different models for different scenarios offer different levels of geographic granularity. Data can be viewed either as a line / bar chart or in a table, with a horizon of 2100.
- 6.5. The ISIMIP database contains projections for physical risk variables that can be useful for non-life insurers to model the evolution of claims for property damage or other NATCAT-related perils. The database contains a myriad of impact models which all use common pre-processed input data to yield outputs of varying levels of geographical granularity and frequency.
- 6.6. While the database contains over 100,000 individual variables, they can be filtered based on factors such as the RCP scenario, frequency, underlying climate model or geographic zone. These data are downloadable in a geo-localised NetCDF (.nc). Even at a monthly frequency, these data files tend to be large (100-200 MB+) and generally require expertise on climate data, although the format can be opened in R using the `ncdf4` package.

⁵³ <https://data.ene.iiasa.ac.at/ngfs/#/workspaces>

⁵⁴ <https://esg.pik-potsdam.de/search/isimip/>

⁵⁵ https://www.ngfs.net/sites/default/files/ngfs_climate_scenario_technical_documentation_final.pdf

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