

IMPACT UNDERWRITING

Report on the Implementation of Climate-Related Adaptation Measures in Non-Life Underwriting Practices

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1. EXECUTIVE SUMMARY

1. The expected growth in physical risk exposures and insurance claims due to climate change will increase risk-based premium levels over time, potentially impairing the mid- to long-term affordability and availability of insurance products with coverage against climate-related hazards. Climate-related adaptation measures, for example water-resistant walls or doors in case of flood risks, reduce the policyholder's physical risk exposures and insured losses, and can be a key tool to maintain the future supply of non-life insurance products covering climate-related hazards. Adaptation measures can therefore help to reduce the climate-related insurance protection gap in Europe.¹
2. EIOPA has conducted a pilot exercise on the implementation of climate-related adaptation measures in non-life insurance products with 31 volunteering insurance undertakings from 14 countries. EIOPA would like to express its gratitude to each of the participants for dedicating time and resources to the pilot exercise, and thereby contributing to foster the discussions about the implementation of climate-related adaptation measures in non-life underwriting practices.
3. The pilot exercise particularly aims to better understand the industry's current underwriting practices regarding climate change adaptation and to assess their prudential treatment under Solvency II, and whether the prudential framework introduces any obstacles potentially hindering the incorporation of adaptation measures in insurance products.
4. Overall, the European insurance market appears to be at an early stage regarding non-life insurance products implementing climate-related adaptation measures, particularly in context of the retail insurance business. While the current implementation level of adaptation measures in the European insurance market shows progress in making the society and economy more resilient against the occurrence of climate- and weather-related loss events associated with climate change, a comparison with other insurance markets around the world suggests there is further room for improvement. Particularly in terms of standardising the implementation of climate-related adaptation measures in insurance contracts, for instance through dedicated risk-based certificates and programs, as well as the risk-based recognition of adaptation measures in insurance premiums, for instance through discounts, can be considered important development areas for a widespread implementation of climate-related adaptation measures in the European insurance market.

¹ Currently only 23% of the total losses caused by extreme weather and climate-related events across Europe are insured, leading to a substantial insurance protection gap, which is expected to become even wider given the current trajectories of climate change (EIOPA (2022a)).

5. Regarding the overall objective of adapting the society and economy appropriately to climate change, it is however important to consider that this objective cannot be reached through the sole contribution of insurance, but further accompanying actions beyond the scope of insurance should be taken, for instance in terms of developing and enforcing public building codes adapted to the dynamics of climate change.
6. The participants in the pilot exercise perceive climate change to affect several lines of business already materially, but property insurance to be the insurance line most strongly exposed to physical risks related to climate change. Typically, the individual insurance lines are affected by multiple climate-related hazards, but water-related hazards appear to be the most frequent type driving claims. Interestingly, only few participants mentioned to provide explicit information to policyholders about climate change and its potential impact on risk exposures.
7. As risk-based insurance premium levels are expected to rise in several lines of business due to climate change, risk prevention in terms of adaptation measures is considered by the participants as an important and effective approach for maintaining the long-term availability and affordability of non-life insurance products covering climate-related hazards. The variety of adaptation measures implemented by the participants in their underwriting practices generally underlines that climate change adaptation is a topic taken seriously by both large and small insurance undertakings. However, the use of adaptation measures currently appears to be rather a use case for commercial insurance products due to typically individualized risk assessments (e.g. loss engineering services) and insurance contracts compared to the standardized retail business.
8. Underwriting practices and adaptation measures referred to by participants comprise, for instance, dedicated risk assessments and corresponding advice on prevention measures in property insurance, alert and warning systems against extreme weather events or static risk prevention measures like anti-flood shutters. The measures implemented have a wide cost range, starting by 1300 EUR (anti-flood shutters) to 100000 EUR (micropiles against subsidence risk). Only few participants mention to explicitly incentivize the take up of climate-related adaptation measures through premium discounts, particularly due to difficulties in assessing the precise impact of these measures on risk exposures.
9. Overall, three main areas of challenges regarding the implementation of adaptation measures in non-life insurance products emerge from the responses of the participants. Firstly, a lack of awareness about climate change and related adaptation measures by policyholders is naturally limiting the market demand for corresponding insurance products. Secondly, difficulties seem to exist in the appropriate risk-based recognition of adaptation measures particularly in standardized insurance contracts for the retail insurance business. Thirdly, the costs of adaptation measures can be material, requiring financial incentives for policyholders (e.g. premium discounts, tax reductions, grants) to stimulate the take up of risk prevention measures.

10. To overcome these challenges and to foster climate change adaptation in non-life insurance in a European-wide context, several areas need to be in the scope for next steps to which public and private stakeholders should jointly contribute to. Climate-related risk awareness could be raised, for instance, by means of dedicated information campaigns targeted at the individual policyholders, ideally incorporating granular information about the local effects of climate change on the policyholders' risk exposure. Awareness about adaptation measures and their potential effectiveness in risk reduction could be raised, for instance, by means of web-based tools. Furthermore, improvements in the risk-based modelling of the effects of adaptation measures on climate-related risk exposures, especially in case of small-scale measures (e.g. mobile water barriers like sandbags), as well as improvements in standardizing adaptation measures and underwriting practices (e.g. in terms of common risk assessment programs or risk labels) could help to foster the widespread implementation of adaptation measures in underwriting practices and to provide risk-based incentives for policyholders (e.g. lower premium levels).
11. EIOPA will continue its work on impact underwriting to foster climate change adaptation in non-life insurance in the EU, and will contribute with its work programme for 2023 to help overcoming some of the challenges arising from the pilot exercise. In particular, EIOPA will focus on raising the public awareness about climate risks and related prevention measures, and will promote the use of open-source modelling and data in relation to climate risks. Moreover, through its assessment of the potential for a dedicated prudential treatment of climate change adaptation in non-life underwriting practices and the re-assessment of the standard formula for natural catastrophe risk, EIOPA will ensure the appropriate recognition of these climate-related aspects in the prudential framework.

2. INTRODUCTION

12. Climate change is expected to materially increase the frequency and severity of climate- and weather-related events, thereby raising the physical risk exposures of the society and real economy (IPCC (2021)). For Europe, findings by the JRC (2020) and Forzieri et al. (2016) show a pronounced impact of climate change and rising temperature levels on the risk exposures of southern regions, particularly regarding heatwaves, wildfires and droughts.
13. The insurance industry as risk manager plays an important and unique role in raising the resilience of the society and real economy against climate change. Insurance products pricing risks and compensating financial losses regarding climate- and weather-related events help to protect economic wealth and social welfare. However, due to the expected growth in physical risk exposures related to climate change, risk-based premium levels are expected to increase as well over time, potentially impairing the mid- to long-term affordability and availability of insurance products with coverage against climate-related hazards.² Currently only 23% of the total losses caused by extreme weather and climate-related events across Europe are insured, with material differences in the scope of the protection gaps across countries and perils (EIOPA (2022a)). Given the current trajectories of climate change, these insurance protection gaps are expected to become even wider in the future as more frequent and severe natural disasters are likely to occur. Climate-related adaptation measures that are implemented ex-ante to a loss event, for example water-resistant walls or doors in case of flood risks, reduce the policyholder's physical risk exposure and insured losses (e.g., Poussin et al. (2015), Kreibich et al. (2011)). As such, adaptation measures can be a key tool to stabilize risk-based premium levels in light of climate change and to maintain the future availability and affordability of insurance products with coverage against climate-related hazards.
14. In this regard, EIOPA introduced the concept of impact underwriting, capturing the ability of insurance undertakings, consistent with actuarial risk-based principles, to contribute to the adaptation of the society and real economy to climate change by means of their underwriting practices in terms of data, risk assessment and expertise, thereby promoting and incentivizing policyholders to take up climate-related adaptation measures (EIOPA (2021)). As a subsequent step and motivated by the EU Commission's "Strategy for Financing the Transition to a Sustainable Economy",³ EIOPA has been conducting a pilot exercise on the implementation of

² For instance in the United States, the state of California introduced in 2018 one-year moratoria on insurance companies stopping to provide property insurance coverage in wildfire-prone areas (California Department of Insurance: [Senate Bill 824 \(2018\)](#)).

³ [Annex 2 \(c\)](#) of the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Empty - Strategy for Financing the Transition to a Sustainable Economy.

climate-related adaptation measures in non-life insurance products with volunteering insurance undertakings in 2022.

15. The pilot exercise focuses on two particular aims.⁴ Firstly, to better understand how insurance undertakings implement climate-related adaptation measures in non-life insurance products and to promote the further development of these climate-resilient products. Secondly, to assess the appropriateness of the prudential consideration of climate-related adaptation measures in Solvency II, as an inadequate reflection of the risk-based effects of adaptation measures could potentially prevent insurance undertakings from a large-scale implementation of such measures in their underwriting practices.
16. The report on EIOPA's pilot exercise provides a descriptive assessment of current underwriting practices of the participating EU insurance undertakings related to the environmental objective of climate change adaptation. The scope of the pilot exercise is also motivated by the EU Taxonomy and its technical criteria for non-life insurance underwriting to be eligible under the objective of climate change adaptation.⁵ In this regard, the technical criteria comprise, for instance, the disclosure of the impact of climate-related hazards on physical risk exposures and the provision of risk-based incentives for policyholders regarding risk prevention, for instance through reduced premiums or deductibles.

3. PILOT EXERCISE

17. The following sections of the report provide an overview of EIOPA's pilot exercise and its main findings regarding current underwriting practices and challenges mentioned by the participating insurance undertakings.

3.1. CLIMATE-RELATED ADAPTATION MEASURES

18. Climate-related adaptation measures can differ substantially regarding their form and ability to protect against climate-related hazards. Practical examples involve: specific building improvements like water-resistant walls, windows and doors or external building measures like sandbags and domestic protection walls against flood risk, heat- and fire-resistive construction materials for buildings against wildfires or forecasting and warning systems to enable policyholders to protect their goods in advance to severe weather events.

⁴ EIOPA (2022): [Factsheet on the Pilot Exercise](#).

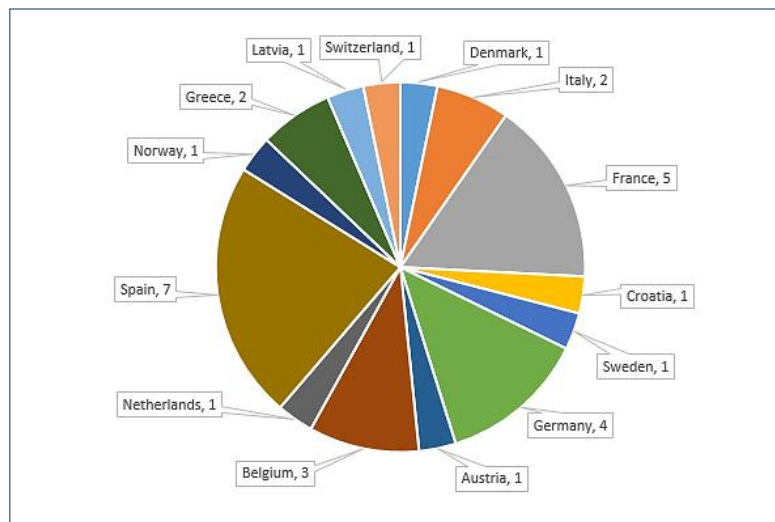
⁵ Delegated Regulation (EU) 2021/2139, Section 10.1.

19. Although the exact impact of climate-related adaptation measures on physical risk exposures depends on multiple factors, e.g., the type of adaptation measure implemented, the targeted climate-related hazard or the spatial exposure of the object to be protected, evidence in the literature underlines that climate-related adaptation measures can be an effective tool to reduce climate-related risk exposures.
20. Several empirical studies exist that analyze the effect of climate-related adaptation measures on physical risk exposures and the corresponding costs to implement those measures, thereby particularly focusing on risk prevention measures for buildings against flood risk. Poussin et al. (2015) analyze the cost-effectiveness of flood-related adaptation measures in France, showing the potential of several adaptation measures (e.g., use of water-resistant materials, raised power sockets, sandbags, etc.) to reduce flood risk in a cost-efficient way. In particular, for moderate loss events occurring with a relatively high frequency, the cost efficiency of these measures seems to be advantageous compared to the case of less frequent but more severe loss events. Similar evidence on the cost efficiency is provided by Hudson et al. (2014), comparing flood-related adaptation measures in terms of (i) a building's adapted use (e.g., storage of valuable goods on higher floors), (ii) its interior fitting (e.g., use of resistant materials), (iii) its buildings structure (e.g., raised foundation) and (iv) external water barriers (e.g., sandbags). Kreibich et al. (2011) and Kreibich et al. (2005) underline these findings, but also highlight that small-scale adaptation measures, e.g., external water barriers like sandbags, can have a material impact on reducing flood-related damages in case of tail events.
21. From a risk-based perspective, a clear link between climate-related adaptation measures and insurance premiums is directly given, as adaptation measures aim to reduce the policyholders' physical risk exposures and losses associated with climate change, and thereby contribute to reduce the actuarial fair premium of an insurance contract. Climate-related mitigation measures, however, focus on actions to reduce greenhouse gas emissions, for instance motor insurance products focusing on electric vehicles, for which a risk-based impact on the actuarial fair premium does not necessarily exist and are therefore excluded from the scope of the pilot exercise.
22. Climate-related adaptation measures have been defined for the pilot exercise as: Structural measures and services that are implemented by the policyholder ex-ante to a loss event, which reduce the policyholder's physical risk exposure to climate-related hazards through lowering the probability that a climate-related loss occurs or lowering the severity of a climate-related loss.
23. The definition focuses on private and typically small-scale measures with limited costs that can be implemented by policyholders or insurance undertakings on their own. In contrast, public measures like dikes against flood risks are not captured, as these measures are not under the control of policyholders or the undertakings and cannot be legally implemented in the terms and conditions of a private insurance contract.

3.2. STRUCTURE OF THE PILOT EXERCISE

24. EIOPA has been particularly focusing in the pilot exercise on insurance products that:
- i. Offer insurance coverage for climate-related hazards according to the EU Taxonomy (temperature-, wind-, water- and solid mass-related; Table 1 in the Annex)
 - ii. Implement climate -related adaptation measures that lower the policyholders' physical risk exposures to climate-related hazards
 - iii. Set incentives for policyholders to take up adaptation measures, e.g., through reduced premiums or deductibles
25. The pilot exercise has been based on a two-step approach in 2022: Firstly, an excel-based questionnaire has been sent to all participants, and based on the responses, dedicated interviews with a limited number of insurance undertakings have been conducted to collect further insights into their climate-related underwriting practices.
26. The questionnaire contained twenty-four questions (provided in the Annex), related to four main areas:
- i. Influence of climate change on non-life insurance lines of business
 - ii. Implementation of climate-related adaptation measures in non-life insurance products
 - iii. Underwriting effects of climate-related adaptation measures
 - iv. Prudential treatment of climate-related adaptation measures
27. The pilot exercise aimed for a voluntary participation of undertakings with non-life insurance business. The final sample consisted of thirty-one undertakings from fourteen countries (Figure 1), and three responses by insurance-related associations that have been included in the analysis to reach a more comprehensive picture.
28. The structure of the responding undertakings ranged from small- and medium-sized companies that have a more regional focus to large insurers and groups which are globally engaged with their underwriting business. Furthermore, the company- and ownership structures varied: Some undertakings and groups that participated in the exercise are listed stock companies, others are organized as stock companies but are closely tied to the public sector. A third group comprises mutual insurance companies and groups. The geographic distribution of the participating undertakings covers various regions differently exposed to climate change (Figure 1), and the heterogeneity of the undertakings in the sample shows that climate change and corresponding adaptation measures are not only of interest for large undertakings but affect a much broader spectrum of the undertakings in the European insurance market.

Figure 1: Geographic Distribution of the Sample of Insurance Undertakings



Source: Own Figure.

3.3. NON-LIFE INSURANCE AND CLIMATE CHANGE

29. The questions in this section focused on the impact of climate change on physical underwriting risk in certain non-life insurance lines as perceived by the insurance undertakings (questions 1-8). The list of insurance lines considered comprises as a starting point those insurance lines mentioned by the EU Taxonomy for the eligibility of non-life insurance under the objective of climate change adaptation,⁶ and is extended by further insurance lines that could be potentially exposed to climate change as well. The insurance lines considered are: Motor vehicle liability; Other motor insurance; Marine, aviation and transport insurance; Fire and other damage to property insurance; General liability insurance; Credit and suretyship insurance; Legal expenses insurance; Assistance insurance; Miscellaneous financial loss.
30. Moreover, undertakings have also been asked whether they have raised premiums or deductibles due to climate change, or reduced insurance coverage after an extreme weather-related loss event. Further questions were raised whether the insurance undertakings adjusted the terms and conditions of their insurance products in relation to climate change, in particular regarding contractual definitions and specific exclusions regarding climate-related loss events, and to what extent the insurance undertakings provide specific information to policyholders on the potential impact of climate change on their physical risk exposures.
31. Property insurance has been mentioned as the line of business most strongly affected by climate change, with a large consensus among the participants (two-thirds of respondents). This

⁶ Delegated Regulation (EU) 2021/2139, Section 10.1.

outcome is in line with recent findings by EIOPA (2022b), showing massive property-related claims due to extreme weather-related events in the last decade. The lines other motor insurance, and marine, aviation and transport insurance have been indicated as moderately influenced by climate change, followed by motor vehicle, general liability, and assistance insurance indicated as weakly impacted by climate change.

32. Interestingly, regarding insurance against legal expenses, most respondents indicated the line of business as not affected by climate change, whereas several respondents consider it weakly impacted. The perceived relatively low exposure can be underlined by the global climate change litigation database of the Sabin Center for Climate Change Law, showing currently only a relatively small number of climate-related cases against firms outside the U.S. jurisdiction (102 cases).⁷ However, the introduction of stricter requirements on climate- or environmental-related governance and disclosures for firms in the EU, for instance in terms of the Corporate Sustainability Reporting Directive (CSRD), could potentially increase climate-related litigation risks in the real economy, which might affect insurance products covering legal expenses more materially in the future.
33. Insurance undertakings also mentioned that individual business lines are typically affected by multiple climate-related hazards. Most business lines seem to be affected by water-related hazards, followed by wind-related hazards and temperature-related hazards as driving force for physical risk exposures. Solid-mass related hazards have been reported as a minor driving force.
34. In most lines of business, the respondents mentioned not to have raised insurance premiums due to climate change. However, many respondents mentioned increases in premium levels in property insurance, which is in line with property insurance being the insurance line of business most strongly exposed to climate change as reported by the participants. Similarly, respondents mentioned not to have raised the level of deductibles of insurance contracts in most lines of business, besides property insurance. In this case, the respondents have, generally, imposed higher deductibles after extreme weather-related loss events, either globally or on a case-by-case basis, by adjusting the terms and conditions after suffering losses higher than expected. Moreover, most respondents (around two-thirds) mentioned not to have reduced insurance coverage after an extreme weather-related loss event, and also not to have changed the contractual definitions of weather-related loss events for insurance products in relation to climate change, mainly due to uncertainty about the exact effects of climate change on loss events.
35. As for the specific exclusions in the contractual terms and conditions of insurance products related to the effects of climate change, most of the participants (around 70%) mentioned not to have specific climate-related exclusions in their insurance products. In some cases, it is highlighted that the purchase of specific climate-related loss coverage is optional for the

⁷ Sabin Center for Climate Change Law at Columbia School: [Global Climate Change Litigation](#).

policyholder (apart from countries where specific legislative measures apply, e.g., France or Spain). Some respondents pointed out to consider that the typical duration of insurance coverage is one year, making any contractual links to climate change considerations, e.g., in terms of exclusions, substantially subjective. Regarding multi-year insurance policies, specific contractual features may be present to allow for flexibility, either generally (possibility of updating tariffs annually with the right for the policyholders to recede) or specifically in case of losses (e.g., possibility of cancelling the policy or review tariffs). Around 10% of participants mentioned that they have specific climate-related exclusions in the contractual terms of their insurance products, however, without further specifying these exclusions in their responses to the pilot exercise.

36. Regarding the information provided by insurers to their policyholders on the potential impact of climate change on their insurance coverage or insurance premiums, around one fourth of the sample stated that they provide specific climate-related information to their policyholders. Some undertakings provide information on practical risk management actions (e.g., window closing in advance to severe weather-related events, empty water pipes in winter in secondary homes, etc.) or organize information sessions to raise awareness on climate risks, others refer to information already available on the web or dedicated communications have been sent to policyholders to explain the impact of climate changes on the policies underwritten. Regarding commercial insurance products, participants reported to provide detailed reports to clients on their exposure to weather- and climate-related risks, and on ex-ante actions that increase the resilience to these risks, e.g., as part of a loss prevention and risk engineering activity.

3.4. UNDERWRITING PRACTICES

37. The questions addressed to participants in this section focus on their underwriting practices related to climate change adaptation, particularly regarding the specific climate-related adaptation measures implemented in their non-life insurance products, corresponding costs and incentives for policyholders to take up the risk prevention measures.
38. Most participants (around 70%) considered climate-related adaptation measures to be an effective tool to maintain the long-term availability and affordability of non-life insurance coverage in light of climate change. Around half of the participants specified they offer insurance products that include or incentivize climate-related adaptation measures, primarily regarding property insurance and, to a lesser extent, crop and motor insurance. Several respondents explicitly mentioned to be in an early testing phase regarding the implementation of climate-related adaptation measures in their insurance products, thereby being at the starting point to collect findings on the effect of the implemented adaptation measures on underwriting risks and insurance premiums. Several conceptual approaches highlighted by the participants are described in more detail in the following sections.

39. As property insurance has been mentioned by participants to be the line of business most strongly exposed to climate change, climate-related risk prevention becomes an important measure to maintain the long-term affordability and availability of property insurance coverage. As it is typically difficult for individual policyholders to assess their climate-related risk exposure, insurance undertakings with their unique expertise in risk management can play an important role on making the society and real economy more climate-resilient by providing dedicated risk assessments and advice. One underwriting practice provided in the pilot exercise focuses on dedicated risk assessments for residential buildings.

Example: Dedicated Risk Assessments in Property Insurance

As part of the property insurance product, dedicated risk assessments with a duration of about 90 minutes are offered to policyholders owning single family homes, and costs are already covered by the paid insurance premium. These on-site risk assessments are conducted with a professional external partner and aim to inform the policyholders about their individual exposures to climate-related hazards (e.g. flood risks) and provide dedicated recommendations to reduce the risk exposures. The policyholders can conduct these risk assessments voluntarily on a regular pattern and are not obliged to follow the provided recommendations through the insurance product's terms and conditions. According to the undertaking, the risk assessments lead to a general reduction in the volume of property claims in the underwriting portfolio.

40. Climate change is expected to increase the frequency and intensity of climate- and extreme weather-related loss events. In conjunction with a generally increasing urbanization and settlement of costal and river areas, increasing fractions of the society are exposed to the physical risk consequences of climate change, making early warning systems and predictive models an important aspect to raise the climate resilience of the society and real economy.
41. Through digitalization of communication, and the availability of granular climate- and weather-related data from public sources (e.g. the Copernicus Climate Change Service (C3S), the European Flood Awareness System (EFAS)), alert and warning systems can relatively easily be implemented, and aim to provide policyholders with the opportunity to take specific precautionary actions to protect insured goods in advance to an extreme weather-related event. Particularly in case of insured goods with a fixed geolocation, alert systems in conjunction with clear recommendations can be an effective tool for risk prevention. Although public warning systems often exist around the world to forecast and warn people against climate-related hazards like, e.g. severe floods, storms or wildfires, an application in the insurance context provides a unique advantage as alert messages can be combined with tailored recommendations on precautionary measures specific to the insured good on which insurance

undertakings already have data. Multiple participants highlighted the implementation of early warning and alert systems against extreme weather events in their underwriting practices.

Example: Early Warning Systems

In the examples provided, digital alert messages are typically sent to property insurance policyholders in advance to weather-related events associated with severe rain, wind, hail, storm, snow and cold wave. The alert system is often a default approach in the product's terms and conditions and alert messages are sent to all policyholders according to the geolocation of the insured property. Weather data and forecasts usually stem from professional external providers. While one participant highlighted the difficulty in assessing the effect of alert and warning systems on claims, particularly as the effectiveness in risk prevention depends on policyholders' quick reaction to follow recommendations, another participant highlighted a decline in the frequency of claims.

42. Ecosystems, for instance wetlands, forests or coastal systems, can act as natural climate-related adaptation systems and contribute to reducing the physical risk exposure to multiple climate-related hazards, for instance, in terms of water- and wind-related hazards (EEA (2021)).⁸ The overarching concept, nature-based solutions, describes thereby dedicated approaches building on nature to address societal challenges, for instance climate change adaptation. In addition, through the conservation and restoration of ecosystems, nature-based solutions can also contribute to preserve biodiversity which is a further environmental objective of the EU Taxonomy.
43. Also in the insurance context, nature-based solutions can be implemented to reduce climate-related risk exposures. Some participants in the pilot exercise mentioned explicitly the implementation of nature-based solutions in their underwriting practices.

⁸ For a comprehensive overview of the conceptual framework of nature-based solutions with regard to climate change adaptation, please see EEA (2021).

Example: Nature-Based Solutions

One participant mentioned green roofs as a climate-related adaptation measure. Through greening roofs with plants, negative consequences from heavy precipitation could be reduced, for instance in terms of damages related to drains and sewers or pluvial flood. The undertaking incentivizes the construction of green roofs with a 10% premium discount on property insurance.

As part of green infrastructure, green roofs can also reduce urban heat islands and compared with bare roofs, materially improve the insulation of buildings and contribute to biodiversity (EEA (2021)).

Another example provided by a participant comprises the insurance of coral reefs. By mitigating up to 95% of wave energy, coral reefs can act as an important nature-based solution to reduce damages related to shoreline erosion, coastal flooding and storm surge (EEA (2021)). These insurance products aim to persevere coral reefs as ecosystems by supporting the restoration after a damage. Typically, the insurance product is based on a parametric mechanism triggered by wind speeds exceeding certain threshold levels. The insurance premiums are usually paid by local communities and not by private parties, e.g. by taxes collected from the tourism industry.

Not mentioned by participants, but agroforestry (integration of trees in crop farming) or crop diversification, for instance, can also be considered as effective examples of nature-based adaptation measures against drought risk (EEA (2021)), and could potentially be implemented in crop insurance contracts.

44. Crop insurance has also been mentioned by participants as an insurance business line materially exposed to climate change. One participant mentioned to implement hail protection nets or field irrigation systems as preventive actions in its crop insurance products but pointed out the difficulties in measuring the exact effect of these adaptation measures on crop yields due to seasonal weather-related effects, differences in the spatial exposure to climate change across policyholders as well as the crop's individual resilience to climate-related hazards. Another practical example of implementing climate-related adaptation measures in crop insurance and providing related financial incentives to policyholders can be found in the public-private-insurance scheme Agroseguro.⁹ As part of the insurance scheme, specific premium discounts are provided if certain climate-related adaptation measures are implemented by policyholders,

⁹ Agroseguro (2022): [Seguro de explotaciones de producciones tropicales y subtropicales](#).

for instance sprinklers against frost risk, hail protection nets against hail risk or semi-permeable windbreaks against wind risk.

45. Further examples of climate-related adaptation measures implemented in underwriting practices as provided by the respondents include:
- ▶ Build-Back-Better, i.e., restoring damages with climate-resilient materials to prevent future damages
 - ▶ Anti-flood shutters and doors with automatic closing against flood risk
 - ▶ Elevation of ground floor or electric installations against flood risk
 - ▶ Micropiles under buildings and soil-rehydration-systems against subsidence risk
 - ▶ Tempered glass against hail risk
46. One respondent mentioned national legislation and building codes requiring specific risk prevention measures (e.g. the installation of a backwater valve) as a prerequisite to obtain property insurance coverage in high flood risk areas. However, some respondents also mentioned that public compensation schemes covering damages related to natural catastrophes can act as disincentive to implement climate-related risk prevention measures in private insurance contracts.
47. Only a few respondents mentioned to explicitly evaluate the expected impact of climate-related adaptation measures on physical risk exposures. Most respondents mentioned material challenges when assessing the potential effect on the risk insured or on the number of claims, particularly due to difficulties to clearly disentangle the climate-related effect from other risk factors. Assessments are typically conducted only regarding specific policies, particularly on a case-by-case basis for commercial insurance products for which the policies' terms and conditions are individualized and better suited to reflect climate-related adaptation measures, or, on the opposite, on the total aggregated underwriting portfolio level subsuming the individual effect of climate-related risk prevention measures.
48. The participants explained that adaptation measures can be very costly for policyholders as these are typically linked with innovative technologies and materials. For instance, one participant mentioned costs of suggested adaptation measures regarding flood risk of 1300 EUR (anti-flood shutters) to 3000 EUR (anti-flood doors), and against subsidence risk, a range of 15000 EUR (soil-rehydration systems) to 100000 EUR (micropiles). However, many participants argued not to explicitly collect data on the costs of adaptation measures or raised substantial challenges when quantifying the costs, as these depend on the specific measure implemented, the insurance business line concerned, the risk exposure involved, and the value of the assets insured.
49. Only a minority of undertakings provided explicit premium discounts to incentivize the take up of adaptation measures by policyholders. Some participants in the exercise raised doubts whether premium discounts should be considered an effective measure to incentivize adaption

measures, especially if applied in the highly standardized retail insurance business. Most participating undertakings (approximately 70%) also denied using deductibles to incentivize policyholders to take up climate-related adaptation measures. It has been pointed out that the cost of implementing adaptation measures could also exceed the potential benefits for the policyholders in terms of reduced deductibles (especially in the retail insurance business). Overall, the answers suggest that the insurance undertakings' incentivizing practices seem to be more developed for commercial insurance products than for retail products, as in commercial insurance lines the terms and conditions of an insurance contract are more flexible to take the specificities of risk prevention related to the individual policyholder into account.

50. Asked for potential obstacles that could prevent a broader implementation of climate-related adaptation measures in the product design of non-life insurance products, some participants named legal issues and costs as potential factors. In this regard, participants pointed out that the high level of standardization necessary in retail insurance contracts makes it difficult to recognize the risk-based effects of adaptation measures individually implemented by policyholders. It appears to be particularly difficult to generalize the risk-based effects of adaptation measures for standardized terms and conditions of insurance contracts, since the effectiveness of adaptation measures to reduce and prevent risks can be influenced by multiple factors, for instance by the spatial characteristics of the insured object or the type of climate-related hazard. Moreover, it has been raised that the monitoring of the adequate implementation of adaptation measures by individual policyholders can be challenging in mass business, and can constitute a potentially hindering factor.

3.5. PRUDENTIAL ASPECTS

51. The questions in this section focused on the prudential reflection of climate change and climate-related adaptation measures in Solvency II, particularly regarding the best estimate calculation of technical provisions and the solvency capital requirements.
52. Insurance undertakings are generally required to take environmental developments into account for the best estimate calculation.¹⁰ Overall, responses show a heterogeneous picture on the corresponding approaches used. Several undertakings argued that the annual pricing principle of non-life insurance contracts allows only for a limited effect of climate change on premiums and claims. Hence, the influence of climate change on cash flows is considered negligible. Other participants in the exercise have stated that they are conducting trend analysis to monitor the effects of climate change on their business, particularly including expert judgement and adjustments to the assumptions on inflation.

¹⁰ Article 260 of the Commission Delegated Regulation 2021/1256, and Article 29 of the Commission Delegated Regulation 2015/35.

53. As long claim settlement periods can potentially increase prediction errors in insurance pricing and increase reserve risk, participants have been asked for the average time period for claims settlement in the lines of business they consider most affected by climate change. The responses show substantial differences in settlement periods across participating insurers for certain lines of business, but overall, the time it takes to settle claims appears to be relatively short, i.e. two to three years. However, as the usual settlement periods reported in the responses are slightly longer than one year as the basis for the typical annual pricing period, a minor impact of climate change on reserve risk could potentially be possible. One participant mentioned a potential link between climate change and cost inflation following significant natural catastrophe events, which could increase the costs for claim settlement.
54. Most participants did not see general prudential obstacles that could hinder a risk-based consideration of climate change in the best estimate calculation and of the risk reducing effects of climate-related adaptation measures.
55. Regarding the question to what extent climate-related adaptation measures could affect the solvency capital requirements for premium-, reserve- and catastrophe risk, most respondents stated not to have explicitly assessed a potential link so far. Approximately one fourth of the participants expected no or limited effects of adaptation measures on underwriting risk from a prudential perspective, and pointed out that while there are clear risk reducing effects of adaptation measures on underwriting risk, mostly in terms of natural catastrophe risk, there are several side effects influencing the efficiency of adaptation measures in that regard. Particularly, adaptation measures can be very costly and have an impact area typically limited to a specific climate-related hazard, and reinsurance schemes as well as public compensation schemes for natural catastrophes could substitute the effects of adaptation measures on underwriting risks.
56. Overall, most respondents mentioned to be at an early testing phase of adaptation measures in their underwriting practices and not to explicitly conduct prudential assessments on the effects of adaptation measures on the solvency capital requirements. While participants did not mention explicit prudential obstacles that could disincentivize a large-scale implementation of adaptation measures in the underwriting practices, e.g. in the requirements on technical provisions or the solvency capital requirements, it is also mentioned that Solvency II's Standard Formula is relatively inflexible regarding the risk-based recognition of these measures in the capital requirements. For instance, the fixed parameters for the standard deviation in premium risk or the fixed natural catastrophe risk factors ("Q") would not allow for an explicit recognition of a potential effect of adaptation measures on physical risk exposures. However, undertakings can, after supervisory approval, calculate the solvency capital requirements by means of undertaking-specific parameters instead of using the standard parameters, which could be an appropriate prudential approach to recognize risk management in terms of climate-related adaptation measures in the capital requirements.

3.6. CHALLENGES FOR CLIMATE CHANGE ADAPTATION IN NON-LIFE INSURANCE

57. Three particular challenges emerge from the pilot exercise that appear to hinder the large-scale provision of non-life insurance products implementing climate-related adaptation measures:
- The lack of policyholders' awareness about climate change and related adaptation measures
 - Difficulties in the risk-based recognition of adaptation measures in standardized insurance contracts
 - Substantial costs of adaptation measures and lack of corresponding financial incentives for policyholders
58. Evidence in the literature shows that people tend to consider climate change to cause rather long-term consequences than short-term (Frondelet et al. (2017)). In particular, personal experience with natural catastrophes and related damages is shown to be a key determinant for corresponding climate risk awareness and raises the propensity to take up risk prevention measures ex-post to a natural disaster (Frondelet et al. (2017), Zaalberg et al. (2009)). However, as climate change is expected to materially increase the frequency and intensity of weather- and climate-related loss events, strengthening the implementation of adaptation measures ex-ante to climate- or weather-related loss event is an important aspect of making societies more climate-resilient in the future.
59. The responses by the participants have shown that only a minority provides specific climate-related information to policyholders, which could hinder the widespread implementation of climate-related adaptation measures in non-life insurance products as policyholders might not be aware of their climate-related risk exposures and related adaptation measures. For instance, De Boer et al. (2016) show that clear information about people's local climate-related risk exposures and corresponding socio-economic consequences can effectively increase climate risk awareness and stimulate the take up of risk prevention measures. In this regard, dedicated information campaigns focusing on reducing policyholders' uncertainty about their climate-related risk exposures, and taking their core values and worldviews into account can contribute to foster climate change adaptation in non-life insurance (Poussin et al. (2014), Rogers et al. (2012), Poortinga et al. (2011)).
60. Also public information on climate change is an important and necessary tool to raise awareness about climate risks and, as typically provided on a more general exposure level not focussing on individuals, could reinforce dedicated climate-related information campaigns of the insurance industry. For example, EIOPA provides a dashboard to address the natural catastrophe

protection gap in the EU and to raise general awareness about climate change and its consequences on risk exposures.¹¹

Example: EIOPA’s Dashboard on the Natural Catastrophe Protection Gap

The dashboard brings together data on economic and insured losses, vulnerabilities and exposure as well as insurance coverage across the European Union Member States. This information should allow for evidence-based decision-making on measures to improve society’s resilience against natural catastrophes. At the same time, the pilot dashboard should also help increasing the awareness of the protection gap, promote science-based approach to protection gap management and decision-making. This approach will help in identifying regions at risk, protection gap risk drivers as well as defining proactive prevention measures.

61. Information campaigns also need to contain clear recommendations for policyholders regarding climate change adaptation. Web-based tools, for instance, could be a relatively easy and effective tool to show the potential influence of climate-related adaptation measures on policyholders’ physical risk exposures. There are already several general examples outside the insurance context existing that could foster a corresponding development in the insurance context.

Example: Web-Based Tools on Climate Change Adaptation

- The Resilient House – ready for the new weather extremes?¹²
- AgriWizard – is your farm ready for the whims of the weather?¹³
- AWA - AgriAdapt Webtool for Adaptation¹⁴
- Climate change - ADAptation actions¹⁵

62. Raising policyholders’ awareness about climate change and potential adaptation measures through specific and targeted information provided by public authorities and insurance

¹¹ EIOPA (2022a).

¹² [Ministry of Environment of Denmark and Enviromental Protection Agency.](#)

¹³ [Ministry of Environment of Denmark and Enviromental Protection Agency.](#)

¹⁴ [LIFE AgriAdapt.](#)

¹⁵ [Life ADA.](#)

undertakings constitute a key step to reduce the climate-related insurance protection gap and should therefore be considered one of the most important areas for future work.

63. While loss engineering services including risk assessments and dedicated recommendations for risk prevention are often included in commercial insurance products which are based on more individualized terms and conditions of insurance contracts, major difficulties have been reported by participants to recognize climate-related adaptation measures and their impact on risk exposures in standardized insurance contracts for the retail business. In particular, generalizing the risk reducing effects of adaptation measures for standardized insurance contracts remains a difficult and complex task, as corresponding risk-based effects typically depend on multiple influencing factors, for instance:
- The spatial characteristics of the insured object (e.g. distance to disaster prone areas),
 - The existing physical condition of the insured object in terms of climate resilience (e.g. existence of damage resistant structures and materials),
 - The effectiveness of adaptation measures to reduce risk exposures (e.g. dependence on human interaction in case of alert systems)
64. Evidence on the risk-based effects of climate-related adaptation measures that could be used to generalize effects for standardized insurance contracts remains scarce, particularly linked to a general lack of open-source related data and modelling. Moreover, as mentioned by participants, the granular scope of information to be requested from policyholders in order to properly assess and recognize the implementation of climate-related adaptation measures in standardized insurance contracts might be too burdensome for policyholders. Therefore, improvements in the risk-based modelling of the effects of adaptation measures on climate-related risk exposures, as well as improvements in standardizing adaptation measures and underwriting practices are considered important approaches for next steps.
65. One property insurance underwriting practice highlighted in Section 3.4 provides dedicated risk assessments and recommendations on risk prevention at the individual policyholder level. By means of clear and reliable criteria, risk assessments could be standardized and provide the granular information necessary for an appropriate risk-based recognition of climate-related adaptation measures in standardized insurance contracts. Similar approaches exist in the U.S. insurance market, for instance on basis of the IBHS Fortified Home Program, which provides recommendations on climate-related risk prevention measures related to wind-, hail or wildfire risks.¹⁶ In certain U.S. states, policyholders are eligible to receive premium discounts for their property insurance if houses meet the required standards.¹⁷ Another example of standardization is California's "Safer from Wildfires" framework, which provides a list of effective adaptation

¹⁶ Insurance Institute for Business & Home Safety (IBHS): [Fortified Solutions](#); Insurance Institute for Business & Home Safety (IBHS): [Wildfire Prepared Home](#).

¹⁷ Insurance Institute for Business & Home Safety (IBHS): [Regulatory Framework for FORTIFIED Insurance Incentives](#).

- measures to make existing buildings more resilient against wildfires and to prevent the spread of wildfires to further buildings. Several insurance undertakings incentivize the take up of these measures by offering dedicated premium discounts for safer homes based on the framework.¹⁸
66. Developing a standardized assessment program for EU insurance markets focusing on climate-related risks and corresponding adaptation measures, for instance regarding property insurance as the insurance line of business most strongly exposed to climate change as mentioned by participants, could help to overcome the reported lack of standardization for retail insurance contracts. Some related approaches are already discussed in the EU context, for instance regarding the static and seismic safety of buildings in Italy, or a risk label capturing the exposure of buildings to natural catastrophes in Germany, which could be used as blueprints to discuss a standardized and EU-wide climate-related risk assessment program.¹⁹
67. The responses from the participants have shown that the costs of climate-related adaptation measures can be quite substantial, ranging, for instance, from 1300 EUR (anti-flood shutters) to 100000 EUR (micropiles against subsidence risk). For example in case of flood risk, Poussin et al. (2015) and Kreibich et al. (2011) underline the generally wide range of the cost structure that adaptation measures can have. Interestingly, the evidence in the literature shows that the climate-related adaptation measures requiring relatively low upfront investments, such as mobile water barriers (e.g. sandbags) or raised power sockets, can not only cost efficiently reduce damages particularly in case of low to medium loss events occurring relatively frequently, but also materially reduce damages in case of tail events (Poussin et al. (2015), Kreibich et al. (2011)). In this regard, non-life insurance products might not necessarily need to focus on climate-related adaptation measures requiring large-scale investments from policyholders to effectively contribute to climate change adaptation. However, further quantitative evidence is needed to properly assess the cost effectiveness of climate-related risk prevention for a broader set of adaptation measures, particularly in context of their upfront costs, and in context of the dynamically increasing exposures to climate-related hazards.
68. As climate-related adaptation measures require material upfront investments by policyholders, financial incentives are particularly important to stimulate the take up of these measures. In particular, the uncertain benefits in terms of prevented damages and losses materialize only at later stages, constituting a decision problem for policyholders to make the necessary upfront investments today. Risk-based insurance pricing can immediately reflect the reduced risk exposure due to the implementation of climate-related risk prevention measures and create immediate savings for policyholders that can effectively foster the take up of these measures (e.g., Hudson et al. (2016), Medders et al. (2015)). In addition, the EU Taxonomy requires for

¹⁸ California Department of Insurance (2022): [Safer from Wildfires](#).

¹⁹ ENEA (2019): [Earthquake: A "quality label" for the seismic safety of buildings](#); German Insurance Association (2021): [Ergänzung zum Gesamtkonzept der deutschen Versicherer - Naturgefahrenausweis für jedes Gebäude in Deutschland](#).

non-life insurance to be eligible under the objective of climate change adaptation the provision of risk-based incentives for preventive actions taken by the policyholders, for instance through reduced insurance premiums or deductibles.²⁰

69. Only a few participants in the pilot exercise mentioned the provision of premium discounts to incentivize the take up of climate-related adaptation measures by policyholders. Main arguments raised were difficulties in assessing the risk-based effects of adaptation measures, but also that public grants or lower taxes could be effective incentives to foster the implementation of climate-related adaptation measures in non-life insurance products.
70. The U.S. insurance market already shows interesting examples on dedicated premium discounts regarding climate-related adaptation measures that could foster the corresponding developments in the European context. For instance, the National Flood Insurance Program offers discounts up to 45% for the implementation of adaptation measures against flood risk, and several U.S. states require insurance discounts for buildings implementing wind- and storm-resistant features, for instance up to 87% of the windstorm portion of property insurance premiums in Florida (Multi-Hazard Mitigation Council (2020)).
71. Overall, the challenges mentioned by the participants suggest that targeted climate-related information campaigns from insurance undertakings to policyholders, improvements in the risk-based modelling and a higher level of standardization of climate-related adaptation measures in a European context could substantially help to raise policyholders' awareness about climate change adaptation, to better reflect adaptation measures in risk-based insurance premiums, and to stimulate the take up of preventive actions by policyholders through risk-based rewards, for instance in terms of premium discounts.

4. CONCLUSION

72. Implementing climate-related adaptation measures in the underwriting practices of non-life insurance undertakings is a key task to maintain the future availability and affordability of non-life insurance with coverage against climate-related hazards.
73. The EU market appears to be at an early stage regarding the implementation of adaptation measures in non-life underwriting practices, however already showing interesting and promising examples. For a wider implementation of adaptation measures, three main areas of challenges emerged from the pilot exercise: the lack of policyholder awareness about the influence of climate change on their physical risk exposures and corresponding preventive actions, difficulties for insurance undertakings to implement adaptation measures in

²⁰ Delegated Regulation (EU) 2021/2139, Section 10.1.

standardized insurance contracts and the material costs associated with adaptation measures that would require financial incentives for an effective stimulation of climate change adaptation in non-life insurance.

74. EIOPA's next steps on sustainable finance include several working areas that will support overcoming these challenges:²¹

- Under the annual operating objective on addressing protection gaps, EIOPA aims to study possible tools to enhance climate-related risk awareness and understanding of related prevention measures among society and industry, for instance by means of web-based tools or databases.
- EIOPA's annual operating objective on promoting the use of open-source modelling and data in relation to climate risks will focus on developing ways to improve the collection of insured loss data and on facilitating the use of open-source modelling of climate risks, which will contribute to raise climate-related risk awareness and help to improve the modelling of the risk-based effects of climate-related adaptation measures.
- Under the annual operating objective on integrating ESG risks in the prudential framework of insurers and pension funds, EIOPA will assess the potential for a dedicated prudential treatment of climate-related adaptation measures in non-life insurance, and will initiate the reassessment of the capital charges for natural catastrophe risk in Solvency II's Standard Formula. Both working areas will contribute to increase awareness about climate risks and climate-related adaptation measures, and ensure their appropriate recognition in the prudential framework.

²¹ EIOPA (2022): [Single programming document 2023-2025](#).

APPENDIX

Table 1: Classification of Climate-Related Hazards

	Temperature-related	Wind-related	Water-related	Solid mass-related
Chronic	<p>Changing temperature (air, freshwater, marine water)</p> <p>Temperature variability</p> <p>Heat stress</p> <p>Permafrost thawing</p>	<p>Changing wind patterns</p>	<p>Changing precipitation patterns and types (rain, hail, snow/ice)</p> <p>Precipitation or hydrological variability</p> <p>Ocean acidification</p> <p>Saline intrusion</p> <p>Sea level rise</p> <p>Water stress</p>	<p>Coastal erosion</p> <p>Soil degradation</p> <p>Soil erosion</p> <p>Solifluction</p>
Acute	<p>Heat wave</p> <p>Cold wave/frost</p> <p>Wildfire</p>	<p>Cyclone, hurricane, typhoon</p> <p>Storm (including blizzards, dust and sandstorms)</p> <p>Tornado</p>	<p>Drought</p> <p>Heavy precipitation (rain, hail, snow/ice)</p> <p>Flood (coastal, fluvial, pluvial, ground water)</p> <p>Glacial lake outburst</p>	<p>Avalanche</p> <p>Landslide</p> <p>Subsidence</p>

Source: Annex A of the EU Taxonomy Climate Delegated Act supplementing Regulation (EU) 2020/852.

Questions included in the questionnaire

Q1: Based on your assessment, how strongly is the physical underwriting risk exposure in the following non-life LoBs (Motor vehicle liability; Other motor insurance; Marine, aviation and transport insurance; Fire and other damage to property insurance; General liability insurance; Credit and suretyship insurance; Legal expenses insurance; Assistance insurance; Miscellaneous financial loss) generally affected by climate-related hazards (Table 1, Annex)?

Please indicate according to the drop-down list.

Q2: Based on your assessment, which type of climate-related hazards (Table 1, Annex) influences the physical underwriting risk exposure in the following LoBs most?

Please indicate according to the drop-down list.

Q3: Have you raised in the past, or do you plan to raise, insurance premiums in specific LoBs due to the impact of climate-related hazards (Annex, Table 1) on physical risk exposures?

If yes, please explain with regard to your lines of business and the impact of climate-related hazards.

Q4: Have you raised in the past, or do you plan to raise, the level of deductibles in specific LoBs due to the impact of climate-related hazards (Annex, Table 1) on physical risk exposures?

If yes, please explain with regard to your lines of business and the impact of climate-related hazards.

Q5: Have you reduced in the past insurance coverage to policyholders after an extreme weather-related loss event?

(Y/N) Please explain with regard to the LoB affected.

Q6: Climate change is expected to raise the frequency and severity of extreme weather events. Have you adjusted in the past, or do you plan to adjust, the contractual definitions of weather-related loss events for your insurance products in relation to climate change?

(Y/N) Please explain.

Q7: Do you have specific exclusions in the contractual terms of your insurance products that are explicitly related to the effects of climate change on the policyholder's physical risk exposure? (Y/N) Please explain.

Q8: Do you provide specific information to your policyholders on the potential impact of climate change on their insurance coverage or insurance premiums? (Y/N) Please explain and if possible, provide examples of the format of communication with the policyholders.

Q9: Do you consider climate-related adaptation measures according to the provided definition to be an effective tool to maintain the availability and affordability of insurance coverage in the future? (Y/N) Please explain.

Q10: Do you currently offer insurance products that include or incentivize climate-related adaptation measures? (Y/N) Please list these insurance products and give details on the climate-related adaptation measures included in these products.

If you plan to offer products in the future, please list them as well.

Q11: What is the estimated level of risk reduction due to climate-related adaptation measures in your insurance products?

Please give quantitative examples of the risk reduction according to your insurance products as a percentage of the (net) premiums or EUR amounts.

Q12: What are the estimated costs policyholders have to pay for implementing climate-related adaptation measures suggested in your insurance products?

If possible, please give quantitative examples of the costs/expenses in EUR amounts.

Q13: Do you use deductibles as a measure to incentivize policyholders to take up climate-related adaptation measures? (Y/N) Please explain with regard to your lines of business and, if possible, give quantitative examples of the reduction in the level of deductibles.

Q14: Do you offer premium discounts as a measure to incentivize policyholders to take up climate-related adaptation measures? (Y/N) Please explain with regard to your lines of business and, if possible, give quantitative examples of the premium discounts.

Q15: What potential issues (e.g. legal, practical, solvency related...) might prevent the general integration of climate-related adaptation measures in the product design of non-life insurance products? Please explain.

Q16: Do you consider public climate-related adaptation measures (e.g. dikes against flood risk) as essential to continue your insurance business in the future? (Y/N) Please explain with regard to your lines of business and, if possible, give examples of public adaptation measures you consider to be most relevant in that regard.

Q17: Do you use Standard Formula, Standard Formula with undertaking-specific parameters (USPs), a Partial Internal Model or a Full Internal Model to calculate solvency capital requirements?

- Please indicate according to the drop-down list.
- Please comment on the line of business covered by USPs and risks covered by internal models, if relevant.

Q18: Do you consider the claim equalization reserve as a tool to mitigate the impact of climate change on the physical underwriting risk exposure in your lines of business? (Y/N) Please explain.

Q19: The amended Article 260 of the Commission Delegated Regulation (EU) 2021/1256 and Article 29 of the Commission Delegated Regulation (EU) 2015/35 require to take environmental developments for the calculation of the Best Estimate into account.

In how far do you take account of climate change and climate change assumptions (e.g. time horizon, frequency and severity of extreme weather events) in the Best Estimate calculation? Please explain.

Q20: What is the average time period for claim settlements in those lines of business you consider most affected by climate change and does this time period affect your consideration of climate change in the calculation of the Best Estimate? Please explain.

Q21: Do you experience in the calculation of the Best Estimate any prudential obstacles that prevent an appropriate risk-based consideration of i) the impact of climate change on physical risk exposures, and of ii) the risk reduction stemming from climate-related adaptation measures?

(Y/N) Please indicate and explain.

Q22: Based on your assessment, how do climate-related adaptation measures affect your solvency capital requirements for i) non-life premium and reserve risk, and for ii) non-life nat catastrophe risk?

Please differentiate between the SCR input factors for premium risk, reserve risk and nat cat risk, and if possible, give quantitative examples of the effects of adaptation measures on the amount of solvency capital related to your insurance products.

Q23: Do you experience in the solvency capital requirements for i) non-life premium and reserve risk, and for ii) non-life nat catastrophe risk any prudential obstacles that prevent a full reflection of the risk reducing effect of climate-related adaptation measures? (Y/N) Please explain.

Q24: Do you apply an own natural catastrophe model to assess your capital requirements in the ORSA?(Y/N)

If yes, in how far do you take climate change into account in this Nat Cat ORSA model and how frequently do you adjust your Nat Cat model? Please explain.

REFERENCES

De Boer, Botzen, and Terpstra (2016): Flood risk and climate change in the Rotterdam area, The Netherlands: enhancing citizen's climate risk perceptions and prevention responses despite skepticism, *Regional Environmental Change*, Vol. 16, pp. 1613-1622.

European Environment Agency [EEA] (2021): Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction.

European Insurance and Occupational Pensions Authority [EIOPA] (2022a): Dashboard on insurance protection gap for natural catastrophes.

European Insurance and Occupational Pensions Authority [EIOPA] (2022b): European Insurers' Exposure to Physical Climate Change Risk.

European Insurance and Occupational Pensions Authority [EIOPA] (2021): Report on non-life underwriting and pricing in light of climate change.

Frondel, Simora, and Sommer (2017): Risk Perception of Climate Change: Empirical Evidence for Germany, *Ecological Economics*, Vol. 137, pp. 173-183.

Hudson, Botzen, Kreibich, Bubeck and Aerts (2014): Evaluating the effectiveness of flood damage mitigation measures by the application of propensity score matching, *Natural Hazards and Earth System Sciences*, Vol. 14, pp. 1731–1747.

Intergovernmental Panel on Climate Change [IPCC] (2021): Climate Change 2021 - The Physical Science Basis, Sixth Assessment Report.

Joint Research Centre [JRC] (2020): Climate change impacts and adaptation in Europe, JRC PESETA IV final report, Feyen, L., Ciscar, J.C., Gosling, S., Ibarreta, D. and Soria A. (eds.), European Commission.

Kreibich, Christenberger, and Schwarze (2011): Economic motivation of households to undertake private precautionary measures against floods, *Natural Hazards and Earth System Sciences*, Vol. 11, pp. 309–321.

Kreibich, Thieken, Petrow, Müller and Merz (2005): Flood loss reduction of private households due to building precautionary measures – lessons learned from the Elbe flood in August 2002, *Natural Hazards and Earth System Sciences*, Vol. 5, pp. 117–126.

Medders, Nyce, and Maroney (2015): Public Policy and Regulation to Reduce Underlying Risks: Two Insurance-Mitigation Strategies Following the Recent Gulf Coastal Property Insurance Crisis, *Journal of Insurance Regulation*, Vol. 34 (5), pp. 1–20.

Multi-Hazard Mitigation Council (2020): A Roadmap to Resilience Incentivization. Porter, K.A. and Yuan, J.Q., eds., National Institute of Building Sciences, Washington, DC.

Poortinga, Spence, Whitmarsh, Capstick, and Pidgeon (2015): Uncertain climate: An investigation into public scepticism about anthropogenic climate change, *Global Environmental Change*, Vol. 21 (3), pp. 1015-1024.

Poussin, Botzen, and Aerts (2015): Effectiveness of flood damage mitigation measures: Empirical evidence from French flood disasters, *Global Environmental Change*, Vol. 31, pp. 74-84.

Poussin, Botzen, and Aerts (2014): Factors of influence on flood damage mitigation behaviour by households, *Environmental Science & Policy*, Vol. 40, pp. 69-77.

Rogers, Curtis, and Mazur (2012): The influence of cognitive processes on rural landholder responses to climate change, *Journal of Environmental Management*, Vol. 111, pp. 258-266.

Zaalberg, Midden, Meijnders, and McCalley (2009): Prevention, Adaptation, and Threat Denial: Flooding Experiences in the Netherlands, *Risk Analysis*, Vol. 31 (12), pp. 1759-1778.

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