Prudential Treatment of Sustainability Risks

Report

EIOPA-BoS-24/372
07 November 2024

European Insurance and
Occupational Pensions Authority

CONTENTS

EXECUTIVE SUMMARY

1. EIOPA's work on sustainable finance recognizes the important role of insurers as long-term investors and risk managers, aiming to ensure that the prudential framework continues to adequately address sustainability risks to safeguard solvency, consumer protection, and financial stability.
2. The Article 304c of the Solvency II Directive mandates EIOPA to assess the potential for a dedicated prudential treatment of assets or activities associated substantially with environmental or social objectives, or harm to such objectives, and to assess the impact of proposed amendments on insurance and reinsurance undertakings in the European Union. EIOPA is required to submit a corresponding report to the Commission within 1 month from the entry into force of the Solvency II amending Directive.
3. In response to this mandate, EIOPA's report followed a step-by-step approach. A discussion paper outlining the scope, methodologies, and data sources for the analysis has been published in 2022 as the first outcome of EIOPA's work under this mandate.[1] As a second outcome, a consultation paper on findings and policy implications has been published in 2023, based on the discussion paper's public feedback received, together with the feedback received from the Platform on Sustainable Finance and the European Banking Authority (EBA).[2] The European Systemic Risk Board (ESRB) has been consulted as regards EIOPA's findings and policy implications stated in the consultation paper.[3]
4. EIOPA considers it essential that the prudential analyses are risk-based and policy implications evidence-based. By considering the status and pace of discussions around environmental and social objectives at EU and international level, current best practices on the modelling of sustainability risks, as well as the availability of sustainability-related data, EIOPA decided to focus its analyses on the following three conceptual areas that are considered to be appropriate for a risk-based analysis.
5. The first area of the analysis is dedicated to the potential link between prudential market risks in terms of equity, spread and property risk and transition risks. Based on a broad stream of literature highlighting corresponding effects of transition risks, EIOPA considers a risk-based analysis as regards Solvency II's solvency capital requirements in terms of the Standard Formula appropriate. Although the availability of sustainability-related data is still a material challenge

[1] EIOPA (2022a).

[2] EIOPA (2023d).

[3] ESRB (2024).

for prudential analyses, EIOPA considers the progress that has been made in this regard to be sufficient to provide meaningful evidence. EIOPA considers that transition risks can be already sufficiently reflected in Solvency II's requirements as regards risk management (Pillar II) and disclosure (Pillar III).

6. The second area of the analysis focuses on the potential link between non-life underwriting risks and climate-related risk prevention measures, since the prudential treatment of assets or activities as referred to in the mandate includes insurance undertakings' underwriting activities. While a direct and risk-based link between the policyholders' level of greenhouse gas emissions and the respective insured losses remains uncertain (climate change mitigation), EIOPA focuses on the environmental objective of climate change adaptation on which a direct and risk-based link to insured losses is given. The expected growth in physical risk exposures and insured 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. In this regard, the environmental objective of climate change adaptation becomes increasingly important, and the insurance industry has a unique role to play by helping society and the economy become more climate resilient through developing innovative insurance products that could incentivize climate-related risk prevention, consistent with actuarial risk-based principles. EIOPA focuses its analysis on the solvency capital requirements, as risk management and disclosure requirements are considered to sufficiently reflect the effects of climate-related risk prevention in the non-life underwriting business.
7. The third area of the analysis is related to the potential link between social risks and prudential risks, including market and underwriting risks. Social risks are a nascent topic from a prudential perspective, and EIOPA considers it to affect insurance undertakings conceptually in a similar manner as other sustainability risks. Starting with the identification of social risks and objectives, EIOPA discusses how social risks can translate into prudential risks on undertakings' balance sheets. In light of the Commission's mandate, EIOPA provides an initial and principle-based analysis of the Pillar II and III requirements under Solvency II to identify potential areas for further work.
8. Since sustainable finance is an area characterized by an ongoing progress regarding data availability and risk modelling, certain natural limitations of the analysis exist at this stage. Firstly, the sample size of certain asset portfolios for the analysis is relatively small due to general data constraints that can hardly be overcome. Further to this, the limited sample size covered in the present analysis might not reflect the overall insurers' exposure to transition risks, which could also materialize from indirectly held assets. Secondly, since legally binding transition plans of firms, for instance in relation to the Corporate Sustainability Reporting Directive (CSRD), are not yet available, reliable firm-specific characteristics affecting the (long-term) transition risk exposures of firms are difficult to obtain as further input data for the analysis. In this respect, a sectoral classification approach is generally not able to model firm-

specific transition risk characteristics, which would require a firm-level approach instead. Thirdly, technical challenges for the analysis exist in isolating transition risks from other risk drivers, such as the impact of the Covid-19 shock on asset prices, which is an important determinant for the backward-looking analysis, but not for the forward-looking analysis. Fourthly, the exact extent to which credit ratings reflect transition risks remains unclear at this stage, making it challenging in the case of the prudential treatment of spread risk in the Standard Formula whether a dedicated treatment would be justified.

Area 1: Market Risks and Transition Risks

9. EIOPA conducts both a backward- and forward-looking risk assessment to conclude whether there is sufficient evidence for a dedicated prudential treatment of transition risks. The backward-looking evidence using historic time series data and a Value-at-Risk (VaR) approach is consistent with Solvency II's risk-based perspective and builds the basis for determining the appropriateness for supplementary capital requirements and their respective levels. Since historical data do not sufficiently reflect the emerging changes in risk patterns that are related to climate change, the complementary forward-looking, model-based assessment is used to cross-check and validate the findings.

Equity and Spread Risk

10. EIOPA follows a sectoral classification approach for assessing the transition risk exposures of stocks and bonds in terms of NACE codes to maintain a balance between simplicity and risk sensitivity in the context of the objectives of the Standard Formula in Solvency II.
11. The analysis outlines that the definition of economic activities with a relatively low exposure to transition risks is particularly challenging in the context of dynamic risk drivers such as market sentiment and climate-related technological developments, ultimately preventing a robust conclusion on risk-based effects in this regard. In contrast, broad consensus exists on the definition of economic activities that are particularly harmful to the objective of climate change mitigation such as fossil fuel-related activities, which can allow for more robust conclusions on potential risk-based effects.
12. The findings of the backward-looking and forward-looking analysis on equity and spread risk show evidence for a differentiated and elevated risk profile of fossil fuel-related stocks and bonds relative to other economic activities, which could be reflected through a dedicated prudential treatment.
13. Concerning equities, the first option is the no change option, which is neutral as regards to the debates about sustainability risks and Pillar I. The two other options echo the backward- and forward-looking evidence, despite some limitations regarding the sample size, that fossil fuel-related stocks present an elevated risk profile and that scope for a dedicated prudential treatment of such assets may exist. To reflect the elevated equity risk of fossil fuel-related

stocks, the second policy option proposed would treat fossil fuel-related stocks as Type 2 equity, corresponding to a moderate increase in the capital requirements for respective stocks currently classified as Type 1. The third policy option would introduce a supplementary capital requirement of up to 17% in additive terms to the current capital charges, which also corresponds to a moderate increase in the capital requirements. The impact assessment of the proposed policy options based on directly held assets shows a limited impact on the undertakings' solvency ratio mainly stemming from the undertakings' low exposures to directly held fossil fuel-related stocks (on average about 1% of total investments). Following a careful consideration of pros and cons of the possible policy options, the preferred option for managing equity risk associated with fossil fuel-related stocks, based on the analysis provided, is Option 3.

14. Concerning bonds, the first option is the no change option, which is neutral as regards to the debates about sustainability risks and Pillar I. The two other options echo the backward- and forward-looking evidence on spread risk, despite some limitations particularly regarding the data availability in certain "duration-rating" buckets, that fossil fuel-related bonds present a higher risk profile and that a scope for a dedicated prudential treatment of such assets may exist. To reflect the higher spread risk of fossil fuel-related bonds, the second policy option proposed would introduce a rating downgrade for fossil fuel-related bonds. The third policy option proposed would introduce a supplementary capital charge of up to 40%, in multiplicative terms, to the current capital charges, to maintain the Standard Formula's duration-rating-based mapping of capital charges. The impact assessment of the proposed policy options shows a limited impact on the undertakings' solvency ratio mainly stemming from the undertakings' low exposures to directly held bonds associated with the fossil fuel sector. Following a careful consideration of pros and cons of the possible policy options, the preferred option for managing spread risk associated with fossil fuel-related stocks, based on the analysis provided, is Option 3.

Property Risk

15. On property risk, EIOPA analysed whether differences in the level of the energy performance of buildings could be associated with differences in the level of property risk. Differences in the operating costs associated with the level of a building's energy efficiency could lead to differentiated loss patterns in market transactions, as buyers may require compensation for higher or more volatile operating costs of inefficient buildings relative to efficient buildings.
16. Collecting granular data covering the energy performance of buildings however has been a particular challenge for EIOPA. The responses to the discussion paper in 2022 did not provide recommendations for suitable data sources. EIOPA has finally analysed granular data on residential house offerings in Germany for the analysis.
17. The findings show overall an inconclusive effect of a building's level of energy efficiency on property risk. Hence, EIOPA, at this stage, cannot conclude whether a dedicated prudential

treatment is justified. EIOPA proposes to repeat the analysis in the future on the condition that data availability improves, for instance in relation to the Energy Performance of Buildings Directive (EPBD) in the EU, to allow for a broader set of data for the analysis.

Area 2: Non-Life Underwriting Risks and Climate-Related Risk Prevention Measures

18. EIOPA studied to what extent climate-related adaptation measures (e.g., anti-flood doors) could influence non-life underwriting risks in terms of premium risk. The focus of the analysis lies on private adaptation measures that can be directly implemented in insurance products either by policyholders or by insurance undertakings.
19. The quantitative assessment regarding premium risk is based on data EIOPA collected from non-life insurance undertakings in 2022. A qualitative survey has been included in the data collection to get further insights into potential effects regarding reserve risk and natural catastrophe risk.
20. The findings indicate a potential reduction in premium risk, but the collected data sample is considered too small to allow for a robust conclusion from a prudential perspective. Hence, at this stage, EIOPA cannot conclude whether a dedicated prudential treatment of climate-related adaptation measures in the capital requirements for premium risk is justified.
21. Given the importance of climate-related risk prevention for non-life underwriting activities in light of climate change, EIOPA proposes to repeat the analysis in the future when more and better data will be available. Moreover, an extension of the quantitative analysis to the prudential treatment of natural catastrophe risk should be considered as well.

Area 3: Social Risks

22. The analysis discussed how social risks could potentially materialize into prudential risks on the asset and underwriting side. In that regard, EIOPA argues that conceptually, all components of sustainability risks, such as climate and social risks, are to be treated in a similar manner. Hence, social risks need to be identified and managed. Moreover, in the context of the double materiality principle, social impacts matter from a prudential perspective. However, EIOPA also highlights in its qualitative analysis that not all concepts and prudential measures from climate analysis may apply in a similar manner to social aspects (e.g. potential requirements for scenario analysis or quantitative prudential reporting).
23. While social risks can be expected to translate into prudential risks and practical guidance for insurance undertakings on identifying and managing social risks is scarce, EIOPA suggests continuing work on this topic in terms of developing an application guidance to support the social risk materiality assessment for the purpose of (re)insurers' ORSA.

1. INTRODUCTION

24. Insurers with their long-term business model are increasingly recognizing sustainability risks. Climate change introduces transition risks related to the decarbonization of the real economy that may raise investment losses due to stranded assets, particularly in relation to economic activities unable to adapt their business models accordingly. As a source of physical risks, climate change already affects insured losses stemming from natural catastrophes and extreme weather events, making the adaptation to climate change a key objective for the long-term availability and affordability of insurance products.[4]
25. EIOPA's work on sustainable finance recognizes the important role of insurers as long-term investors and risk managers, aiming to ensure that the prudential framework continues to adequately address sustainability risks concerning the areas of solvency, consumer protection, and financial stability.
26. Solvency II, as a risk-based and forward-looking framework, can effectively enable insurers to manage sustainability risks alongside other prudential risks within its conceptual structure. Many of the existing tools to assess and mitigate investment and underwriting risks can be applied to address sustainability risks as well. However, since sustainability risks continue to evolve in a very dynamic pattern, it is essential that Solvency II also continues to evolve along the line with the future challenges sustainability risks impose.

EIOPA’s Mandate

27. EIOPA is mandated under Article 304c of the Solvency II Directive to assess the potential for a dedicated prudential treatment of assets or activities associated substantially with environmental or social objectives, or harm to such objectives, and to assess the impact of proposed amendments on insurance and reinsurance undertakings in the European Union. EIOPA is required to submit a corresponding report to the Commission within 1 month from the entry into force of the Solvency II amending Directive.
28. In response to this mandate, EIOPA’s report followed a step-by-step approach. A discussion paper outlining the scope, methodologies, and data sources for the analysis has been published in 2022 as the first outcome of EIOPA’s work under this mandate.[5] As a second outcome, a consultation paper on findings and policy implications has been published in 2023, based on the discussion paper’s public feedback received, together with the feedback received from the

[4] EIOPA (2022a).

[5] EIOPA (2022a).

Platform on Sustainable Finance and the European Banking Authority (EBA).[6] The European Systemic Risk Board (ESRB) has been consulted as regards EIOPA's findings and policy implications stated in the consultation paper.[7]

29. Since the scope of environmental or social objectives in the context of sustainable finance is broad and subject to inconsistent definitions as well as material data gaps, EIOPA considers the following three conceptual areas to provide appropriate economic rationale and data for a prudential risk analysis in context of the mandate and the respective report:

    i. Market Risks of Assets and Transition Risk Exposures
    ii. Non-Life Underwriting Risks and Climate Change Adaptation
    iii. Social Objectives and Social Risks from a Prudential Perspective

Asset-related Market Risks and Transition Risk Exposures

30. The first conceptual area centers on the environmental objective of climate change mitigation and assesses the link between climate change-related transition risks and prudential market risks for insurers' investment activities. The environmental objective of climate change mitigation, particularly in context of the 2015 Paris Climate Agreement, requires a material de-carbonization of society and the real economy to limit the rise in global temperature levels.[8] Current research estimates the need for material cuts in greenhouse gas emission levels across most economic sectors over the next decades, but with particularly massive emission cuts needed for sectors heavily related to the production or use of fossil fuels in terms of oil, coal and gas.[9] In this regard, firms need to adapt their business models quickly to a low carbon economy. Firms unable to transition in the short to medium term or even unable to transition at all and thereby continuing to contribute to climate change materially may be impacted by transition risks, induced by changes in regulation or market sentiment, negatively affecting their business performance.[10] For instance, if transition risks materialize in more volatile cash-flows for firms engaging in environmentally harmful economic activities due to changes in market sentiment in terms of investor or consumer preferences, the financial instruments issued by these firms should show elevated levels of market risks relative to firms with less harmful activities.
31. Substantial international progress has been made over the last years regarding the definition of transition risk channels as well as the availability of corresponding data, inducing a large stream

[6] EIOPA (2023d).

[7] ESRB (2024).

[8] UNEP (2021); IPCC (2018).

[9] Teske et al. (2022).

[10] EIOPA (2022b).

of literature studying the potential for a materialization of transition risks in asset prices.[11] Therefore, EIOPA considers it relevant to start assessing quantitatively the potential for a dedicated prudential treatment of transition risk exposures in the solvency capital requirements. EIOPA focuses its asset-related analysis on market risks, and in particular equity, spread and property risk, as these market risks relate to the most relevant asset classes for insurers' investment decisions. In its analysis, EIOPA considers it important to assess the potential for a dedicated prudential treatment for the entire range of transition risk exposures, i.e., for assets with a higher exposure to transition risk as well as those with a lower exposure.

32. Firms carrying out business activities with higher levels of transition risk exposures are typically associated with higher levels of greenhouse gas emissions, and these firms need to adapt quickly and fundamentally to be aligned with a low-carbon economy.[12] However, the opposite relationship does not necessarily hold, as firms conducting business activities with relatively low greenhouse gas emission levels can also be exposed to transition risks. For instance, changes in the market preferences towards a specific climate-friendly technology (e.g., hydrogen vs. electric propulsion) could cause losses in the asset prices for firms engaging in the technology less preferred by the market.
33. Since historical asset data might not fully capture the dynamic impact of environmental externalities on asset prices, a forward-looking assessment is important to complement the analysis.[13] A forward-looking approach is thereby in line with the conceptual characteristics of Solvency II as a forward-looking regulatory framework. Therefore, EIOPA extends the backward-looking analysis based on historic time series data with a forward-looking model-based assessment to cross-check the findings from the historical time-series analysis and to provide further insights to conclude on the potential for a dedicated prudential treatment of assets associated with different levels of transition risk exposures.
34. The analysis focuses on transition risk exposures related to climate change, while physical risk exposures, such as, for instance, damages to facilities due to natural disasters, are excluded due to the more pronounced lack of data that is needed for a risk-based analysis. Material data gaps exist pertaining to exposure, hazard and vulnerability data at a very granular spatial level, e.g., street-level, to allow for analysing a potential impact of physical risks on the financial performance of firms. Moreover, data on risk mitigation measures implemented by firms that could indemnify potential losses in cash flows related to physical damages is largely missing.

[11] For instance, Bolton and Kacperczyk (2021); Carbone et al. (2021); EIOPA (2020a); Battiston et al. (2017).

[12] For example, the economic activities mentioned as Climate Policy Relevant Sectors (CPRS) by Battiston et al. (2017) to capture transition risk exposure are typically associated with high greenhouse gas emission levels: fossil fuel- related activities, utility and energy-intensive activities, buildings, transportation and agriculture.

[13] For instance, Ilhan et al. (2021) show that carbon-related tail risk is perceived to be higher in times of high public attention to climate change. In that regard, the climate-related pricing process could be non-stationary. On the need for a forward-looking assessment, see also: NGFS (2022b).

Non-Life Underwriting Risks and Climate Change Adaptation

35. The second area of the report focuses on the non-life underwriting activities of insurers with regard to climate change adaptation as a risk-based environmental objective. With climate change expected to further amplify physical risk exposures in the non-life insurance market over time, risk-based premium levels are expected to rise significantly over time, thereby reducing the affordability and availability of insurance coverage against climate-related hazards in the long-term.
36. Climate change adaptation fostering risk prevention in non-life insurance markets constitutes an important environmental objective in light of climate change. For instance, the EU Taxonomy refers to non-life insurance as a taxonomy eligible activity.[14] In that regard, climate-related adaptation measures implemented before a loss event occurs, such as water-resistant doors to mitigate flood risks, can reduce policyholders' physical risk exposures and insured losses. Growing evidence in the literature underlines the effectiveness of such risk prevention measures in reducing loss exposures related to climate change.[15] Therefore, climate-related adaptation measures can be a key forward-looking tool to maintain the long-term availability and affordability of non-life insurance coverage against climate-related hazards and contribute to reducing the insurance protection gap for natural catastrophes in the EU.
37. In its previous work on impact underwriting, EIOPA focused on the potential for insurers to contribute to the adaptation of societies and economies to climate change through their underwriting practices.[16] Building on this work, the second area of this report assesses the potential for a dedicated prudential treatment of climate-related adaptation measures in Solvency II's Standard Formula for non-life underwriting risks. If climate-related adaptation measures lead to a difference in the prudential risks for insurance products with and without these measures, risk-based capital requirements should recognize the resulting risk differential appropriately.

Social Objectives and Social Risks from a Prudential Perspective

38. The third area of the report addresses the prudential treatment of social risks and objectives under Solvency II. Considering the definitional challenges and the intricacy of identifying risk channels related to social objectives, in conjunction with material data gaps preventing a quantitative analysis, EIOPA provides an initial analysis of the extent to which Pillar II and III requirements under Solvency II could cover social objectives, to identify potential areas for

[14] Commission Delegated Regulation (EU) 2021/2139.

[15] For instance, Hudson et al. (2016); Kreibich et al. (2011); Kreibich et al. (2005).

[16] EIOPA (2023a).

further analysis, and to foster future discussions on the appropriate prudential treatment of social objectives.

39. In that regard, EIOPA considers social risks to have conceptually similar prudential consequences on insurers' business activities as climate risks, but not all concepts and prudential measures related to climate risks may be directly applicable to social risks. For instance, risks related to socially harmful activities, such as labor and human rights violations, can lead to direct financial losses in insurance undertakings' investment and underwriting activities, as well as reputational risks, but methodologies for a corresponding scenario analysis do not seem to be available yet.
40. While progress is being made, for example under the requirements of the Sustainable Finance Disclosure Regulation (SFDR), many aspects of social objectives are subject to broad definitions at EU level and national rules might diverge. Consequently, EIOPA outlines the prudential treatment of social risks from a Pillar II and III perspective in the amended Solvency II Delegated Regulation, focusing on governance and risk management, as well as reporting and disclosure requirements.

2. ASSETS AND TRANSITION RISK EXPOSURES

41. Transition risk refers to the potential impact on the market value of assets arising from the adjustment process towards a low-carbon economy, driven by the environmental objective of climate change mitigation requiring the material and immediate reduction of greenhouse gas emissions. The European Climate Law sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, requiring all economic sectors and activities to take respective actions.
42. A range of factors can influence this adjustment process, and thereby the materialization of transition risks, in a dynamic manner. For instance, climate change-related developments in policy and regulation (e.g., policy shocks such as changes in carbon taxes), the emergence of disruptive technologies (technology shocks such as the development of carbon capturing processes) or shifting market sentiment and societal preferences (e.g., towards electric instead of combustion propulsion) can affect the transition risk patterns materially. Firms unable to adapt quickly to a low-carbon economy might experience a potential materialization of transition risks in their financial performance, deteriorating the market values of the assets, such as stocks and bonds related to these firms.
43. In the feedback to EIOPA's discussion paper in 2022, some respondents argued that sustainability risks, and in particular transition risks, should be treated within Solvency II's Pillar II which focuses on risk management. Other respondents, in contrast, argued for a dedicated treatment of transition risks under Pillar I which focuses on capital requirements. In that regard, the public feedback to EIOPA's discussion paper showed overall mixed views.
44. From a prudential perspective, Solvency II requires insurers to identify, measure and manage all risks relevant to their business activities. In that regard, insurers can be subject to losses which can be conceptually differentiated between expected and unexpected losses. Undertakings can manage the expected losses through risk mitigation practices and accounting actions. This includes, from a quantitative perspective, asset write downs and the determination of the best estimate of insurance liabilities. For instance, Solvency II explicitly refers under Pillar II to sustainability-related requirements on risk management [e.g., Art. 260 and 269 of the Delegated Regulation 2015/35] and the prudent person principle regarding investments. Moreover, EIOPA's recent climate-related ORSA-application guidance illustrates how climate-related materiality assessments and scenario analyses of climate risks, not only in the short term, but also in the long-term, can be incorporated under Pillar II.[17]

[17] EIOPA (2022b).

45. The solvency capital requirements under Pillar I instead are used to ensure insurers have sufficient capital to withstand the unexpected losses in a one in two-hundred-year event within a one-year time horizon. If transition risks materialize in a way affecting the variance of losses, the potential for unexpected losses increases and the capital requirements should ensure that undertakings set aside sufficient capital to withstand those losses.[18] Transition risks, stemming from the misalignment of a firm's business model with overarching commonly acknowledged climate goals (e.g., the European Climate Law and the 2015 Paris temperature goal), have certain characteristics that may increase the potential for unexpected losses to materialize. In particular, its risk level depends on (long-term) climate actions taken now and in the future by different parties (consumers, firms, regulation, etc.), making the transition risk pattern dynamic and endogenous as it evolves with the accelerating pace of climate change. As these climate actions are expected to be more severe the later they get implemented (e.g., in terms of a disorderly transition of the real economy), the potential for unprecedented transition shocks to occur is increasing.[19]
46. While Solvency II already incorporates several measures to mitigate transition risks under Pillar II, EIOPA considers it important to assess the potential of transition risks to cause unexpected losses in terms of a Pillar I treatment as regards the mandate under Article 304c of the Solvency II Directive.

2.1. BACKWARD- AND FORWARD-LOOKING RISK ASSESSMENT

47. To study whether there is potential for a dedicated prudential treatment of transition risks in Solvency II's capital requirements for market risks, a risk- and evidence-based analysis needs to be conducted. Although the calibration of Solvency II's capital requirements for market risks typically relies on historical data, a purely historical perspective might not be sufficiently informative about the dynamic materialization pattern of climate-related risks. This is because the realisation of pure transition risks is difficult to observe in historical data, as transition risks can be considered as events not broadly represented in historic data, and be accompanied by further market risk drivers (e.g., inflation). In this context, the challenging question arises as to whether to rely on historic asset price data to conduct an empirical risk analysis (backward-looking) or to use model-based risk assessments, typically in terms of stress scenarios (forward-looking), or a combination of both.

[18] Transition risks can be expected to materialize not only in the long-term but also in the short-term: For instance, recent results from the ECB's climate stress testing highlight the material loss potential associated with transition risks over a one-year horizon for corporate securities (ECB (2023)).

[19] UN FCCC (2022), showing that the climate pledges of the 193 Parties under the Paris Agreement could lead to a 2.5 degrees Celsius warming by the end of the century.

48. Considering the forward-looking nature of environmental risks, in the ESRB's recent advices on the prudential treatment of environmental and social risks as regards the mandates for the EBA and the EIOPA, it is highlighted that emerging risks such as transition risks require a forward-looking approach for risk assessment and management, as historical data do not reflect the changes in risk patterns that will be related to climate change.[20] Also, the EBA highlights the importance of analysing (future) environmental risks using forward-looking methodologies,[21] and the NGFS concludes that both financial institutions and credit rating agencies are moving away from classification-based, backward-looking analysis of risk differentials to a more granular, forward-looking assessment of counterparties' vulnerability to climate-related risks.[22]
49. The feedback EIOPA received to its discussion paper showed overall support for the methodologies outlined regarding the forward-looking analysis. Some respondents mentioned that the use of a model-based assessment can be subject to technical bias due to the model assumptions taken, and corresponding findings should be treated with caution regarding the conclusion on potential prudential implications. Several respondents suggested focussing only on a forward-looking assessment, since historic time series data might not be able to show a potential materialization of transition risks. The public feedback to EIOPA's consultation paper in 2023 showed a similar outcome.
50. EIOPA considers forward-looking model-based risk assessments to offer valuable insights into the potential impact of transition risks on asset prices, particularly since historical asset price data may not fully reflect the dynamic nature of environmental externalities and the complexities of transitioning to a low-carbon economy. Market sentiment, technological advancements, regulatory changes, and societal awareness of climate issues can significantly influence transition risks in the future. A comprehensive model-based approach can complement historical data analysis and provide a holistic view of how transition risks may materialize in asset prices.
51. The use of forward-looking elements to set solvency capital requirements is not new to Solvency II. For example:

- The valuation principles of liabilities in terms of the best estimate require to consider expected future environmental developments [Art. 29 (EU/2015/35)].
- The use of credit quality steps / credit ratings to assess spread risk can be considered a forward-looking element, since credit ratings are forward-looking opinions on the relative ability of a borrower to meet financial commitments at future time periods.

[20] ESRB (2024) and ESRB (2023).

[21] EBA (2022).

[22] NGFS (2022b). Also, from a practical perspective as regards the insurance sector, see GDV (2023), in which the German Association of Insurers provides guidance to include forward-looking climate change scenario in the own risk and solvency assessment (ORSA) of insurance undertakings.

- The underwriting premium risk is meant to cover “future claims arising during and after the period for the solvency assessment”, and the volume measure is supposed to be an estimate of the premiums to be earned over the following 12 months.

52. Due to the complexity of modelling future climate trajectories, a forward-looking analysis for prudential purposes however needs to strike a certain balance between simplicity and risk sensitivity. EIOPA acknowledges the potential bias in quantitative findings that can arise from potentially inappropriate model-based assumptions. Therefore, EIOPA considers the forward-looking analysis to provide further insights on the dynamic materialization of transition risks in asset prices and to be used to cross-check and validate the findings from historical time series analysis.

Overview of the Forward-Looking Analysis of Transition Risk

53. A forward-looking assessment requires models and assumptions regarding the future developments of climate change and the transition to a carbon neutral economy. In particular, uncertainty surrounds the nature and timing of policy actions, technological change and the extent to which financial markets are already reflecting a transition scenario in asset prices. In other words, the results and conclusions obtained can be quite sensitive to the choices adopted for such parameters and assumptions. To capture such uncertainty, researchers make use of scenario analysis to analyse a broad range of future states of the world.
54. A number of supervisory authorities – both at national and European level – have developed climate change scenarios to assess the exposure of financial institutions to climate risks in terms of transition risks. EIOPA studied several analyses of climate transition scenarios developed by ACPR/Banque de France, DNB, ESRB/ECB as well as EIOPA/2DII to build a conceptual framework for the forward-looking analysis presented in this section. EIOPA’s discussion paper in 2022 briefly summarised these studies[23], whereof the main conclusions are:
    - The assessments make use of different scenarios. ESRB/ ECB and ACPR/Banque de France use as a basis the climate scenarios developed by the Network for Greening the Financial System (NGFS), DNB developed its own bespoke shock scenario and the EIOPA/2DII sensitivity analysis makes use of transition scenarios developed by the International Energy Agency (IEA);
    - The analyses use two ways to measure the impact of disorderly transition scenarios by either comparing them with the baseline results for an orderly transition or with the current, no policy change pathways;

[23] EIOPA (2022a).

- The forward-looking assessments employ several models to translate high-level climate scenarios into pathways for equity and corporate bond prices at sector level using either the NACE breakdown of economic activities or - in case of the EIOPA/2DII sensitivity analysis – fifteen climate-policy relevant activities;
- The assessments exhibited substantial differences in exposures to transition risk for the various economic activities and technologies. On the one hand, equity exposures to mining and power generation would be fully stranded in the DNB combined policy and technology shock scenario. On the other hand, equity exposures to renewable energy would double in value in the EIOPA/2DII late and sudden policy shock scenario.

55. In its 2021 special topic edition of the Global Insurance Market Report (GIMAR), the IAIS carried out a scenario analysis to assess the impact of disorderly transition scenarios on the value of investment of insurance undertakings.[24] The starting point of the assessment are the scenarios developed by the NGFS which are translated into numerical stress factors by sector and asset class using external sources.
56. Most of these studies assess the potential vulnerability towards transition risk on an asset class and sectoral level only. Individual firm-specific transition objectives and transition paths have not been considered in these studies.
57. In its discussion paper, EIOPA outlined - as a starting point for a forward-looking analysis - a mapping of the Transition Vulnerability Factors (TVFs) developed by the DNB on the NGFS's transition risk scenarios to assess the potential exposure of economic activities to transition risks from a forward-looking and risk-oriented perspective. The TVFs capture the sensitivity of stock returns to forward-looking scenario-specific excess market returns, for instance in case of a rise in carbon prices or a technological shock. Based on this mapping exercise, the economic activities that seem to be particularly exposed to transition risk from a forward-looking perspective are the following:[25]

- B05-09 – Mining and quarrying (coal, lignite, crude petroleum, natural gas, etc.);
- C19 - Petrochemical;
- C22 – Manufacture of rubber and plastic products;
- C23 – Manufacture of non-metallic mineral products;
- C24 – Manufacture of basic metals;
- D35 – Utilities (electricity, gas, steam and air conditioning supply);
- H50 – Water transport and
- H51 – Air transport.

---

[24] IAIS (2021).

[25] EIOPA (2022a) and see Annex 5.2.

58. The list of economic activities strongly exposed to transition risk remains stable across the different NGFS climate scenarios applied. Moreover, these sectors' exposure to transition risks is highly related to the level of their carbon emissions and their use of fossil fuels. Based on this mapping exercise, the economic activities regarding the extraction and production of fossil fuels (B05-09, C19, D35) are the economic activities most strongly exposed to transition risks across the NGFS's scenarios and show little variation across all climate scenarios analysed. Regarding the interpretation of results, it is important to differentiate economic activities that might be able to follow a transition to a low carbon economy in the future from those which might not. Indeed, in terms of carbon footprint, sectors related to the extraction, production, processing, transportation and reselling of fossil fuels will hardly be able to reduce their carbon emission levels as it is directly linked with their activity. In this regard, the Platform on Sustainable Finance (PSF) states that "*the Platform recognizes there are other economic activities for which no technological possibility of improving their environmental performance to avoid significant harm exists across all objectives and which might be thought of as 'Always Significantly Harmful' activities*", referring particularly to economic activities B5 (Mining of coal and lignite), B8.92 (Extraction of peat) and D35.11 (Power generation from solid fossil fuels).[26] According to article 19(3) of the taxonomy regulation, power generation activities that use solid fossil fuels do not qualify as environmentally sustainable economic activities.[27]

Forward-Looking Quantitative Assessment Methodology

59. To conclude on the potential of a dedicated prudential treatment of assets associated with different levels of transition risk exposures, EIOPA complements its backward-looking analysis based on historic time series data of asset prices with a quantitative forward-looking analysis that is based on the external work as outlined in EIOPA's discussion paper.
60. The deterministic results of the existing forward-looking assessments do not provide information on the probability distribution of transition risk-sensitive asset prices over a one-year time horizon. Such information on the probability distribution would be important to establish the size of potential risk differentials in terms of the risk measure used in the solvency capital requirement (SCR) of the Solvency II framework.
61. To express transition risk differentials in terms of the 0.5% VaR, the forward-looking assessment generates one-year return distributions, including the effects of transition risk, by means of Monte Carlo simulations. The outcomes very much depend on the probability of a disorderly transition materialising on the sector (NACE code) specific transition shock. The analysis considers equity and spread risk differentials for a range of carbon-intensive economic activities

[26] PSF (2022a).

[27] Regulation (EU) 2020/852 on the establishment of a framework to facilitate sustainable investment.

as well as commercial and residential property risk differentials for the different energy efficiency labels.

62. Three possible types of transition scenarios can be envisaged in the coming decade:

- An orderly type of transition scenario in which there is no or little impact on the real economy and financial sector. This type of scenarios consists of a timely and predictable path to a carbon-neutral economy with companies gradually adjusting their business models and capital stock to this new reality. An orderly transition is considered to be the baseline scenario in the ACPR and ECB transition stress tests.
- A disorderly type of transition scenario where there is a substantial impact on the real economy and – through their asset exposures to carbon-intensive sectors – the financial sectors. This type of scenarios tends to be characterised by unexpected, sudden and delayed actions to achieve carbon-neutrality. A disorderly scenario is generally considered to be a low probability, but yet plausible event.
- A type of scenario where there is no transition or an insufficient transition to a carbon-neutral economy. Such a type of scenarios is also bound to have substantial negative impacts on the real economy and financial sector. Not due to transition risk, but as a consequence of a further increase in (acute) physical risks, like floods, fires and storms that may damage production facilities and disrupt supply chains.[28] However, such risk differentials will materialise in another dimension, i.e. depending on the geographical location of companies rather than their carbon sensitivity.

63. Given that a disorderly transition poses the biggest transition risk, a prudential forward-looking VaR-analysis should focus on transition risk differentials relating to a disorderly scenario. Since it is difficult to estimate the probability of such a scenario, it is proposed to assess its impact under various annual probabilities of occurrence, e.g. ranging from 0.5% to 4.5% per year. To put these annual probabilities into a longer-term perspective, assume for example that the probability of an orderly transition amounts to 50% during the coming decade. The annual probabilities of 0.5-4.5% will then translate in a cumulative probability of 5-30% after 10 years, leaving a cumulative probability of no (or insufficient) transition of 20-45%.[29]

[28] The ECB economy-wide climate stress test of September 2021 shows that the change in banks' expected losses on their credit portfolio is more than twice as large for a physical risk scenario (hot house world) compared to a disorderly risk scenario.

[29] The cumulative probability equals the sum of the probabilities that a disorderly transition occurs in each year, given that there was no disorderly transition in the previous year(s), and subject to the condition of no orderly transition, multiplied by the probability of no order transition. I.e. $P(\neg A) \cdot \{P(B|\neg A) \cdot [1 + (1 - P(B|\neg A)) + .. + (1 - P(B|\neg A))^{10-1}]\}$, where $P(\neg A)$is the probability of not having an orderly transition scenario and $P(B|\neg A)$ the conditional probability of a disorderly transition scenario given that there is no orderly scenario. In terms of the unconditional probability of a disorderly scenario used in the text, the cumulative probability can be rewritten as $P(\neg A \cap B) \cdot \left[1 + \left(1 - \frac{P(\neg A \cap B)}{P(\neg A)}\right) + .. + (1 - \frac{P(\neg A \cap B}{P(\neg A)})^{10-1}\right]$, where $P(\neg A \cap B)$is the unconditional probability of having a disorderly transition and no orderly transition.

64. To generate the return distributions using Monte Carlo simulations, a statistical model is assumed in which the one-year asset return depends on:

- a normally distributed market return, which is the same for all investments within an asset class, irrespective of their carbon-sensitivity (historical component);
- an additional probabilistic disorderly transition return shock, which is uncorrelated with the market return (forward-looking component).

The assumption that market returns follow a normal distribution is a simplification, given that asset returns tend to exhibit fat tails. However, this simplification is not expected to materially affect the results, since the forward-looking analysis will focus on the change in the 0.5% VaR due to the inclusion of transition risk. Note that the joint statistical distribution including transition risk does not follow a normal distribution.

65. The standard deviation of the normally distributed market return can be calibrated to reproduce the 0.5% VaR for respectively type 1 equities,[30] bonds and loans,[31] and property[32] in the SCR standard formula. The EIOPA discussion paper[33] illustrated the workings of the model for the case of equities and a hypothetical transition return shock based on 15,000 simulations.[34] This report further specifies the model by using transition return shocks for stocks (section 2.2.4), bonds (section 2.2.7) and property (2.5.5) derived from the disorderly scenarios developed by ACPR, DNB, ESRB/ECB and IAIS mentioned earlier.

66. The Monte Carlo analysis does not consider the time dimension underlying the transition scenarios. The three DNB scenarios are assumed to materialise in the present, ACPR's sudden transition scenario in a time horizon of five years, the delayed transition scenarios of ACPR and ESRB/ECB in a time horizon of ten years and also the transition scenarios of IAIS manifest themselves over longer time horizons. Instead, the analysis assumes that all scenarios are equally likely to materialise within one year. The advantage is that the analysis captures parameter uncertainty and sensitivity to different scenario assumptions, while yielding results that are representative for a longer time period.

---

[30] One-year equity returns can be calibrated to a normal distribution with $\mu=0\%$ and $\sigma=15.2\%$ to reproduce the 0.5% VaR of -39% for type 1 equities, excluding the symmetric adjustment.

[31] One-year corporate bond returns can be calibrated to a normal distribution with $\mu=0\%$ and $\sigma=4.8\%$ to reproduce the 0.5% VaR of -12.5% for bonds and loans with CQS=3 and a duration of 5 years.

[32] One-year property returns can be calibrated to a normal distribution with $\mu=0\%$ and $\sigma=9.4\%$ to reproduce the 0.5% VaR of -25% for property investments.

[33] EIOPA (2022a).

[34] I.e., 15,000 draws from the normal distribution of market returns as well as 15,000 randomly generated evenly distributed numbers between 0 and 1 with the transition return shock being added to the market return if the random number is smaller than the annual probability of occurrence (e.g., 4%).

2.2. STOCKS AND BONDS: RISK ASSESSMENT

2.2.1. STOCKS AND BONDS: TRANSITION RISK CLASSIFICATION

67. The analysis uses historical equity prices for listed companies and historical spreads for traded bonds to assess if risk differences between suitably defined portfolios of companies exposed to different levels of transition risk (in the following "transition risk differentials") can be observed in past equity returns and bond spreads.
68. The definition of portfolios follows the purpose of the analysis, which is to assess whether any changes to the regulatory capital requirements in Solvency II's Standard Formula could be justified to differentiate the solvency capital allocation based on the asset's transition risk exposure. Thereby, the classification approach to be chosen needs to maintain a balance between simplicity and risk sensitivity as regards Solvency II's Standard Formula.
69. To assess the potential for a dedicated prudential treatment of transition risk exposures, it is necessary to construct for this specific exercise portfolios of debt and equity issued by companies subject to different levels of transition risk and to calculate their historical risk. In its discussion paper, EIOPA outlined two general ways of assessing the transition risk exposures of stocks and bonds:

    i. A sectoral approach, in which the level of transition risk is predominantly determined by the economic sector in which the company operates;
    ii. A firm-level approach, in which the level of transition risk is predominantly determined by idiosyncratic firm-specific characteristics, such as, for instance, the firm's greenhouse gas emissions (GHG) or the individual transition plans.

70. The main advantage of the firm-level approach is that it can determine a more risk sensitive solvency capital allocation towards transition risks as it treats firms being idiosyncratically in a net-zero transition pathway differently from their sectoral competitors. Therefore, the firm-level approach can acknowledge firm-level data such as greenhouse gas emissions or the implementation of transition plans. The main drawback of the firm-level approach is that it would also materially increase the complexity of the Standard Formula as it would imply firm-specific solvency capital requirements. In particular, such an approach would require a high quality and availability of granular firm-specific data (e.g., greenhouse gas emissions, implementation of transition plans, etc.) with a high level of homogeneity across data providers to be implemented by insurers and supervisors for determining the solvency capital requirements. Given the material ESG-related data gaps at firm-level regarding GHG emission data, and the current lack of legally binding transition plans of firms, such an approach seems to be impractical at the moment.

71. From a prudential perspective, the sectoral approach is more aligned with the current Standard Formula calibration. Moreover, it requires less data and seems to be more practical against the background of data availability and limited complexity of the Standard Formula.
72. The feedback EIOPA received to its discussion paper outlining both approaches shows a mixed outcome, however, with a slight preference of respondents towards the sectoral "averaging" approach in context of the Standard Formula.
73. EIOPA therefore follows the sectoral approach for its analysis and assesses the transition risk exposure of stocks and bonds according to their primary business activity. In that regard, EIOPA uses the assets' NACE codes as a determinant of the business activity. Sectoral classifications of assets based on NACE codes are used frequently for assessing transition risks (e.g., EIOPA (2020), Battiston et al. (2017)), and NACE codes form the basis of the EU taxonomy for sustainable activities. NACE codes are widely available, and a vast majority of assets can be classified on a homogeneous basis, ensuring a level playing field from a prudential perspective.[35] Moreover, NACE sectors are already routinely reported under Solvency II and would not cause additional costs if introduced in a dedicated prudential treatment.
74. There are also some drawbacks to this high-level classification. Investment funds often do not present a look-through based on the sectors, making it difficult to disentangle the relevant exposure from the overall investment in funds. For firms operating in multiple sectors, assigning a single overall sectoral classification to capture transition risk exposures becomes a challenging task. Moreover, NACE sectors are generally broadly defined and can in certain cases mix activities with different transition risk exposures. Mixed activities could in particular be relevant for transition sensitive economic sectors where firms are quickly adapting their transition plans and changing business models. For instance, regarding power generation it is not possible to separate out renewable power generation by means of the NACE sectors.
75. However, NACE codes are assigned to a firm's primary business activity from which the majority of operating cash flows stem. In that regard, it is likely that the firm's overall transition risk exposure will be dominated by this primary business activity, supporting the use of NACE codes for EIOPA's analysis. Moreover, NACE codes can be considered inherently sensitive to a potential introduction of a firm's transition plan, as corresponding changes in the business activity of a firm, if material in magnitude, would lead to the assignment of a different NACE code better reflecting the new primary business activity of the firm and thereby, its transition risk exposure. However, it is acknowledged that with the use of NACE codes firms' transitions plans are not taken into account in a forward-looking, but in a backward-looking manner.

[35] EIOPA explored different potential drivers for the classification before selecting the one used in the analysis [CPRS by Battiston et al. (2017), Transition Vulnerability Factors by the DNB, greenhouse gas emissions and E-Scores at firm-level]. The objective was to evaluate the correlation among different potential classification drivers used for the creation of the equity/bonds portfolio to assess their comparability. The portfolios obtained using different classification drivers, despite coming from the same universe of assets, are very different in terms of constituents and show a very low correlation among the different classification drivers.

Definition of Asset Portfolios in terms of Transition Risks

76. Based on the sectoral approach and the NACE codes of stocks and bonds, different asset portfolios can be constructed in terms of transition risk. EIOPA evaluated two main approaches as outlined in the discussion paper as regards a prudential risk assessment from the perspective of Solvency II's Standard Formula:
    i. A broad portfolio approach, allocating stocks and bonds to three overarching transition risk buckets: high, medium and low transition risk, thereby mixing different economic activities which are however perceived to have similar transition risk levels;
    ii. A narrow portfolio approach, focusing on individual economic activities, which is more sensitive in terms of differentiating sectors across their transition risk exposures.

I) The Broad Portfolio Allocation Approach

77. Economic sectors based on NACE codes associated with higher transition risk exposures are defined as the climate policy relevant sectors (CPRS) introduced by Battiston et al. (2017): fossil-fuel, utility/electricity, energy-intensive, buildings, transportation, and agriculture. These are sectors that are subject to a higher level of transition risk and have been mainly determined on basis of GHG emissions. There is however no ranking in terms of the transition risk exposure of these climate relevant sectors.
78. The CPRS are widely recognized as appropriate approach for the definition of transition risk. They provide high granularity for the included NACE codes.[36] The CPRS are also typically associated with high levels of greenhouse gas emissions.
79. In order to define the group of economic sectors based on NACE codes associated with lower or medium levels of transition risk exposures, the equity shocks from the DNB transition risk stress test are used to provide the basis for the definition of the two corresponding asset portfolios. The DNB transition risk stress test provides the shocks to equity prices for different scenarios in which transition risk materialises at the level of second digit NACE codes.[37] Sectors with shocks below the (arbitrary) threshold level of five percent on equity returns of the double shock scenario – which is the most severe transition scenario - are classified as relatively low transition risk sectors.
80. Once the sectors with higher and lower transition risk exposures have been defined, the sectors with medium transition risk exposure are simply the remaining ones. They mainly correspond to financial assets.

[36] CPRS are used as reference in (i) EIOPA's ORSA application guidance on climate scenarios (EIOPA (2022b)) and (ii) EIOPA's Sensitivity Analysis for Transition Risk (EIOPA (2020a)).

[37] DNB (2018).

II) The Narrow Portfolio Allocation Approach

81. Since economic sectors can differ in their transition pathway towards a low carbon economy, under consideration of sufficient data availability, a granular analysis by means of building asset portfolios tailored to capture individual economic activities is conducted. This narrower approach leads to a more precise capital allocation from a prudential perspective while maintaining a limited level of complexity as regards a potential use in the Standard Formula. But for certain economic activities data limitations and empirical uncertainties can arise in case there are only few data observations available for the calibration of the shock regarding the considered specific activity.
82. A major challenge for both approaches is the classification of low transition risk activities. While for the asset portfolios with a high level of transition risks one can rely on widely accepted research approaches as the CPRS by Battiston et al. (2017), there are no comparable proposals on the classification of low transition risk portfolios. Therefore defining economic activities associated with a medium or low transition risk exposure as part of the first portfolio allocation approach is more strongly dependent on expert judgement due to setting appropriate levels of the TVF-threshold than defining economic activities with higher transition risk exposures. Moreover, the prudential treatment of financial institutions (e.g. banks, insurers) in terms of transition risks is a challenging task as they are only indirectly exposed to transition risks via their investments.
83. The EU taxonomy on sustainable activities is not considered a feasible approach for the purpose of the analysis as it is not a risk-based taxonomy. In that regard, sustainable activities defined by the EU Taxonomy can also be subject to transition risk, e.g., related to technological changes (e.g., electric vs. hydrogen propulsion). Also, the EU taxonomy does not provide information on environmentally harmful activities, typically associated with higher levels of transition risk. However, EIOPA acknowledges that once the EU taxonomy is developed in a sufficiently granular and risk-based manner in the future, this would be an appropriate source to use for the classification of transition risk portfolios.
84. Therefore, EIOPA focuses in its narrow portfolio allocation approach on a homogeneous scheme in terms of the CPRS. Asset portfolios are constructed based on the NACE codes in each of the CPRS defined by Battiston et al. (2017).

2.2.2. CONSTRUCTION OF EQUITY PORTFOLIOS AND MEASUREMENT OF HISTORICAL RISK

85. This section describes the details of the construction of equity portfolios and the calculation of their historical risk. The steps taken are:

    i. Identify the universe of listed companies;
    ii. Identify the listed companies to be included in each of the transition risk portfolios;
    iii. Set the time window of the analysis;
    iv. Allocate these companies to NACE codes;

v. Address missing data for individual stocks;
vi. Set the rules for determining the value of the portfolios at each point in time (e.g., consideration of dividends, free float or all shares, currency, etc.);
vii. Choose an appropriate risk measure (e.g., Value-at-Risk).

Universe of Listed Companies

86. For the construction of the portfolios, a close proxy for the constituents of the MSCI World Index as of spring 2022 is used.[38] The calibration of the equity risk in the Standard Formula was mainly based on the MSCI World Index, which covers companies from various countries and shows a large variety of economic activities included.[39]
87. Although the composition of the MSCI World Index changes over time, the calculations conducted use a fixed portfolio based on the current index composition, simplifying the calculations.

Time Window of the Analysis

88. EIOPA's mandate is to study whether a potential for a dedicated prudential treatment of assets and activities associated with environmental objectives exists. As EIOPA is considering in this regard climate change mitigation as environmental objective, and from a risk-based perspective transition risks associated with climate change as potential driver for prudential market risks, defining an appropriate time window for a quantitative analysis becomes a challenging task.
89. The objective of climate change mitigation, and thereby transition risks, has become a societal concern mainly in recent time periods, making a potential materialization of transition risks in asset prices more likely to occur in a shorter time window, putting more weight to recent time periods (e.g., around the 2015 Paris Climate Agreement). Setting a longer time window for the analysis, for instance through including the 2000-2010 time period, puts more weight in the time series to periods mainly driven by pricing factors other than climate factors, thereby limiting the potential to find evidence justifying a dedicated prudential treatment of transition risks in the context of EIOPA's mandate. In that regard, it is important to note that EIOPA's mandate is not requesting to re-assess the general appropriateness of the prudential calibration of market risks.
90. Therefore, the time window chosen for the analysis runs from 2010 to 2021. The period from 2010 to 2021 captures a crucial juncture when societies and the real economy began to increase their awareness and mitigate climate change, for instance in terms of international agreements, such as the Paris Agreement in 2015, set ambitious targets for greenhouse gas emissions reduction, prompting nations to formulate and implement climate action plans. Consequently,

[38] This was due to licensing considerations.

[39] Certain sectors like information technology are not well represented in European equity indices.

businesses activities across various sectors faced growing pressure to begin with aligning their business activities with the overarching pathway to a low-carbon economy, resulting in investors and firms to start considering climate-related risks and opportunities in their decision-making processes. For instance, literature shows that the introduction of the 2015 Paris Climate Agreement led to increasing levels of transition risks, particularly regarding fossil fuel-related assets: Ehlers et al. (2021) and Delis et al. (2018) find higher loan spreads charged by banks only after the 2015 Paris Agreement, supporting the existence of transition risk channels in asset prices. Zhou et al. (2021) show material increases in loan spreads for coal mining when comparing the time windows 2007-2010 and 2017-2020, and moderate increases in loan spreads for oil and gas projects over the same time window. However, it is acknowledged that even a recent and representative time window does not solely capture transition risk effects but includes a variety of different market risk drivers in the data.

91. The feedback EIOPA received to its discussion paper supports the rationale that more recent periods are better candidates to find evidence, if existing, for a materialization of transition risks in asset prices. EIOPA considers the time window of 2010 to 2021 as an appropriate timeframe regarding the analysis to shed light on the extent to which transition risks can influence prudential market risks. In addition, the primary objective of the analysis is not to recalibrate the market risks in the standard formula but to assess and quantify potential risk differentials with regard to transition risks.

Allocation of Companies to NACE Codes

92. The allocation of NACE codes to companies is based on a number of sources: The ECB provides NACE codes for individual ISINs in the CSDB (Centralised Securities Database). Further sources for NACE codes per ISIN are Refinitiv and an EIOPA internal database, which uses the NACE codes that insurers assign to their investments in the regulatory reporting.
93. The different sources did not always coincide but the NACE codes were normally “close”. For example, an oil company may be assigned the NACE codes B6 or C19.2 depending on how the proportion of up- and downstream activities is determined. The results for the portfolio risk assessment are not necessarily affected by such ambiguities as both NACE codes may belong to the same transition risk portfolio (for example both B6 and C19.2 are in the high transition risk category).
94. A number of plausibility checks were performed based on the industry classification system “GICS”.[40] For a number of companies no NACE codes were available from the above-mentioned sources. For these firms, the NACE codes were assigned based on information about their activities and the GICS classification, provided there could be sufficient certainty about the

[40] Global Industry Classification Standard (GICS) is a private industry classification system developed by MSCI and Standard & Poor's widely used in the financial industry.

classification. As the number of cases where NACE codes were determined manually is quite small, there should be no meaningful impact on the results.

95. The allocation of equities is based on the current NACE code of the company. The basic premise is that, on average, the assigned NACE code remains relatively stable over time, at least in the short-term. There will of course be migrations but at least for the broad categories they do not necessarily change the results. As in the example above there may for instance simply be a migration from one higher transition risk sector to another.

Treatment of Missing Data

96. The share price and the number of shares were retrieved from Refinitiv for all companies in the considered universe of listed companies for each day in the period between 2010 and 2021. As can be expected there were gaps in these data. The approach chosen has the objective to maximise the number of companies that can be included in the calculation. This is of particular importance for calculations on the level of NACE codes where the initial number of companies in the universe of listed companies is limited.

97. The following steps are taken:

   i. All companies are removed for which data is missing for the first day of the period;
   ii. Certain holidays are removed (e.g., 24 December);
   iii. Days for which less than 75% of the principally available prices are available are removed.[41] This eliminates many holidays;
   iv. Gaps of a length of up to 6 days for the number of shares and up to two for the price are filled with the most recent value before the gap, provided it deviates by not more than 0.5% from the value directly after the gap;
   v. Days are removed if the available number of shares or prices is 5% lower than the principally available numbers.

Calculation of Portfolio Values

98. The methodology follows the MSCI Index methodology. The reason to choose the methodology of this particular index provider is that the original Solvency II Standard Formula equity risk calibration was derived from MSCI indices.

99. Dividends are not taken into account for the following reasons:

   i. the original equity risk calibration was based on price indices;
   ii. the impact of excluding dividends over a 12-month period is limited.

100. For the number of shares, all outstanding shares instead of the free float are used. It is not expected that this produces significantly different results.

[41] Prices are principally available for a certain stock at a certain day if they are available for a previous day.

101. The U.S. Dollar ("USD") is used as the reference currency (i.e., all stock prices in other currencies are translated into US Dollar using the exchange rate for the day). This approach is chosen because the original equity calibration was based on the MSCI World Index denoted in USD.

Selection of Risk Measures

102. The SII framework determines the solvency capital requirement as the 99.5% 12-month Value-at-Risk of basic own funds. Following the approach taken by CEIOPS and EIOPA in the Standard Formula for all market risk calibrations, the 99.5% VaR of the 12-month daily return series is calculated.

2.2.3. EQUITY RISK: BACKWARD-LOOKING RESULTS

103. This section presents the results of the different equity portfolios assessed.

Table 1: Results of the Broad Portfolio Allocation Approach

Start Date	End Date	Portfolio	VaR	No. Shares
04/01/2010	31/12/2021	Low Transition Risk	-14.0%	457
04/01/2010	31/12/2021	Medium Transition Risk	-26.3%	287
04/01/2010	31/12/2021	High Transition Risk	-20.2%	798
04/01/2010	31/12/2021	All (Market)	-14.5%	1542

Source: Own Table.

104. Table 1 shows the results for the broad portfolio allocation approach considering three broad transition risk categories, i.e., "low transition risk portfolio", "medium transition risk portfolio" and "high transition risk portfolio". The results are displayed for the period 2010-2021. The last row shows the empirical 99.5% VaR for a portfolio that includes all companies in the considered universe (the "market portfolio"). The other rows show the results of the different portfolios considered.

105. A slight historical equity risk differential between the low and the high transition risk portfolio can be observed. The high transition risk portfolio shows an up to 6% higher historical VaR than the low transition risk portfolio. However, the medium transition risk portfolio shows the highest equity risk (VaR of -26%). This is because the medium portfolio is mainly composed of financial firms, which showed elevated historical equity risk in the time period assessed.

106. Due to the elevated risk level of the medium transition risk portfolio compared to the remaining two portfolios (high and low transition risk), and since the broad portfolio allocation approach mixes sectors with quite different transition pathways, the figures do not provide a clear finding whether transition risk-related risk differentials exist. Moreover, since the definition of low transition risk activities is difficult in the context of market sentiment and

technological disruptions (e.g., E-cars vs. hydrogen cars), the second, i.e. narrow portfolio allocation approach focusing on individual sectors (i.e., CPRS) is considered to provide more robust findings.

107. Regarding the narrow portfolio allocation approach in terms of the climate policy relevant sectors (CPRS) defined as in Battiston et al. (2017), the Table 2A shows the historical equity risk for the period between 2010 and 2021.

Table 2A: VaR Results of the CPRS-based Portfolio Allocation (2010 – 2021)

CPRS Portfolio	VaR	No. Shares
Fossil Fuel	-56.50%	47
Finance	-28.20%	240
Energy-intensive	-24.60%	324
Housing	-23.00%	95
Transportation	-17.80%	49
Utilities	-16.50%	49
Other	-13.20%	726

Source: Own Table. The agriculture sector contains only three stocks and is neglected for further analysis.

108. Overall, the fossil fuel sector shows a differentiated risk profile relative to the other sectors in terms of the highest VaR (-56.5%) in the relevant time period from 2010-2021. This sector includes the following NACE codes: B5, B6, B8.92, B9.1, C19, D35.2, H49.5, G46.71, which mainly relate to activities associated with the extraction of crude oil, natural gas and the mining of coal.[42] A large number of studies underline that these activities, due to their inherent carbon intensity and limited potential to transition, tend to be more exposed to transition risks, as European economies gradually converge towards the objectives set out by the 2015 Paris Climate Agreement and the EU Green Deal. For instance, Zhou et al. (2021) show material increases in loan spreads for coal mining firms when comparing the time windows 2007-2010 and 2017-2020, and moderate increases in loan spreads for oil and gas projects over the same time window. Moreover, EIOPA's first sensitivity analysis of climate-change related transition risks in the portfolio of European insurers shows that losses on equity investments in the high-carbon sector can be high, reaching more than 25% on average for these particular equity holdings. These losses are in particular driven by investments in fossil fuel extraction, especially

[42] B5: Mining of coal and lignite; B6: Extraction of crude petroleum and natural gas; B8.92: Extraction of peat; B9.1: Support activities for petroleum and natural gas extraction; C19: Manufacture of coke and refined petroleum products; D35.2: Manufacture of gas; distribution of gaseous fuels through mains; H49.5: Transport via pipeline; G46.71: Wholesale of solid, liquid and gaseous fuels and related products. This combination of NACE codes brings together fossil fuels-related activities from different sectors, which are characterized notably by a very low or no "fuel substitutability": a low (high) substitutability of fossil fuel as an input implies higher (lower) levels of transition risk, since the sector can adapt slower (faster) to the low carbon transition (Battiston et al. (2017)).

oil and gas, but also by investments in car production based on traditional internal combustion engines.[43]

109. Further sectors show an elevated equity risk profile (e.g., finance, energy-intensive), but are usually considered to have a material potential for a transition to become less climate harmful, e.g., in conjunction with the progressive introduction of transition plans.[44]

110. As an additional robustness checks and for the sake of comparison, Table 2B focuses on four specific equity portfolios: the overall market portfolio, a financial sector portfolio, a non-financial sector portfolio (i.e., real economy) and a fossil-fuel sector portfolio for the period from 2010 to 2021. The introduction of the market portfolio, and the distinction between financial and non-financial equities is provided to get further insights into the relative contribution of the respective sectors to the market's overall performance. Overall, Table 2B underlines the differentiated risk profile of fossil fuel-related assets in terms of the VaR compared to the other portfolios (VaR of -56.5% for fossil fuel-related equities compared to -28.2% (financial firms), (-12.6% non-financial firms) and -14.5% (total market)).

Table 2B: VaR Results of Selected Portfolio Allocations (2010 – 2021)

Portfolio	VaR	No. Shares
Non-Financial	-12.6%	1246
Finance	-28.2%	240
Fossil Fuel	-56.5%	47
All (Market)	-14.5%	1542

Source: Own Table. For nine shares, there is no NACE code assigned.

111. As a complement to the analysis and to evaluate the impact of different classification approaches on the findings, the existing MSCI indices for the different GICS economic sectors are studied, in particular at level 2 and 3 regarding the sectoral classification.

112. The analysis in Table 3 shows substantial differences in equity risk between the economic sectors assessed, underlining the material challenges of mixing different economic sectors in an aggregated asset portfolio as regards the interpretation of the potential impact of transition risk exposures on corresponding market risks.

[43] See EIOPA (2020a). Moreover, Battiston et al. (2017): "Fossil fuels firms are relevant to identify carbon stranded assets in the economy and finance because in all decarbonization scenarios (e.g., IPCC, 2021) their output is estimated to decline considerably in order to achieve a carbon budget coherent with a 1.5 degrees C or a 2 degrees C target (IPCC, 2022)."

[44] In its Final Report on Taxonomy extension options supporting a sustainable transition (March 2022), the Platform for Sustainable Finance (PSF) "recognises there are other economic activities for which no technological possibility of improving their environmental performance to avoid significant harm exists across all objectives and which might be thought of as 'Always Significantly Harmful' activities" (p. 24)

Table 3: VAR Results of the GICS-based Portfolio Allocation

GICS level 2 (2010 - 2021)	VaR
Automobiles & Components	-40%
Banks	-32%
Capital Goods	-19%
Commercial & Professional Services	-27%
Consumer Durables & Apparel	-31%
Consumer Services	-36%
Diversified Financials	-22%
Energy	**-57%**
Food & Staples Retailing	-15%
Food, Beverage & Tobacco	-22%
Health Care Equipment & Services	-10%
Household & Personal Products	-15%
Insurance	-28%
Materials	-37%
Media & Entertainment	-14%
Pharmaceuticals, Biotechnology & Life Sciences	-17%
Real Estate	-26%
Retailing	-27%
Semiconductors & Semiconductor Equipment	-32%
Software & Services	-17%
Technology Hardware & Equipment	-21%
Telecommunication Services	-43%
Transportation	-19%
Utilities	-17%

Source: Own Table.

113. Overall, the energy sector, which includes the oil, gas and consumable fuels sub-sectors, continues to display the highest equity risk in terms of the VaR (-57%). Several economic sectors typically associated with higher levels of transition risks also show elevated risk profiles compared to the total MSCI index (-14.5% VaR), such as materials, automobiles and real estate, whereas other sectors such as utilities and transportation show lower risk profiles. Some economic sectors like health care and media, which are mainly part of the low transition risk portfolio in the broad portfolio approach, have shown a relatively lower equity risk compared to the total MSCI index (-14.5% VaR). Other economic sectors of the low transition risk portfolio, like telecommunication services (-43% VaR), however, show a relatively higher equity risk compared to the market.

114. It is worthwhile to mention that empirical uncertainties in the risk assessment can exist, as the sample size of the fossil fuel-related portfolio is limited to 47 shares. Furthermore, since the time period for the risk assessment runs from 2010 to 2021, it is important to assess whether

certain events might have driven the historical risk profiles. One major economic stress event in the period from 2010 onwards is the period of the Covid-19 pandemic.

Table 4: Sensitivity Analysis: Covid-19 Time Period

	GFC (2006 – 2009)	Normal Times (2010 – 2018)	Covid Period (2019 – 2021)	
CPRS Portfolio	VaR [Relative to Market]	VaR [Relative to Market]	VaR [Relative to Market]	No. Shares
Other	-52% [0.93]	-13% [1.18]	-28% [0.85]	726
Finance	-79% [1.41]	-36% [3.27]	-37% [1.12]	240
Energy-intensive	-64% [1.14]	-20% [1.82]	-22% [0.67]	324
Transportation	-47% [0.84]	-16% [1.45]	-36% [1.09]	49
Utilities	-48% [0.86]	-18% [1.64]	-19% [0.58]	49
Fossil Fuel	-47% [0.84]	-33% [3.00]	-60% [1.82]	47
Housing	-70% [1.25]	-31% [2.82]	-37% [1.12]	95
Market	-56% [1]	-11% [1]	-33% [1]	1542

Source: Own Table. The agriculture sector contains only three stocks and is neglected for further analysis.

115. Table 4 shows the results for the CPRS portfolios for three different periods: the pre-COVID time period (2010 to 2018), the COVID time period (2019 to 2021) and, for the sake of comparison, the time period of the global financial crisis as another major economic stress event (2006 to 2009). One can observe that the fossil-fuel portfolio (47 shares) is showing risk levels in terms of the absolute VaR among the highest in the pre-Covid and during the Covid period, although in the pre-COVID period sectors like finance (240 shares) and housing (95 shares) show comparable risk levels in terms of the absolute VaR. The historical equity risk is particularly high during the Covid period for fossil fuel-related assets. In this respect, it is worthwhile to mention that the fossil-fuels sector is a relatively cyclical sector showing particularly high downturn movements in periods of economic distress. The Covid-19 period as exogenous shock highlights thereby the significant influence of demand effects (e.g., consumer and investor preferences) on the risk profile of the fossil fuel-related assets.

116. Considering the relative risk performance of the fossil fuel-related assets, i.e., relative to the market's VaR, the fossil fuel-related assets show a differentiated and elevated risk profile compared to the other sectors in times of economic stress in the market. During the pre-Covid period, the fossil fuel-related assets reacted substantially stronger to market stress (ratio of 3.0) than the other sectors, apart from the financial sector (ratio of 3.27). However, during the Covid-period, the assets related to the financial sector showed a stronger decline in their reaction to the market stress than the fossil fuel-related assets, suggesting a differentiated risk profile between both sectors.

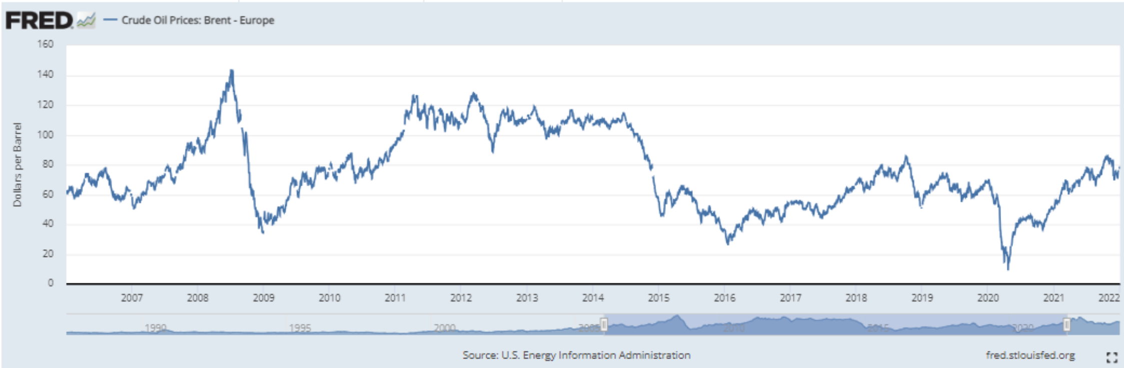
117. Another time period of major economic stress was the global financial crisis from 2006 to 2009, which provides a suitable tail event for comparison with the Covid time period. Interestingly, the fossil fuel-related sector, despite its cyclical behavior, was the sector with the least relative reaction to the market's distress (ratio of 0.84) during the GFC. In comparison with the Covid time period, the fossil fuel-related sector shows a substantial increase in its risk profile relative to the market (ratios of 0.84 and 1.82), although the correlation of the index returns between the fossil fuel-related sector and the market stayed almost constant during the GFC and the Covid time period (0.82 vs. 0.85). While oil prices in the two crisis events show a stronger decline during the Covid period (-77% from July 2007 to December 2008 vs. -87% from January 2020 to April 2020), they also show a substantially quicker recovery during the Covid period improving the risk profile of fossil fuel-related equities (see Figure 1).

118. Comparing the absolute VaR levels with the results for the entire data period from 2010-2021, the high equity risk for the fossil fuel-related portfolio (VaR of -57%) is largely driven by the return distribution in the Covid period. However, when comparing the time period of the GFC with the Covid time period, the stronger reaction to economic stress in the market during the Covid period in conjunction with a constant correlation pattern suggests an evolving differentiation in the risk profile of the fossil fuel-related equities beyond the impact of cyclicality. In particular, other cyclical sectors such as transportation and energy-intensive do not show a similar differentiation in their risk profiles in both stressed market periods. Interestingly, most sectors, apart from the fossil fuel-related sector, show relatively comparable figures, in relative terms, during the GFC and the Covid time period.

119. In the context of a transition risk channel, it could be expected that not the market as a whole becomes substantially riskier over time, but the climate harmful activities less able to transition become riskier while the less climate harmful activities become less risky. In particular, the strongly elevated risk profile of the fossil fuel-related sector during the time period of 2010 to 2018 (ratio of 3.0) could be related to a particular strong materialization of transition risks in assets prices in relation to major climate-related events such as the 2015 Paris Climate Agreement. Ilhan et al. (2021) show that carbon-related tail risks are higher in times of high public attention to climate change.

120. Overall, the backward-looking findings indicate a differentiated and elevated risk level of fossil fuel-related equities compared to other economic activities. To add further robustness to the findings whether fossil fuel-related assets can be considered riskier than other activities, and whether a dedicated prudential treatment could be justified, the backward-looking analysis is complemented by a forward-looking analysis.

Figure 1: Crude Oil Prices: Brent - Europe



Source: U.S. Energy Information Administration, Crude Oil Prices: Brent - Europe [DCOILBRENTEU], retrieved from FRED, Federal Reserve Bank of St. Louis.

2.2.4. EQUITY RISK: FORWARD-LOOKING RESULTS

Transition Shocks and Assumptions

121. The forward-looking analysis uses the projected equity shocks for the different economic sectors being distinguished in:

- the sudden and delayed transition scenarios of ACPR;
- the policy shock, technology shock and double (or combined) shock scenarios of DNB;
- the delayed transition scenario of ESRB/ECB;
- the disorderly transition and ‘too little, too late’ scenarios of IAIS.

In the Monte Carlo simulations, if a disorderly transition scenario materialises, a probability of 1/8 is attached to each of these eight specific scenarios occurring.

122. Figure 2A displays the projected equity shocks in the eight scenarios with a breakdown to the 13 most strongly affected economic activities. Since the analysis aims to quantify transition risk differentials relative to overall market risk, the shocks represent the difference in the percentage change of the stocks per NACE category relative to the percentage change of the overall stock market.[45] Some assumptions were made. Most notably, the equity shocks in the IAIS transition scenarios relate to climate-policy relevant sectors and these were mapped to the sectors shown in Figure 2A.[46]

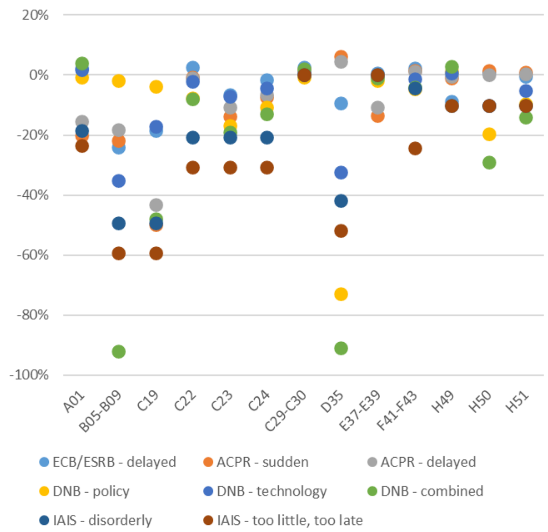
123. Figure 2A shows that the economic activities B05-B09 (Mining and quarrying (coal, lignite, crude petroleum, natural gas, etc.)), C19 (Manufacture of coke and refined petroleum products)

[45] The aggregate shock for equities in the ECB/ESRB scenario constitutes the weighted average of the shocks for the NACE activities using value added from Eurostat as weights.

[46] IAIS (2021) contains a correspondence table linking the CPRS classification to the NACE classification.

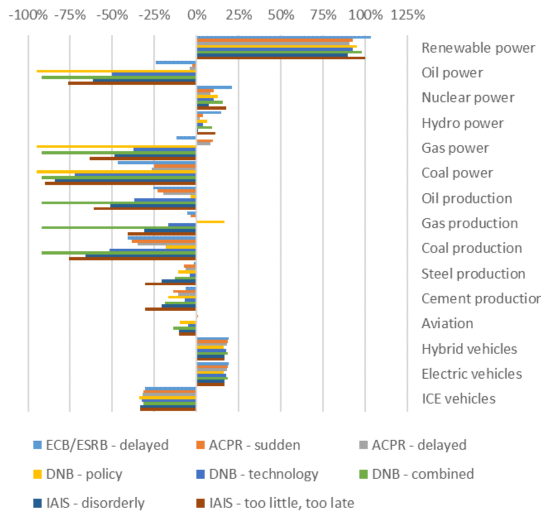
and D35 (Utilities (electricity, gas, steam and air conditioning supply)) experience the largest equity shocks in the forward-looking transition scenarios. Still, the shock sizes differ markedly between the different scenarios.

FIGURE 2A: EQUITY SHOCKS IN TRANSITION SCENARIOS BROKEN DOWN BY NACE ACTIVITY, %



Source: EIOPA calculations based on Banque de France/ACPR (2020), DNB (2018), ESRB/ECB (2022) and IAIS (2021).
Note on NACE-activities – the 13 NACE activities are shown, where available, for which equity prices are most impacted by the transition scenarios of ACPR, DNB, ESRB/ECB and IAIS.

FIGURE 2B: EQUITY SHOCKS IN TRANSITION SCENARIOS BROKEN DOWN BY KEY CLIMATE-POLICY RELEVANT SECTORS, %



Source: EIOPA calculations based on EIOPA (2020).

Equity Risk Differentials

124. This sub-section describes the results from the Monte Carlo analysis to estimate the equity risk differential in terms of 0.5% VaR. The analysis is based on 50,000 simulations, drawing one-year market returns from the normal distribution as well as generating random numbers to determine whether equities will be subject to an additional disorderly transition shock, as shown in Figure 2A. The analysis is done for a range of annual probabilities of a disorderly transition, varying from 0.5% to 4.5%. This implies a cumulative probability over the next decade between 5% and 30%.

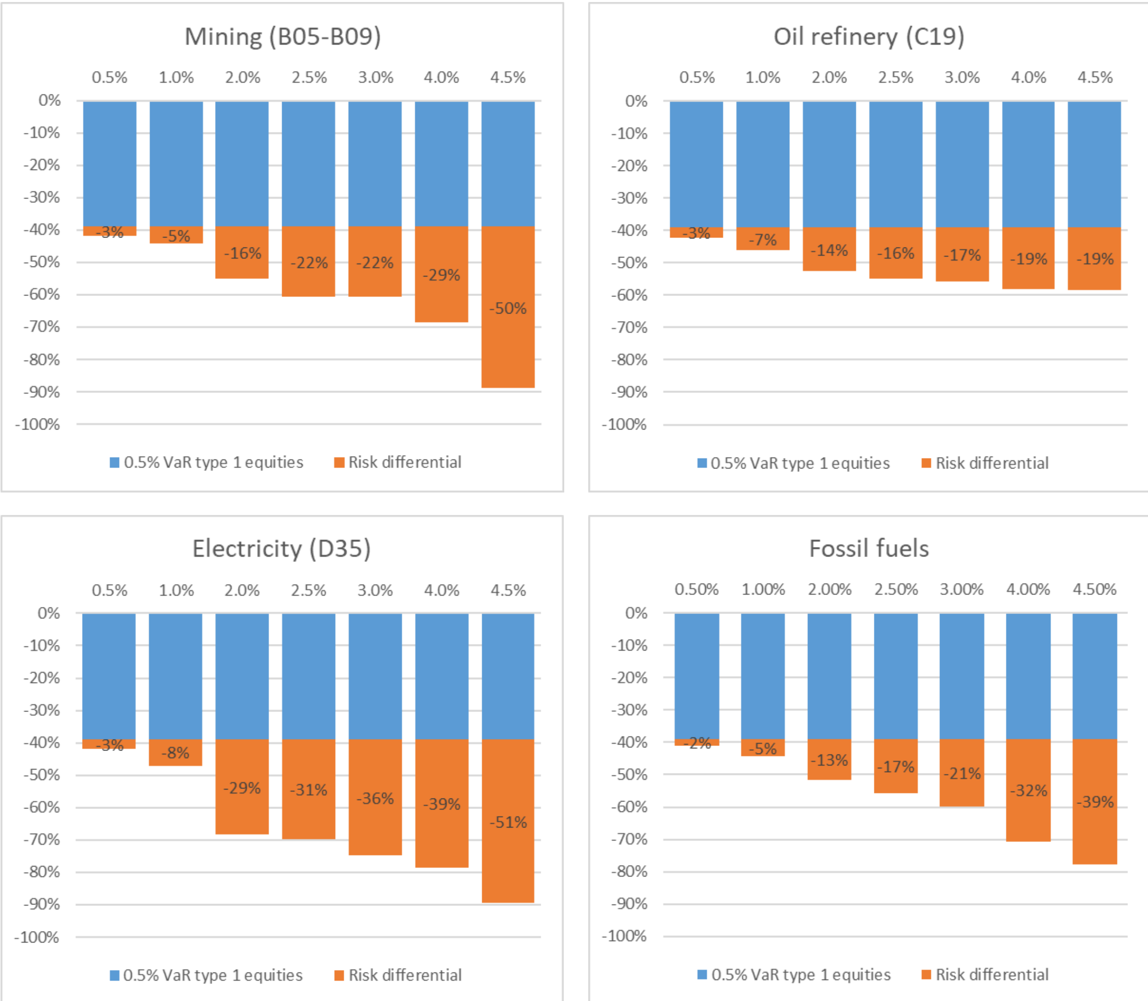
125. The risk differentials are based on the difference between the 0.5% VaR conditional on the disorderly transition of the economy and the baseline 0.5% VaR calibration of equity risk. The latter is calibrated to reproduce the 0.5% VaR of -39% for type 1 equities in the equity risk sub-module of the solvency capital requirement, excluding the symmetric adjustment.

126. Material equity risk differentials in terms of the 0.5% VaR are found for the activities mining (B05-B09), oil refining (C19), electricity generation (D35) and the composite fossil fuel sector(see Figure 3). The fossil fuel sector consists of 66% ‘mining’ (B05-B09), 11% ‘oil refinery’

(C19), 18% 'electricity generation' (D35) and 5% 'land transport and transport via pipelines' (H49) and aims to replicate the fossil fuel index for stocks in the backward-looking analysis.

127. These material risk differentials are due to the substantial shocks the affected activities are exposed to in the disorderly transition scenarios. The risk differentials for the other ten NACE activities considered in the analysis are zero or near zero since these activities do not receive a material downside shock. It is interesting to note that a large positive shock, e.g. for renewable power does not lead to material positive risk differential. Although in some transition scenarios there may be a significant impact on equity prices of these other sectors, the price declines are not large enough to contribute to the 0.5% VaR in a material way.

FIGURE 3: NACE ACTIVITIES WITH MATERIAL EQUITY RISK DIFFERENTIALS IN TERMS OF 0.5% VALUE-AT-RISK BROKEN DOWN BY ANNUAL PROBABILITY OF DISORDERLY TRANSITION



Source: EIOPA calculations.
Note: the 'Fossil fuels' sector is a composite sector consisting of 66% 'Mining' (B05-B09), 11% 'Oil refinery' (C19), 18% 'Electricity generation' (D35) and 5% 'Land transport and transport via pipelines' (H49) and aims to replicate the fossil fuel index for stocks in the backward-looking analysis.

128. The size of the risk differentials in addition to the NACE code specific shocks also very much depends on the annual probability of a disorderly scenario materialising. Estimates range from -2% at low annual probabilities for a disorderly scenario to as much as -50% at higher probabilities for the mining and electricity generation activities. The total 0.5% VaRs for these activities reaches 90% at higher probabilities, reflecting the fact that in some transition scenarios the mining and electricity assets will be largely stranded.

Equity Risk Differentials by Climate-Policy Relevant Sectors

129. A drawback of the NACE classification is that the categories are quite broad. As such, the NACE categories may contain activities that are negatively impacted by a transition scenario as well as activities that benefit from a transition scenario. The transition shocks from EIOPA's sensitivity analysis are used to supplement the eight climate scenarios with a further breakdown of the following NACE-level shocks:

- Mining and Quarrying (B05-B09), broken down by oil, gas and coal;
- Electricity, Gas, Steam (D35), broken down by renewable, oil, nuclear, hydro, gas and coal power; and
- Motor vehicles and Transport (C29-C30), broken down by hybrid, electric and internal combustion engine (ICE) vehicles.

The equity shocks from the EIOPA/2DII analysis have been adjusted to be consistent with the eight disorderly transition scenarios, using a similar approach as in the ESRB/ECB report on climate-related risk and financial stability (see Figure 2B).[47,48] Within the electricity generation activity, the equity prices relating to renewable power increase substantially in the eight transition scenarios. Those relating to nuclear and hybrid power also rise, but more modestly. The stock prices relating to gas, coal and oil power decline more (or increase less) than the prices relating to the aggregate electricity activity. Within the mining activity, equity price declines of coal are most severe, followed by oil and gas exploration. Lastly, within the motor

[47] See page 71-73 of ESRB (2021).

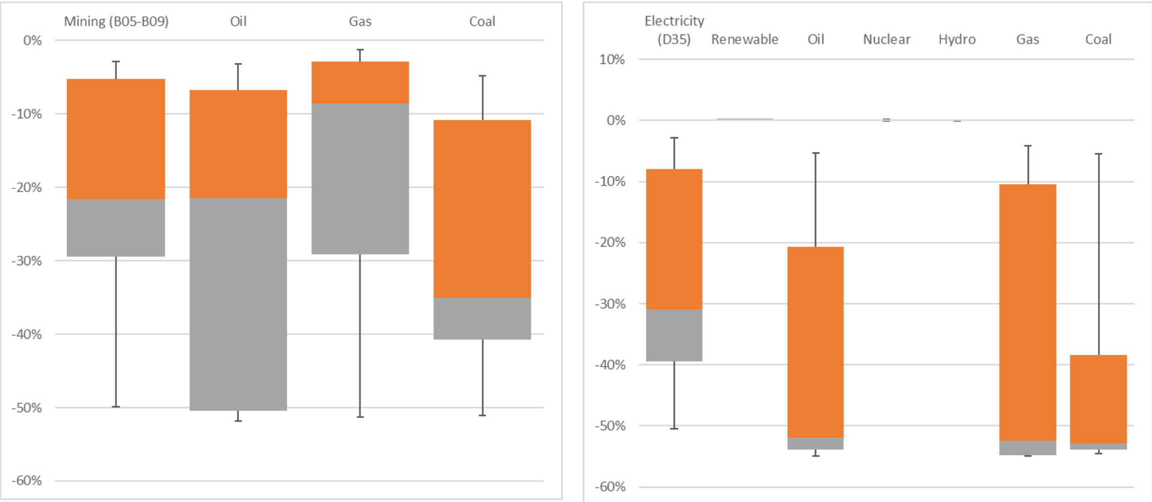
[48] The shocks to oil, gas and coal power have been adjusted, so that the weighted average of all power sources equals the shocks to equities relating to electricity generation (D35) in the eight transition scenarios, while the shocks to renewable, nuclear and hydro power have been left unchanged. Given the large drop in equity prices for electricity generation activities in DNB's policy and combined scenario, and given that the maximum decline of equities for oil, gas and coal power equals -100%, it is using this approach not possible to ensure full consistency, i.e., the aggregate decline exceeds the decline of the weighted average of the different power sources by some margin. The shocks to oil, gas and coal production have been adjusted, so that the average equals the shocks for mining (B05-B09) in the eight scenarios, while preserving the absolute differences to the mean. The same approach was taken for hybrid, electric and ICE vehicles with respect to the manufacture of motor vehicles (C29-C30). Finally, the shocks to steel production, cement production and aviation have been set equal to the shocks for respectively manufacture of basic metals (C24), manufacture of other non-metallic mineral products (C23) and air transport (H51). However, since these shocks correspond one-to-one to the relevant NACE activities, they do not play any further role in the analysis.

vehicle production activity, asset prices in relation to hybrid and electric vehicles increase, while asset prices in relation to vehicles with internal combustion engines decrease.

130. Figure 4 shows the equity risk differentials for the mining and electricity sectors broken down by climate-policy relevant sectors. Within the mining activity, coal exhibits the largest risk differentials at low probabilities of occurrence followed by oil and gas exploration, but at higher probabilities risk differentials are equally high. The large risk differential for electricity generation can be explained by the high risk differentials for coal, oil and gas power, while the risk differentials for renewable, nuclear and hydro power are approximately zero. Even though equity prices for these power sources rise in the disorderly scenarios, especially for renewable energy, this does not translate into a positive risk differential. The estimated risk differential for the manufacturing of motor vehicles is not material, but the analysis finds significant risk differentials, ranging from -2% to -8%, for the production of vehicles with internal combustion engines.

131. Overall, forward-looking risk differentials are identified for activities that are irreversibly connected to coal, gas and oil. Estimated risk differentials in term of 0.5% VaR for other carbon sensitive activities are approximately zero.

FIGURE 4: EQUITY RISK DIFFERENTIALS IN TERMS OF 0.5% VALUE AT RISK BY KEY CLIMATE-POLICY RELEVANT SECTORS AND ANNUAL PROBABILITY OF DISORDERLY TRANSITION



Source: EIOPA.

Note: Intersection of the orange and grey columns is the risk differential in terms of 0.5% VaR at a 2.5% annual probability. The top of the orange column the risk differential at a 1% probability, the bottom of the grey column at a 4% probability. The error bars denote the 0.5% and 4.5% probabilities of occurrence.

2.2.5. CONSTRUCTION OF BOND PORTFOLIOS AND MEASUREMENT OF HISTORICAL RISK

132. The mapping of bonds to their potential transition risk exposure is based on the firm's NACE code and, as for the equity risk analysis, includes both a broad and a narrow approach.

Universe of Companies

133. In order to construct debt portfolios to study the link between spread risks and transition risks, large parts of the considerations regarding the construction of equity portfolios can be transferred (especially the classification and measurement of transition risk exposures of firms). As bonds have - in contrast to equities - a fixed maturity the use of the index constituents as of today is not really an option for constructing historical portfolios (i.e. portfolios with varying compositions have to be used).

134. For the construction of the portfolios, the constituents of the iBoxx € Overall and iBoxx $ Overall indices for certain periods within the time frame of 2010 to 2019 have been used. The spread risk calibration that CEIOPS suggested was based on a European bond index. This approach has been followed also for the present analysis, but it has been extended to U.S. bonds to widen the sample of data.

135. The analysis is not restricted to certain maturities. In terms of credit ratings, only investment grade bonds are considered. However, this is deemed sufficient as investment grade bonds account for more than over 90% of EEA insurers bond investments.

Calculation of Debt Portfolio Values

136. Following the Solvency II framework, historical risk should be measured based on spread volatility. Based on the spreads for individual bonds, the portfolio spread has been estimated as a market value weighted average as this is closer to the actual spread for portfolios of bonds that insurers hold.

137. In the calculation of market weighted spreads for listed bonds, the market price of all bonds would be calculated as the product of the market price for the individual bond and the number of bonds issued. For traded bonds, the spreads can be calculated for each trading day, for non-traded debt the frequency is lower.

138. In order to reduce computational efforts, instead of building a spread index for each day of the considered 12-month period across all bonds, a two-step approach was used.

139. In the first step, for the considered time span, the 12-month time periods in which broad corporate spread indices displayed the largest increase in spreads have been identified. To do this, the monthly time series of the iTraxx Europe CDS index have been taken and, for each month, the annual spread change calculated. These annual changes were then ranked, and the four highest ones were identified. In this way four years in which spread changes have been particularly high have been chosen. The rationale of this approach is that, as prudential risk calibrations are driven by tail events, measuring spread changes in these “crisis-periods” would allow to significantly compare the risk pattern of portfolios in a relative perspective and to derive conclusions on the potential for transition risk related spread risk differentials.

140. In the second step of the analysis the 12-month daily spread changes for the four selected periods have been calculated for each bond.

141. The 12-month periods chosen are the following: Nov 2010 – Nov 2011; Feb 2015 – Feb 2016; Nov 2017 – Nov 2018; Apr 2019 – Apr 2020. In light of the equity risk analysis showing a differentiated and elevated risk profile of fossil fuel-related equities, a particular focus of the spread risk analysis is dedicated to fossil fuel-related bonds. Table 5 displays the number of bonds comprised in the fossil fuel-related bond portfolio, and the financial and non-financial portfolios for the sake of comparison.

Table 5: Numbers of Bonds for the Analysis

NACE Sector	Nov 2010 – Nov 2011	Feb 2015 – Feb 2016	Nov 2017 – Nov 2018	Apr 2019 – Apr 2020
Financial	1151	1530	1937	2130
Fossil Fuel	266	515	550	567
Non-Financial	1841	2943	3969	4441

Source: Own Table. Classification: Fossil fuel-related bonds are the CPRS-based NACE codes, financials are NACE code K, non-financial bonds are the residual economic activities excluding fossil fuels and financials.

142. Table 6 provides a detailed overview of the distribution of fossil fuel-related bonds across ratings and durations in the sample as of April 2019-2020. For the rating categories AAA, BB and B and for long durations, a risk assessment cannot be conducted since the number of fossil fuel-related bonds in the sample is insufficient. However, the duration buckets where EU insurers concentrate the majority of their bond investment are from 0-5, 6-10, 11-15 while the rating categories with the highest market value are AA, A, BBB. Therefore, the fossil fuel-related bond sample for the analysis is considered sufficiently representative for the insurers' investment behavior.

Table 6: Number of Fossil Fuel-Related Corporate Bonds

Duration / Rating	AAA	AA	A	BBB	BB	B
0-5	0	45	77	119	0	0
6-10	0	31	62	95	0	0
11-15	0	10	30	68	0	0
16-20	0	8	12	10	0	0
20+	0	0	0	0	0	0

Source: Own Table.

Selection of Risk Metrics

143. The metric considered most suitable is the 99.5% 12-month Value-at-Risk, calculated on the series of annual spread changes and measured in basis points. This approach is consistent with CEIOPS and EIOPA's advice on Standard Formula market risk calibrations.

2.2.6. SPREAD RISK: BACKWARD-LOOKING RESULTS

144. Table 7 summarizes the results of the broad portfolio allocation approach as in the case of the equity analysis. The column "Difference to the Market" refers to the difference in spread changes between the portfolios and the overall portfolio.

Table 7: VaR Results (in basis points) of the Broad Portfolio Allocation Approach

All ratings and durations

Portfolio	VaR 99.5%	Difference to the Market
High Transition Risk	1,240.91	21%
Low Transition Risk	415.66	-60%
Medium Transition Risk	995.7	-3%
Market (All)	1,028.57	

AA

Portfolio	VaR 99.5%	Difference to the Market
High Transition Risk	218.64	-32%
Low Transition Risk	158.18	-51%
Medium Transition Risk	388.91	20%
Market (All)	322.88	

A

Portfolio	VaR 99.5%	Difference to the Market
High Transition Risk	486.24	-25%
Low Transition Risk	250.83	-61%
Medium Transition Risk	780.19	20%
Market (All)	651.1	

BBB

Portfolio	VaR 99.5%	Difference to the Market
High Transition Risk	1,415.29	6%
Low Transition Risk	586.21	-56%
Medium Transition Risk	1,306.44	-2%
Market (All)	1,332.07	

Source: Own Table. No differentiation across duration.

145. The findings of the broad portfolio allocation approach are mixed. While low transition risk activities show the lowest levels of spread risk across the different rating categories assessed, the portfolios comprising bonds associated with a medium level of transition risks (i.e., mainly financial firms based on the used classification scheme) and those with a high level of transition risks alternate in their risk profiles across ratings relative to each other. Since the aggregation of various different economic activities into high-level portfolios as regards transition risk exposures appears suboptimal for assessing the potential for a risk differential, the following assessment focuses on the narrow portfolio approach, in particular regarding fossil fuel-related bonds.

146. The Table 8A show the results for AA, A and BBB rated bonds for the selected periods from 2010 - 2019. The analysis underlines the equity risk findings, showing a differentiated and elevated spread risk profile of fossil fuel related bonds during the observed time periods, implying a higher risk for the investor.

Table 8A: VaR Results (in basis points) of the Narrow Portfolio Allocation Approach – by Rating

All ratings and durations

Portfolio	VaR 99.5%	Difference to the Market
Fossil Fuel	1,925.57	88%
Financial	1,021.22	0%
Non-Financial	1,029.92	0%
Market (All)	1,026.20	

AA

Portfolio	VaR 99.5%	Difference to the Market
Fossil Fuel	300.47	13%
Financial	317.21	19%
Non-Financial	248.45	-7%
Market (All)	266.36	

A

Portfolio	VaR 99.5%	Difference to the Market
Fossil Fuel	1,821.45	181%
Financial	787.73	21%
Non-Financial	444.91	-31%
Market (All)	649.18	

BBB

Portfolio	VaR 99.5%	Difference to the Market
Fossil Fuel	2,344.34	75%
Financial	1,375.11	3%
Non-Financial	1,333.24	0%
Market (All)	1,336.20	

Source: Own Table.

147. The same analysis has been conducted for a differentiation across duration buckets, showing similar findings (Table 8B).

Table 8B: VaR Results (in basis points) of the Narrow Portfolio Allocation Approach – by Duration

All ratings and durations

Portfolio	VaR 99.5%	Difference to the Market
Fossil Fuel	1,925.57	88%
Financial	1,021.22	0%
Non-Financial	1,029.92	0%
Market (All)	1,026.20	

0-5

Portfolio	VaR 99.5%	Difference to the Market
Fossil Fuel	2,486.72	91%
Financial	1,157.45	-11%
Non-Financial	1,333.93	2%
Market (All)	1,303.64	

6-10

Portfolio	VaR 99.5%	Difference to the Market
Fossil Fuel	1,623.62	92%
Financial	667.37	-21%
Non-Financial	856.53	1%
Market (All)	846.75	

11-20

Portfolio	VaR 99.5%	Difference to the Market
Fossil Fuel	1,140.08	70%
Financial	322.78	-52%
Non-Financial	724.99	8%
Market (All)	671.87	

Source: Own Table.

148. As a robustness check, EIOPA has performed the same analysis using the GICS sectors rather than the CPRS, consistently with what has been done for the equity risk analysis. Results in Table 9 show similar effects:

Table 9: VaR Results (in basis points) of the GICS-based Portfolios

All ratings and durations (GICS)

Portfolio	Var 99.5%	Difference to the Market
Oil & Gas	2,063.63	101.09%
Financial	1,021.22	-0.49%
Non-Financial	1,029.92	0.36%
Market (All)	1,026.20	

AA

Portfolio	Var 99.5%	Difference to the Market
Oil & Gas	223.68	-16.02%
Financial	317.21	19.09%
Non-Financial	248.45	-6.72%
Market (All)	266.36	

A

Portfolio	VaR 99.5%	Difference to the Market
Oil & Gas	1,863.45	187.05%
Financial	787.73	21.34%
Non-Financial	444.91	-31.47%
Market (All)	649.18	

BBB

Portfolio	VaR 99.5%	Difference to the Market
Oil & Gas	2,300.04	72.13%
Financial	1,375.11	2.91%
Non-Financial	1,333.24	-0.22%
Market (All)	1,336.20	

Source: Own Table.

149. The spread risk analysis shares the same limitations related to the sectoral classification driver (NACE codes) as the equity risk analysis, and shows certain limitations in data availability, particularly for AAA, BB and B bonds.

2.2.7. SPREAD RISK: FORWARD-LOOKING RESULTS

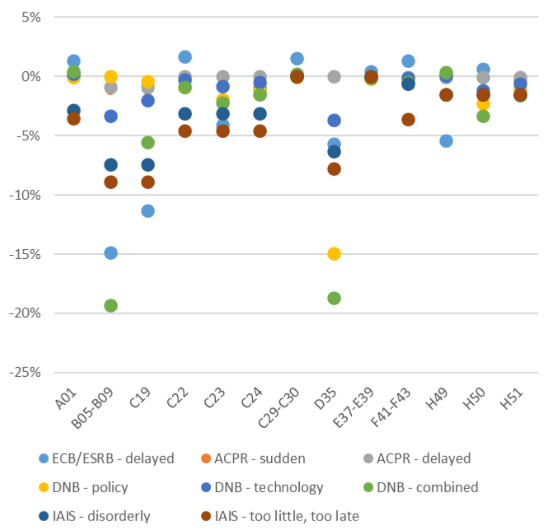
Transition Shocks and Other Assumptions

150. In line with the forward-looking analysis for equity risk, the transition return shocks for corporate bonds for the different economic activities are derived from the disorderly transition scenarios of ACPR (sudden and delayed transition scenarios), DNB (policy, technology and double shock scenarios), ESRB/ECB (delayed transition scenario) and IAIS (disorderly and 'too little, too late' scenarios). In the Monte Carlo simulations, if a disorderly transition scenario materialises, a probability of 1/8 is attached to each of these eight specific scenarios occurring.

151. Figure 5A displays the projected corporate bond price shocks in the eight scenarios with a breakdown to the 13 most strongly affected economic activities. Since the analysis aims to quantify transition risk differentials relative to overall spread risk, the shocks represent the difference in the percentage change of the bond price per NACE category relative to the

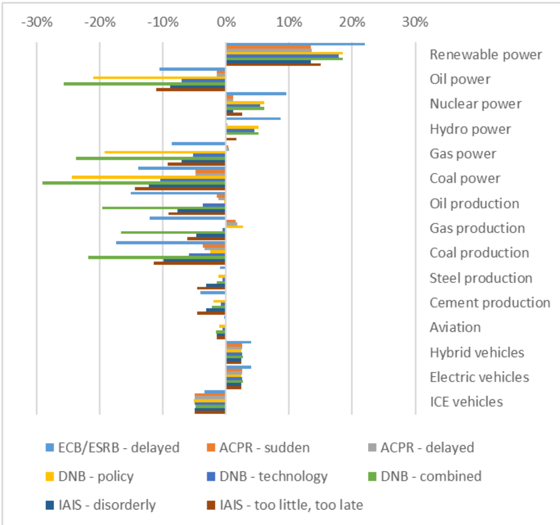
percentage change of overall bond prices.[49] Some transition shocks are only available in relation to the GICS or CPRS classification, are expressed in terms of spread changes or are not available for some NACE categories. Therefore, a number of other adjustments were made to derive the shocks, such as the transposition from the GICS / CPRS to the NACE classification,[50,51] the transformation of credit spread shocks into bond price shocks – assuming a duration of 5 years – and the completion of missing data.[52]

FIGURE 5A: CORPORATE BOND SHOCKS IN TRANSITION SCENARIOS BROKEN DOWN BY NACE ACTIVITY, %



Source: EIOPA calculations based on Banque de France/ACPR (2020), DNB (2018), ESRB/ECB (2022) and IAIS (2021).
Note on NACE-activities – the 13 NACE activities are shown, where available, for which equity prices are most impacted by the transition scenarios of ACPR, DNB, ESRB/ECB and IAIS.

FIGURE 5B: CORPORATE BOND SHOCKS IN TRANSITION SCENARIOS BROKEN DOWN BY KEY CLIMATE-POLICY RELEVANT SECTORS, %



Source: EIOPA calculations based on EIOPA (2020)

---

[49] The aggregate shock for bonds in the ESRB/ECB scenario constitutes the weighted average of the shocks for the NACE activities using value added from Eurostat as weights.

[50] The supporting spreadsheets of the ACPR climate pilot exercise contain a correspondence table with a mapping from GICS companies to NACE activities.

[51] IAIS (2021) contains a correspondence table linking the CPRS classification to the NACE classification.

[52] In relation to the three DNB scenarios, the credit spread shocks for corporate bonds in the mining sector with rating A and B have been interpolated to obtain an estimate for a BBB-rated bond. The same interpolation method has been applied to corporate bonds in the telecom sector, which – given its minimal exposure to transition risk – has been used as a proxy for the aggregate shock to the corporate bond market. The corporate bond shocks for the other 12 NACE sectors have been determined as fixed percentage of the corresponding equity shocks relative to the aggregate shocks: 20.5% with respect to equity shocks that are smaller than -70% and 11.5% with respect to all other equity shocks. This is consistent with the corporate bond shocks for the mining sector in the three DNB scenarios.

Corporate Bond Spread Risk Differentials

152. This sub-section describes the results from the Monte Carlo analysis to estimate the corporate bonds risk differentials in terms of 0.5% VaR. The analysis is the same as for equities, except for the disorderly transition shocks which correspond to the corporate bond price shocks shown in Figure 5A.

153. The risk differentials are again measured as the difference between the 0.5% VaR conditional on the disorderly transition of the economy and the baseline 0.5% VaR calibration of spread risk. The latter is calibrated to reproduce the 0.5% VaR of -12.5% for bonds and loans with credit quality step 3 and a duration of 5 years in the spread risk sub-module of the solvency capital requirement.

154. The outcomes of the Monte-Carlo analysis for corporate bonds are similar to the results of the analysis for equities. Material spread risk differentials in terms of 0.5% VaR are found for the mining (B05-B09), oil refining (C19), electricity generating (D35) activities as well as the composite fossil fuel sector (see Figure 6). The 'fossil fuels' sector consists of 69% 'mining' (B05-B09), 4% 'oil refinery' (C19) and 28% 'electricity generation' (D35) and aims to replicate the fossil fuel index for bonds in the backward-looking analysis.

155. The estimated risk differentials for bonds are considerably lower than for equities, ranging from nearly 0% at low annual probabilities for a disorderly scenario to -6% at higher probabilities. A lower risk differential for bond risk compared to equity risk is however not surprising, given bonds are typically less risky than stocks due to their fixed coupon payments and the bondholder's higher seniority in claiming the firm's assets in case of a bankruptcy. In that regard, for instance the PRA (2019) suggests an equity scaling factor of 0.15 to derive bond risk. Such a relationship also appears in the forward-looking findings between equity risk and bond risk, for instance in terms of fossil fuels, the maximum risk differential is 39% (maximum likelihood of the disorderly shock, see Figure 3), of which by means of the 0.15 scaling factor a bond risk differential of 6% can be postulated (maximum likelihood of the disorderly shock, see Figure 6).

FIGURE 6: NACE ACTIVITIES WITH MATERIAL CREDIT SPREAD RISK DIFFERENTIALS IN TERMS OF 0.5% VALUE AT RISK BROKEN DOWN BY ANNUAL PROBABILITY OF DISORDERLY TRANSITION

Source: EIOPA calculations.

Note: the 'Fossil fuels' sector is a composite sector consisting of 69% 'Mining' (B05-B09), 4% 'Oil refinery' (C19) and 28% 'Electricity generation' (D35) and aims to replicate the fossil fuel index for bonds in the backward-looking analysis.

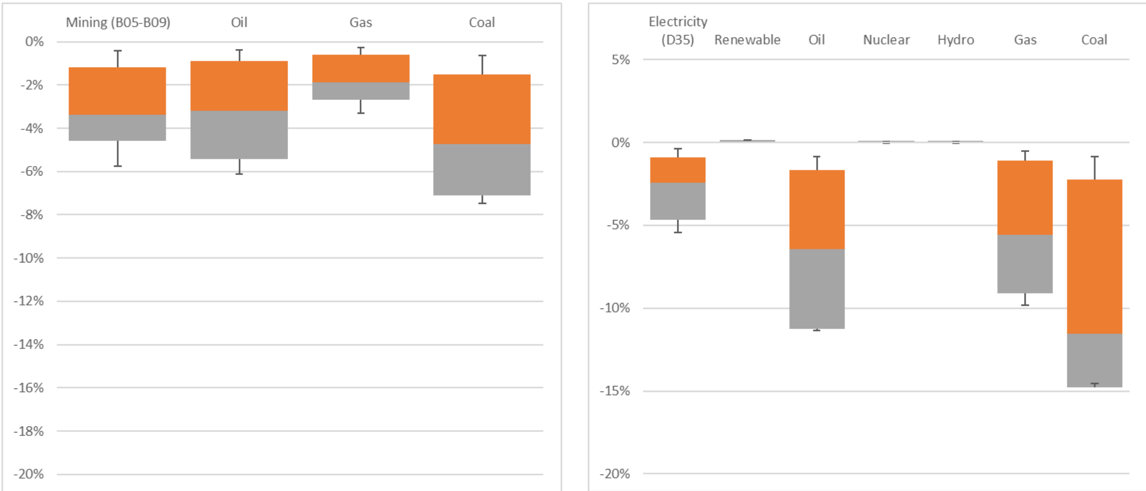
Bond Risk Differentials by Climate-Policy Relevant Sectors

156. Similar to the forward-looking analysis on equity risk, the transition return shocks for mining (B05-B09), electricity (D35) and motor vehicles (C29-C30) have been further broken down by climate-policy relevant sectors, using the approach described in section 2.2.4. The resulting transition shocks for the underlying sectors are displayed in Figure 5B and the resulting risk differentials in term of 0.5% VaR in Figure 7.

157. The resulting risk differentials for sectors within the mining and electricity generation activities is similar to the results found for stocks, but the size of on the risk differentials for corporate bond prices is lower. Coal mining has the highest risk differential, followed by oil and

then gas exploration. The same is true for electricity generation with coal-based power having the highest risk differentials, followed by oil-based and gas-based power. The risk differentials for corporate bonds relating to renewable, nuclear and hydro power are about zero. Where the equity analysis found significant risk differentials for the production of vehicles with internal combustion engines, the risk differentials for corporate bond prices relating to these activities is minimal, ranging from 0% to -1%.

FIGURE 7: CREDIT SPREAD RISK DIFFERENTIALS IN TERMS OF 0.5% VALUE AT RISK BROKEN DOWN BY KEY CLIMATE-POLICY SECTORS AND ANNUAL PROBABILITY OF DISORDERLY TRANSITION



Source: EIOPA Calculations.
Note: Intersection of the orange and grey columns is the risk differential in terms of 0.5% VaR at a 2.5% annual probability. The top of the orange column the risk differential at a 1% probability, the bottom of the grey column at a 4% probability. The error bars denote the 0.5% and 4.5% probabilities of occurrence.

2.3. STOCKS AND BONDS: CONCLUSION AND POLICY IMPLICATIONS

158. The backward-looking analysis of equity risk shows that stocks related to fossil fuel activities have the highest loss potential in terms of the VaR (around 56%) compared to the other CPRS-related sectors (around 13% - 39%) and to the market (around 14%).[53] In that regard, fossil fuel-related stocks show a differentiated and elevated risk profile over the time window assessed. In relation to the market's performance as baseline for comparison, a risk differential up to 42%, in additive terms, is present (56% - 14%).

159. The backward-looking equity risk assessment is complemented by means of a forward-looking approach to assess the potential of economic activities to be exposed to transition risks

[53] Note that this VaR, which is lower than any of the Solvency II capital charges for equity risk, reflects a time period (2010-2021) which were relatively "good times".

in the future. The analysis relies on stress testing elements and shows that under a disorderly transition scenario, forward-looking risk differentials are identified for activities that are irreversibly connected to coal, gas and oil. For fossil fuel-related stocks, supplementary solvency capital up to 39%, in additive terms, is needed to back up potential losses in the equity portfolio. Estimated risk differentials in terms of 99.5% VaR for other carbon sensitive activities are approximately zero.

160. The backward-looking spread risk assessment underlines the pronounced risk profile of fossil fuel-related bonds, which show materially higher levels of annual spread changes compared to the market and other activities. For instance, across all ratings, durations and currencies, the most severe annual spread changes (99.5% percentile) of bonds related to fossil fuel activities are, in multiplicative terms, 88% higher than those of the market, corresponding to a difference of 900 bp in additive terms.

161. The forward-looking spread risk assessment underlines, like the equity-based analysis, the higher loss potential of fossil fuel-related bonds, suggesting supplementary solvency capital up to 5%, in additive terms, and up to 40%, in multiplicative terms (5%/12.5%), is needed to back up potential losses in the bond portfolio. In line with economic rationale, the spread risk differentials are materially smaller than the equity risk differentials, as bonds are generally less risky than stocks due to their fixed coupon payments and first claims on firms' equity in case of a bankruptcy.

162. The sensitivity analysis on basis of the VaR of fossil fuel-related stocks shows a material increase in the absolute levels of the VaR during the Covid-19 time period in 2020 and the correspondingly lower demand for fossil fuels in the economy, which is not an environmental shock. However, in the time windows with and without the Covid-19 shock, fossil fuel-related stocks underline their differentiated and elevated loss potential relative to most other CPRS-sectors and to the market. A comparison with the risk profile during the global financial crisis (2006 to 2009) suggests an increasing differentiation of the risk profile of fossil fuel-related assets over time towards elevated risk levels. Moreover, the spread risk of fossil fuel-related bonds in the time periods outside the COVID period underline the differentiated and elevated risk profile of fossil fuel-related assets.

163. Evidence in the literature underlines the potential materialization of transition risks in the financial performance of fossil fuel-related assets. Measuring transition risk exposures by means of greenhouse gas emissions, work by, for instance, Ilhan et al. (2021), Carbone et al. (2021) and Bolton/Kacperczyk (2021) shows that transition risk exposures significantly increase equity and credit risk of firms.[54] Moreover, evidence shows that the introduction of the 2015

[54] The rationale assumed is that to achieve the environmental objective of climate change mitigation, firms with higher greenhouse gas emissions need to adapt more quickly and substantially to a low carbon environment than firms with lower emission levels. Therefore, high emitting firms are more strongly exposed to transition risks in terms of e.g., political and technological developments and shifts in consumer demand preferences that could negatively affect their business models and lead to financial losses.

Paris Climate Agreement led to increasing levels of risk particularly regarding fossil fuel-related assets. Ehlers et al. (2021) and Delis et al. (2018) find higher loan spreads charged by banks only after the 2015 Paris Agreement, supporting the existence of transition risk channels in asset prices. Zhou et al. (2021) show material increases in loan spreads for coal mining when comparing the time windows 2007-2010 and 2017-2020, and moderate increases in loan spreads for oil and gas projects over the same time window. Moreover, Caldecott et al. (2017) show material increases in asset write-downs for coal-related projects, with accelerating levels after 2010 and after 2013.

164. It is important to note that the findings in the backward- and forward-looking analysis have certain limitations at this stage of the analysis that are difficult to overcome, as sustainable finance is a rather emerging area for quantitative risk-based analysis subject to material challenges particularly as regards the availability of data and research methodologies. The data sample to assess the VaR of the fossil fuel-related assets is limited due to a relatively low number of firms predominantly engaging in fossil fuel-related activities. Moreover, the backward-looking analysis does not disentangle transition risk from other factors driving the loss potential of assets, which is however in line with the Standard Formula's perspective to treat equity and spread risk charges as an aggregate of various underlying risk drivers (e.g., inflation risks). In particular the results of the backward-looking analysis show a material increase in the absolute levels of the VaR during the Covid-19 time period, which was not an environmental event. The forward-looking analysis is based on disorderly transition scenarios developed by various supervisory authorities. These scenarios are generally considered to be ”low probability, yet plausible events”. However, the results of the analysis appear to be very sensitive to the size of this 'low probability' of a disorderly scenario occurring. Moreover, the analysis follows a sectoral approach in terms of NACE codes and does not explicitly take firm-specific transition risk characteristics such as transition plans into account. Legally binding transition plans of firms, e.g. in relation to the Corporate Sustainability Directive (CSRD) in the EU, are however not available at this stage of the analysis. Lastly, fossil-fuel related assets, which are the assets concerned by the proposed policy options, can be considered as activities that by nature cannot transition (the European Platform on Sustainable Finance thus explains: "The Platform recognizes there are other economic activities for which no technological possibility of improving their environmental performance to avoid significant harm exists across all objectives and which might be thought of as 'Always Significantly Harmful' activities"[55]).

165. Overall, the backward- and forward-looking findings show a differentiated and elevated loss potential of fossil fuel-related stocks and bonds compared to the assets of other economic sectors and to the market. While the public feedback to EIOPA's consultation paper in 2023 was largely supporting the finding of an elevated risk profile of such assets, different views were

[55] PSF (2022a), p. 24.

expressed as regards the corresponding policy implications. Some stakeholders argued for a treatment under Solvency II's Pillar II, mainly the ORSA, while others argued for a treatment under the Pillar I (solvency capital requirements).

166. From a prudential perspective, the differentiated and elevated loss potential of fossil fuel-related stocks and bonds in terms of the VaR could be underestimated in the current Standard Formula's assessment particularly in case of asset portfolios materially exposed to fossil fuel-related investments, thereby acknowledging the economy's increasing risk to run into a disorderly transition given the current misalignment with the Paris climate goals as regards the existing national pledges.[56] The materialization of a disorderly transition scenario would likely exacerbate the historical loss potential particularly of those economic activities (largely) unable to transition to a low carbon environment such as the extraction and processing of fossil fuels. For instance, the IEA is assuming that the global demand for oil and gas needs to decline by 75% to reach net zero emissions by 2050.[57]

167. Hence, it is considered appropriate in the context of EIOPA's mandate to develop and propose policy options regarding a dedicated prudential treatment of fossil fuel-related stocks and bonds to mitigate the corresponding loss potential.

2.4. STOCKS AND BONDS: POLICY OPTIONS

168. The backward- and forward-looking analysis is based on a sectoral approach by means of NACE codes to maintain a balance between simplicity and risk sensitivity in the Standard Formula and therefore does not take firm-specific transition risk characteristics such as transitions plans into account. It is important to note that firm-specific transition plans for the real economy, such as under the requirements of the Corporate Sustainability Reporting Directive (CSRD), are not yet available for prudential purposes. Therefore, it is considered appropriate to develop potential policy options on basis of NACE codes and not on firm-specific transition plans. Thereby, for instance two firms with the same NACE code, one with a transition plan and the other without, would be treated similarly as regards the policy options. It is however important to note that firms with cash flows predominantly stemming from fossil fuel related activities for which policy options are proposed based on the backward- and forward-looking findings (e.g. mining of lignite, extraction of crude petroleum and natural gas), will get a different NACE code assigned if they change their business model materially, for instance in case of predominantly engaging in economic activities less harmful to the environment. Hence,

[56] UN FCCC (2022), showing that the climate pledges of the 193 Parties under the Paris Agreement could lead to a 2.5 degrees Celsius warming by the end of the century.

[57] IEA (2023).

those fossil fuel-related firms materially transforming their business model towards less environmentally harmful activities would no longer be covered by a dedicated prudential treatment based on the sectoral NACE code approach.

169. To address the evolving nature of the topic, in particular in relation to (i) technical aspects such as improvements to risk modelling and data, and (ii) socio-economic developments affecting transition risk patterns (e.g., changes to the level of carbon taxes, market sentiment), any changes regarding a dedicated prudential treatment of transition risks should be reviewed five years after implementation.

2.4.1. EQUITY RISK: POLICY OPTIONS

170. Based on the findings from the backward- and forward-looking perspective regarding fossil fuel-related stocks, three policy options are considered:

i. Option 1: “no change”-option
ii. Option 2: treating fossil fuel-related stocks as Type II equity, i.e., a capital charge of 49% rather than 39% for Type I equities;
iii. Option 3: a dedicated supplementary capital requirement to the current equity risk calibration.

Option 1

171. The “no change”-option would not introduce a dedicated prudential treatment of fossil fuel-related stocks. It would be neutral as regards the debates around introducing Pillar I requirements for sustainability risks and put more weight on natural limitations of corresponding analyses in terms of classification (treating firms within a sector similarly), data (small number of stocks in certain sectors as regards the MSCI World Index constituents) and treating transition risk factors in aggregation with other equity risk factors.

Table 10: Pros and Cons - Equity Risk Option 1

Main Pros	Main Cons
Neutral as regards to the debates about sustainability risks and Pillar I	Inconsistent with empirical VaR of fossil fuel-related assets, forward-looking assessment and external stress test findings
No additional complexity added to the standard formula.	
No implementation costs for undertakings.	

Option 2

172. A flat shock of 49% for fossil fuel-related equities would reflect the differentiated and elevated risk profile of fossil fuel-related stocks, even if such shock would reflect a lower risk than the empirical VaR of 56% estimated in the backward-looking analysis. Moreover, such a treatment would not foresee an additional shock for fossil fuel-related assets already included in Type 2 Equity (non-EEA/OECD), which would practically imply a discrimination of fossil fuel-related Type I equities. To limit incentives to classify fossil fuel stocks as participations or long-term equity for the sake of a lower capital requirement (22%) compared to the empirical VaR, corresponding exclusion criteria would be needed. However, the implied increase of the risk charge of assets originally classified as participations or long-term equity would be material (from 22% to 49%).

Table 11: Pros and Cons - Equity Risk Option 2

Main Pros	Main Cons
Reflects higher risk profile of fossil fuel-related stocks due to a supplementary risk charge of 10%, in practical terms, relative to current Type I classification	49% risk charge for Type II equities is lower than the empirically estimated VaR of 56%
Consistent with forward-looking findings that underline the need for a supplementary risk charge.	Would require exclusion criteria regarding potential classification of fossil fuel-related stocks as participations or long-term equity (LTE), leading to a material increase of the corresponding shock for existing determinations(22% to 49%)
	Would not foresee an additional shock for assets already included in Type 2 Equity, leading to a discrimination of Type I assets (EEA/OECD)

Option 3

173. In the context of the backward-looking findings (56% VaR), a potential supplementary capital charge to the current Standard Formula’s risk charge of 39%, in case of Type 1 equities, could lie in the range up to 17% in additive terms, i.e., 39%+17%=56%, as the upper threshold would require a solvency capital allocation consistent with the empirical loss potential of an equity portfolio consisting only of fossil fuel-related stocks. A supplementary capital charge up

to 17% lies in the middle of the findings suggested by the forward-looking assessment, i.e. a range of 2% up to 39% for a supplementary capital charge. A dedicated treatment of fossil fuel-related stocks by means of a supplementary capital requirement to the current calibration (Participation, Type I, Type II) would allow for a more precise solvency capital allocation. Regarding the role of participations or long-term equity, exclusion criteria for fossil fuel-related activities or a potentially higher capital requirement may be needed to limit incentives to re-classify Type I/II stocks as participations for the sake of SCR reduction.

Table 12: Pros and Cons - Equity Risk Option 3

Main Pros	Main Cons
Reflects the higher risk exposure of fossil fuel-related stocks in terms of the empirically determined VaR and allows for a corresponding risk-based solvency capital allocation	May require exclusion criteria regarding potential classification of fossil fuel-related stocks as participations or long-term equity, or higher add-on to limit incentives for SCR reduction
Consistent with forward-looking findings that underline the need for a supplementary risk charge.	Adds complexity to the standard formula.
	Empirical uncertainties exist as regards the relatively small sample size available for risk assessment.

2.4.2. SPREAD RISK: POLICY OPTIONS

174. The spread risk module in the Standard Formula is based on a mapping of shock factors to a bond's rating and its duration. If credit ratings capture sufficiently the transition risk exposure of a bond, a dedicated prudential treatment of the identified elevated loss profile of fossil fuel-related bonds might not be necessary to ensure sufficient solvency capital is set aside by undertakings to cover potential transition-related losses. The public feedback EIOPA received to its consultation paper in 2023 as regards the reflection of transition risks in credit ratings was however inconclusive. While some stakeholders argued credit ratings reflect transition risks, others argued for the opposite.

175. Although the main CRAs indicate in their rating methodologies that some consideration is given to sustainability risks, EIOPA was not able to find clear evidence concerning the accuracy of this treatment. Furthermore, current findings in the literature on this matter point towards

a material lack of comparability and transparency of the reflection of sustainability factors in credit ratings at this stage.[58]

176. In this regard, EIOPA considers the current potential of credit ratings to appropriately reflect transition risk exposures from a prudential perspective to be limited. As there can be the risk of underestimating a bond's transition risk exposure by means of relying on currently available credit ratings, it is considered appropriate, at this stage of the analysis, to develop and propose policy options regarding the prudential treatment of the spread risk associated with fossil fuel-related bonds. If rating methodologies improve further and sufficiently capture a bond's transition risk exposure in a comparable and transparent manner, the proposed policy options for a dedicated prudential treatment of spread risk associated with fossil fuel-related bonds should be revised. Given the backward- and forward-looking findings regarding bonds, there is scope for a dedicated prudential treatment of bonds related to fossil fuel activities. Three policy options are considered:

i. Option 1: no change option.
ii. Option 2: a rating downgrade of bonds related to fossil fuel activities,
iii. Option 3: a dedicated supplementary capital requirement to the current spread risk calibration

Option 1

177. Regarding the "no change"-option, the same advantages and disadvantages apply as for equity risk.

Table 13: Pros and Cons - Spread Risk Option 1

Main Pros	Main Cons
Neutral as regards to the debates about sustainability risks and Pillar I	Inconsistent with empirical VaR of fossil fuel-related assets, forward-looking assessment and external stress tests
No additional complexity added to the standard formula.	
No implementation costs for undertakings.	

Option 2

178. Regarding the rating downgrade, fossil fuel-related bonds would be shocked according to their next higher bucket based on the currently existing calibration in the Standard Formula.

While this approach would constitute limited complexity and reflect a higher risk charge in relation to the backward- and forward-looking findings, a rating downgrade however would not precisely reflect the magnitude of a potential shock based on the empirical findings. Moreover, no additional risk charge would be assumed for bonds being already in the highest credit quality step of the Standard Formula, and a potential interference with credit ratings and corresponding consideration of transition risk might exist.

Table 14: Pros and Cons - Spread Risk Option 2

Main Pros	**Main Cons**
Reflecting backward- and forward-looking findings showing a differentiated and elevated risk profile	Rating downgrade does not precisely reflect the higher risk profile of fossil fuel-related bonds in absolute terms
	There would be no additional shock for bonds already in the highest “duration x rating”-buckets
	Interference with credit ratings and their consideration of transition risk possible

Option 3

179. The capital requirements of the spread risk module are based on combinations between the credit quality step (in relation to the bond’s rating) and the duration of a bond.[59] Regarding a supplementary capital requirement to capture the elevated loss profile of fossil fuel-related bonds, a higher shock factor for each combination of credit quality step and duration could be implemented, thereby acknowledging the general mapping of the Standard Formula to prescribe higher shock factors for longer durations and higher credit quality steps.

180. Setting appropriate shock factors for each combination of credit quality step and duration based on empirical observations is however a challenging task, since the data analyzed lacks empirical spread observations for certain risk buckets (AAA, BB and B), preventing the appropriate empirical estimation of a corresponding shock factor in those buckets. Moreover, the Standard Formula’s general risk mapping as regards higher shock factors for longer durations and higher credit quality steps needs to be maintained when setting shock factors, requiring coherent adjustments of the shock factors across the risk buckets.

[59] Article 176, Commission Delegated Regulation (EU) 2015/35.

181. Therefore, by acknowledging the lack of spread observations in certain risk buckets and the Standard Formula's aim for a balance between simplicity and risk sensitivity, EIOPA suggests implementing a multiplicative approach to set the supplementary capital charges for each risk bucket based on the spread observations of the full set of data, i.e., based on bonds over all ratings and duration. In this regard, multiplying the current shock factors in the Standard Formula with a constant increment ensures the general risk mapping as regards duration and credit quality steps is maintained while allowing to require supplementary capital to reflect the elevated risk profile of the fossil fuel-related bonds.[60]

182. The empirical findings suggest large spread changes of fossil fuel-related bonds relative to the market. Over all durations, ratings and currencies studied, the 99.5 percentile of the spread changes of fossil fuel-related bonds is 88% higher than that of the market. Implementing such a multiplicative increment to each shock factor in the Standard Formula could lead to economically implausible conditions for high-risk bonds in which the solvency capital requirement would be higher than the bond's total value.[61] Therefore, the multiplicative increment needs to be capped.

183. The forward-looking assessment of spread risk suggests a supplementary capital charge of up to 5% in additive terms, which corresponds to an increase in the capital requirements of up to 40% relative to the bond portfolio's current capital requirement (0.175/0.125=1.40). Moreover, the proposed supplementary capital charge for equity risk corresponds to an increase in the capital requirements of 44% relative to the equity portfolio's current capital requirement (0.56/0.39=1.44). Therefore, as a ceiling to the multiplicative increment for the spread risk shock factors in the Standard formula, a supplementary capital charge of up to 40%, in multiplicative terms, is suggested. For instance, a low-risk bond with a duration of 7 years and a credit quality step of zero would be subject to a shock of 7.7% instead of 5.5%.[62]

184. While the supplementary capital requirement would reflect more precisely the empirical evidence derived in the risk buckets with sufficient spread observations, limitations arise as it would be a constant increment to each shock factor due to the lack of spread observations in certain risk buckets e.g., AAA bonds) as well as the potential interference with credit ratings in case transition risk is more strongly reflected there.

---

[60] An additive risk charge, i.e., adding a constant increment to each shock factor could distort the spread risk module's general "duration x credit quality step"-risk mapping.

[61] For example, a bond with a credit quality step of five and a duration of 16 years would be subject to a stress in terms of 115% ((0.61+0.005)*1.88).

[62] Under the proposed supplementary capital charge, the highlighted bond would be subject under consideration of a transition risk increment to a shock of 7.7% ((0.045+2*0.005)*1.4).

Table 15: Pros and Cons - Spread Risk Option 3

Main Pros	**Main Cons**
More granular reflection of the higher risk profile of fossil fuel-related bonds	Increasing complexity of the Standard Formula since differentiation across “credit quality step x duration” for capital charges should be applied
Reflecting backward- and forward-looking findings that show a differentiated and elevated risk profile.	To address empirical uncertainties and limit shock factors that could overcome the bond’s total value in certain instances, expert judgement needed
	Interference with credit ratings and their consideration of transition risk possible

2.4.3. IMPACT ASSESSMENT

185. In order to assess the expected impact on the capital requirement of the policy options, EIOPA has performed an impact assessment. The approach is based on the information available from the Quantitative Reporting Templates (QRTs). More specifically, the templates used have been:

- S 06.02: List of Assets
- S 23.01: Own Funds
- S 25.01: Solvency Capital Requirements – Standard Formula
- S 26.01: Solvency Capital Requirements – Market Risk

186. As the potential policy options are focused on a dedicated prudential treatment for the fossil fuel category, the first step is the isolation of the fossil fuel-related assets. It needs to be mentioned that this analysis takes only fossil-fuel assets from direct exposures into account. Fossil-fuel portions from indirect exposures (e.g., CIUs) were not taken into account due to existing data limitations in the look-through approach. As indirect exposures make up a substantial portion of the total assets in certain markets, there is some additional uncertainty in the impact assessment (e.g., for funds having a large variety of underlying assets from different sectors).

187. The procedure followed for both stocks and bonds is as follow:

- Download List of assets for all countries;

- Isolate fossil fuel-related assets;
- Compute separately the weight of Fossil Fuel Equities and Bonds.

188. In relation to the respective policy options proposed, the dedicated prudential treatment of fossil fuel-related stocks and bonds could be associated with potential administrative and implementation costs, such as, for instance, the identification of sectoral NACE codes of the invested assets.

Impact Assessment on Equity Risk

189. In practical terms, requiring a Type II equity classification instead of Type I would imply a 10%-points increase in the capital charge (Option 2). Regarding Option 3, a supplementary capital charge of 17%-points is suggested. Therefore, the impact assessment outlines the potential impact of Option 3 as it leads to higher risk charges and potential impact on the solvency ratio of undertakings.

190. Once the portion of fossil fuels assets has been identified, the expected impact has been computed assuming that the additional capital charge on the assets would have the same impact on the liabilities as reported in the QRTs, including risk mitigation measures, diversification within modules and symmetric adjustment.

191. Finally, the expected "delta own funds" has been computed using the inputs obtained with the above procedure and they have been subtracted to the amount of eligible own funds as per Solvency QRTs.

192. The resulting impact on the solvency ratios for the option 3, per country, is computed as an absolute change and is as follows:

Table 3: Impact Assessment - Policy Options on Equity Risk

Country	Impact on Solvency Ratio (+17%-points)
AUSTRIA	-0.03%
BELGIUM	-0.69%
BULGARIA	-0.17%
CROATIA	-0.51%
CYPRUS	-0.05%
CZECH REPUBLIC	-0.73%
DENMARK	-1.30%
ESTONIA	-0.04%
FINLAND	-0.67%
FRANCE	-1.27%
GERMANY	-0.02%
GREECE	-0.22%
HUNGARY	-0.63%

ICELAND	-1.21%
IRELAND	-0.32%
ITALY	-0.53%
LATVIA	-0.42%
LITHUANIA	-0.16%
LUXEMBOURG	-1.50%
MALTA	-0.12%
NETHERLANDS	-0.41%
NORWAY	-1.73%
POLAND	-0.06%
PORTUGAL	-0.08%
ROMANIA	-0.28%
SLOVENIA	-0.24%
SPAIN	-0.66%
SWEDEN	-1.70%

Source: Own Table. Changes in the solvency ratio are in absolute terms, i.e., in percentage points.

193. Results vary in a scale from a decline by -0.02% for Germany to -1.73% for Norway, but the impact is overall very limited. The minimal variations observed depend mainly on the direct exposure in fossil fuels equities of the country, which appears to be (on average) very low throughout Europe.

194. Due to limitations related to the granularity of reported assets, it is not possible to exactly quantify the impact of Option 2, i.e., a Type 2 treatment of fossil fuel-related stocks, without using proxies which could lead to results embedding a high level of uncertainty. Given the low weight of fossil fuel-related stocks in the undertakings' portfolios and that such a policy option would in practical terms imply a lower increase in the capital charge than in Option 3, the resulting impact on the solvency ratio would however be lower as in the presented Option 3.

Impact Assessment on Spread Risk

195. The impact assessment for corporate bonds needs to be structured differently as it includes more dimensions than Equities, in particular rating and duration. It is computed as an absolute change.

196. The additional steps followed can be summarised as:

i. Breakdown of fossil fuel corporates by rating;
ii. Calculation of average duration by duration buckets;
iii. Calculation of the Solvency shocks on the generated portfolios, replicating the Standard Formula procedure;
iv. Computation of the expected shock on assets for the proposed options;

v. Run the proxy to assess how the asset shock will impact, in turn, the spread risk, then the market risk and finally the overall SCR

197. The results resulting from the above procedure are as follows:

Table 17: Impact Assessment – Policy Options on Spread Risk

Country	Impact on Solvency Ratio Option 2: Rating downgrade	Impact on Solvency Ratio Option 3: + 40%
AUSTRIA	-1.55%	-0.750%
BELGIUM	-0.95%	-0.459%
BULGARIA	-0.72%	-0.346%
CROATIA	-1.18%	-0.573%
CYPRUS	-2.14%	-1.038%
CZECH REPUBLIC	-1.26%	-0.611%
DENMARK	-0.07%	-0.032%
ESTONIA	-0.32%	-0.154%
FINLAND	-0.34%	-0.164%
FRANCE	-0.91%	-0.440%
GERMANY	-0.40%	-0.192%
GREECE	-1.09%	-0.530%
HUNGARY	-0.07%	-0.032%
ICELAND	-0.01%	-0.003%
IRELAND	-0.19%	-0.090%
ITALY	-2.75%	-1.338%
LATVIA	-0.55%	-0.265%
LIECHTENSTEIN	-0.20%	-0.097%
LITHUANIA	-0.37%	-0.181%
LUXEMBOURG	-0.68%	-0.331%
MALTA	-0.18%	-0.089%
NETHERLANDS	-0.16%	-0.078%
NORWAY	-0.41%	-0.198%

POLAND	-0.55%	-0.268%
PORTUGAL	-1.33%	-0.647%
ROMANIA	-0.16%	-0.077%
SLOVAKIA	-0.82%	-0.399%
SLOVENIA	-0.52%	-0.253%
SPAIN	-0.78%	-0.376%
SWEDEN	-0.01%	-0.004%

Source: Own Table. Changes in the solvency ratio are in absolute terms, i.e., in percentage points.

198. In light of the limited direct exposures of undertakings regarding fossil fuel-related bonds, the overall impact of changes in the respective capital charges on the solvency ratio is limited, on an aggregated country-level. However, the option 2 "Rating downgrade" shows a higher impact on the solvency ratio than the supplementary capital charge. In the case of corporate bonds, the variations in the impact on the solvency ratio do not only come from the exposures held (as per Equity) but also from the credit quality (rating) and durations of the bonds and their respective differences across countries.

Macroeconomic Implications

199. The impact assessment shows a very low impact of the proposed policy options on the solvency ratio of the undertakings mainly due to the undertakings' limited exposure to directly held fossil fuel-related assets. The low impact on the undertakings' solvency ratio thereby suggests a limited impact on the asset allocations of undertakings in terms of potentially triggering fire-sales of fossil fuel-related assets that could contribute to systemic risks in the financial system. Moreover, it is important to note that besides capital charges, insurers take further criteria for their investment decisions into account, such as objectives in terms of duration and cash flow matching between assets and liabilities, further limiting the potential of the proposed policy options to trigger material re-allocations in the undertakings' asset portfolios. It is therefore concluded that the proposed policy options would not materially contribute to systemic risks in the financial system.

2.4.4. ADVICE: EQUITY AND SPREAD RISK

200. The analyses conducted on equity and spread risk, both backward and forward-looking, indicate a clear and heightened risk associated with fossil fuel-related stocks and bonds compared to other economic activities. This suggests the necessity of implementing specific regulatory measures to address these risks effectively. Such measures would align with the economic logic that activities like crude oil extraction have limited potential for environmental

improvement, making them increasingly vulnerable to transition risks associated with climate change mitigation efforts. In accordance with EIOPA's mandate, this report presents a preferred policy option for both spread and equity risk, among those presented in the 2023 consultation paper.**The preferred option for managing equity risk associated with fossil fuel-related stocks, based on the analysis provided, is Option 3**. A supplementary capital requirement on Fossil fuel-related reflects the higher risk exposure of fossil fuel-related stocks, aligning with both backward- and forward-looking findings. Option 3 offers a robust mechanism to address equity risk associated with fossil fuel-related activities and represents a prudent approach to enhancing financial resilience of insurers.

201. Option 1, which maintains the status quo, is excluded due to its inconsistency with empirical findings and forward-looking assessments regarding the risk associated with fossil fuel-related assets.

202. Option 2, which suggests treating fossil fuel-related stocks as Type II equity, presents several challenges. Firstly, it would create a misalignment in capital requirements, as fossil fuel-related assets already classified as Type II would not face further shocks unless explicitly required. This could lead to inconsistencies and confusion in risk assessment. Additionally, there is a risk of confusion when a fossil fuel-related asset is accounted for as long-term equity, further complicating regulatory compliance. Compared to Option 3, Option 2 is perceived as more artificial, potentially undermining its effectiveness in addressing the underlying risk factors associated with fossil fuel-related activities.

203. **The preferred option for spread risk, based on the analysis provided, is Option 3**. A supplementary capital requirement on Fossil fuel-related corporate bonds emerges as a more comprehensive approach, offering a robust mechanism to better align capital requirements with the actual risk exposure of fossil fuel-related bonds. While expert judgment is required to address empirical uncertainties and ensure shock factors remain within reasonable bounds, this option represents a pragmatic approach to enhancing financial resilience while accommodating the complexities of sustainability factors in credit assessments.

204. Conversely, Option 2, which proposes a rating downgrade of fossil fuel-related bonds, presents certain challenges. Notably, it would fail to shock the riskiest credit notches of fossil fuel-related bonds already in existence, resulting in potential inconsistencies within the regulatory framework. Moreover, Option 2 necessitates considerable modeling efforts, particularly for complex models, such as identifying fossil fuel exposures and setting up specific shocks accordingly.

205. Option 1 has been excluded due to its inability to accurately reflect the risk profile of fossil fuel-related bonds, potentially leading to underestimation of transition risk exposure and insufficient solvency capital.

2.5. PROPERTY RISK AND ENERGY EFFICIENCY

2.5.1. RISK OF STRANDED PROPERTIES

206. Buildings can emit greenhouse gas directly, for instance through burning fossil fuels for heating and hot water, or indirectly using electricity or district heating.[63] In this context, transition risk exposures in the housing market could emerge from the sector's need to decarbonize materially to be aligned with the 1.5 degrees Celsius goal of the 2015 Paris Agreement.[64]

207. EIOPA's discussion paper on the prudential treatment of sustainability risks outlines the hypothesis how a building's level of energy efficiency might be linked to property risk.[65] Differences in the operating costs associated with the level of a building's energy efficiency could lead to differentiated loss patterns in market transactions, as buyers may require compensation for higher or more volatile operating costs of inefficient buildings relative to efficient buildings. In this regard, improving the energy efficiency of a building could function as a protection mechanism against shocks related to a building's level of energy consumption, and thereby result in a potential property risk differential between energy efficient and inefficient buildings.

208. The UNEP FI (2023) lists a set of drivers for transition risks in the real estate sector, such as (i) increasing regulation and policy pressure to reduce associated GHG emissions (e.g., carbon taxes, building codes), (ii) costs of indirect emissions (carbon-intensive building materials to become more costly, raising construction and refurbishment costs), (iii) shifting market preferences (higher demand for high-efficiency buildings with renewable energy sources), (iv) shifting investor sentiment (preference towards low-emitting real estate assets), (v) reputational damages (associated with inaction to reduce emissions).

209. Evidence in the literature as highlighted in EIOPA's discussion paper underlines a potential link between energy efficiency and a building's market value. Various papers find a positive impact of energy efficiency on the average (market) value of buildings across different housing markets in Europe, showing a higher price for energy efficient houses typically in a range of 1 to 10% relative to inefficient buildings.[66] In other words, energy inefficient buildings are expected to materialize a loss in value relative to energy efficient buildings while other building characteristics are held equal.

[63] Landry et al. (2023).

[64] Carbon Risk Real Estate Monitor: CRREM Global Pathways, Version: v2.02 - 01.03.2023.

[65] EIOPA (2022a).

[66] EIOPA (2022a).

210. Since empirical research so far typically focuses on the average effects of differences in the energy efficiency on the (market) value of buildings by means of regression analyses, conclusions can be drawn about the level of expected losses to materialize in a property portfolio in relation to the differences in the energy performance of the buildings. However, little is known about the impact of the buildings' energy performance on the variance of their market values, and thereby on the potential to cause unexpected losses in a property portfolio As the capital requirements on property risk are supposed to cover unexpected losses, it is important to understand whether different levels of energy efficiency of buildings could affect the variance of property valuations and thereby the potential for unexpected losses to materialize in a property portfolio. In this context, the following analysis aims to study the potential link between energy efficiency and property risk from a prudential perspective, and whether a dedicated prudential treatment of energy efficiency under Solvency II would be justified.

2.5.2. CASE STUDY: FRENCH HOUSING MARKET AND REGULATION

211. The following case study provides an example how particularly housing regulation in context of the energy efficiency of buildings may lead to re-valuation effects that could materialize a property risk differential. The case study focuses on the French housing market, but similar regulatory developments at national and at EU-level could imply similar trends.

212. In France, as of 1 January 2023, the most energy-consuming buildings can no longer be offered for rent. This measure regards housing whose final energy consumption (including heating, lighting, hot water, ventilation, cooling, etc.) exceeds 450 kWh/m2/year, as defined by the national-wide energy performance criteria (diagnostic de performance énergétique). This measure applies to new rental contracts concluded from 1 January 2023, and applies to the residential market only, pertaining to both private and public landlords.

213. In this regard, these energy performance criteria have been modified and become more stringent.[67] In 2025, all G-rated homes will be affected by this rental ban, while F-rated properties will be affected in 2028 and E-rated properties in 2034 – that is, all housing whose final energy consumption will exceed 250 kWh/m2/year. Already since August 2022, landlords of housing labelled F or G (consumption higher than 330 kWh/m2/year) could no longer increase rents.

214. Hence, a rental ban associated with certain levels of energy consumption might lead to a material drop in the market value for energy inefficient buildings if no refurbishment takes place. The ceiling of rents for buildings not yet excluded from the rental market (e.g., energy performance levels of E, F, G) might also lead to a drop in the market value of these buildings relative to energy efficient buildings not affected by a ceiling of rents.

[67] Decree published in the Official Journal on 13 January 2021.

215. The European Commission proposed in December 2021 a revision of the Energy Performance of Buildings Directive (EPBD), towards a more stringent regulatory framework in context of energy efficiency.[68] The proposal aims to contribute to reaching the target of at least -60% emission reductions by 2030 in the building sector in comparison to 2015. It also seeks to introduce gradually minimum energy performance standards to trigger renovation of the worst performing buildings, and to improve the quality of energy performance certificates.

216. The proposed revision of the EPBD and the French national law are not directly linked, but show a coherent rationale. For instance, the EPBD-proposal requires Member States to adopt own national trajectories to reduce the average primary energy use of residential buildings by 16% by 2030 and 20-22% by 2035. In that regard, at least 55% of the decrease of the average primary energy use should be achieved by means of the renovation of the worst-performing buildings.[69]

217. The French Agency for Ecological Transition (ADEME) indicates that most (i.e., 32%) of existing French residential buildings are classified in the energy performance category of D. In total, as of January 2022, out of the 30 million primary residential buildings in France, approximately 5.2 million buildings (i.e., 17% of the housing stock), were considered as high-energy consumption housing (energy performance of categories F and G), and amongst these 5.2 million buildings about 1.6 million were rented.[70] Some geographic areas tend to concentrate a higher proportion of energy inefficient buildings, particularly regarding Paris, where about two thirds of the private rental stock (265,000 homes) are classified as with an energy performance of E, F or G.[71] Overall, it can be concluded that a material proportion of the private housing market is affected by the new legislation, and potential effects on the market value of affected buildings might arise.

218. One of France's most visited websites for real estate advertisements, Se Loger, indicates that energy inefficient buildings labelled with energy performance categories F or G listed for sale have almost doubled between 2020 and 2022. In the fourth quarter of 2022, buildings in the F- and G- energy performance category accounted for 19% of all properties listed for sale on the website, compared with 11% two years earlier. This increase might be explained – at least in part – by owners anticipating potential value effects of the stricter housing legislation regarding energy efficiency.[72]

[68] EC (2022a).

[69] EC (2023).

[70] Ministère de la Transition écologique et de la Cohésion des territoires (2022).

[71] L'Institut Paris Region (2022).

[72] Le Monde (2023).

219. A study released by the French Notarial Council (Conseil supérieur du notariat) in November 2022 for the year 2021 used a hedonistic pricing model aiming to isolate the effect of energy performance on a building's market value.[73] The study shows a tendency that energy inefficient buildings are sold at a lower price relative to energy efficient buildings.[74] For example, houses sold in the Auvergne-Rhône-Alpes region have a 95% higher likelihood to be sold at a 5% to 8% higher price if they are classified as energy efficient buildings compared to a similar but less energy efficient house. It must be noted that the price differential varies across regions: it can be up to 19% for houses in Nouvelle-Aquitaine, but also relatively low in the region of Ile-de-France (6% to 7%). However, the findings of the study should be interpreted with caution: while the model isolates the energy performance factor from other variables, it could be further refined to consider additional elements that could have an impact on the market value of a building (e.g.: orientation, proximity to public transports, etc.).

2.5.3. QUANTITATIVE ANALYSIS

220. The following section studies from a quantitative perspective the potential of the buildings' energy performance to affect property risk, i.e., the potential of the buildings' energy performance to cause unexpected losses in a property portfolio. Firstly, a regression-based analysis is conducted to study potential effects on the average value of a building and thereby the potential for expected losses to occur, and then secondly, a Value-at-Risk-based analysis is conducted to study the potential for unexpected losses to occur.

Methodology

221. Regarding property risk, the Standard Formula in Solvency II currently foresees a shock to the market value of buildings of 25%.[75] The shock has been calibrated as the annual 99.5%-Value-at-Risk (VaR) of monthly total return real estate indices and does not distinguish between commercial or residential real estate.[76]

222. To study the potential effect of energy efficiency on property risk, EIOPA proposed in its discussion paper to construct property price indices based on samples of buildings with the same energy performance level, while controlling for major property characteristics typically driving the market value of a building.[77] The energy performance-related price indices track the

[73] Notaires de France (2022).

[74] Energy efficiency is defined according to the primary energy consumption (expressed in kwh and per sqm per year), according to the national-wide Energy Performance Criterion (Diagnostic de performance énergétique).

[75] Article 174, Delegated Regulation (EU) 2015/35.

[76] EIOPA (2014).

[77] EIOPA (2022a).

average price series of a specified reference building over time, and allow to calculate the corresponding annual returns. From a prudential perspective on property risk, a comparison of the annual Value-at-Risk values at the 99.5% confidence level across the energy performance-related price indices can provide evidence on a potential energy performance-related risk differential for property risk.

223. The two main variables of interest for the analysis are the building's energy performance and its market value. EIOPA suggested in its discussion paper to use the building's energy performance certificate (EPC) as a categorical measure of its level of energy efficiency. In this regard, the energy performance of a building is defined as the amount of energy needed to meet the building's energy demand associated with a typical use of the building in terms of heating, cooling, ventilation, hot water and lighting.[78] The EPCs typically range from A+ (most efficient) to H (least efficient), and using EPCs as a determinant for transition risk exposures was broadly supported in the public consultation. Moreover, energy performance certificates are also used as measure for the energy performance of buildings under the corresponding technical screening criteria of the EU Taxonomy.[79]

224. The building's market value, measured for the analysis as a building's advertised sales price, is scaled by the building's size (typically the square meter of living area for residential buildings) to reduce selection bias and to raise comparability of prices across buildings.[80] Due to the impact of inflation on the market value of buildings, the building's sales price in a given year is deflated for the analysis.

225. A range of factors can typically influence a building's market value, such as location and age, and should be controlled for when grouping comparable buildings together to construct the house price indices. Generally, grouping data in relation to multiple house characteristics to reach homogeneous groups for comparison can materially limit the number of available price observations to construct respective price indices. In particular, residential buildings are typically infrequently sold during their lifetime, constraining materially the scope of building-specific time series data that could be used to track pricing effects. Therefore, a general tradeoff between complexity (granularity) in terms of building characteristics to construct homogeneous groups of buildings and the sample size arises, and a sufficient balance needs to be found.

226. In particular, since property risk from a portfolio perspective is mainly driven by systematic risk factors, the impact of idiosyncratic risk factors of a building on property risk, e.g., in terms of the number of rooms of a building or the existence of a garden, should be diversified in a sufficiently large real estate portfolio. The systematic risk factors, such as the building's location

---

[78] Art. 2 of Directive 2010/31/EU on the Energy Performance of Buildings.

[79] Delegated Regulation (EU) 2021/2139.

[80] The data for the analysis comprises advertisement data. Therefore, the final transaction price of a building can differ from the advertised sales price of the building, see respective section on data.

or its age (e.g., in context of age-dependent requirements of building codes) constitute material risk channels regarding property risk and should be controlled for in the index construction. The samples of comparable buildings for index construction are therefore grouped among by two main factors besides the level of energy performance: age and location.

227. Regarding age, younger buildings are typically more often associated with higher levels of energy efficiency than older buildings, e.g., due to specific requirements in building codes. Therefore, it becomes a challenging task to identify homogeneous groups of buildings regarding their age but with material variation in the level of energy efficiency. To control for the effect of a building's age on its market value, while maintaining a large number of observations for the analysis, the analysis groups buildings only within a certain age span together. Relatively young buildings are defined by the 25%-quantile of the entire age distribution in the data sample, whereas relatively old buildings are defined to have an age higher than the 75%-quantile of the age distribution. Buildings with an age between both boundaries are considered medium age. Within these three age categories (young, medium, old), it is assumed that the marginal effect of a change in age by one year on the building's market value is negligible. The regression analysis in Table 20 underlines this assumption, limiting the potential for selection bias regarding the age structure of buildings for constructing the property indices for the analysis.

228. A building's location can also materially influence its market value. However, the more granular the spatial location attribute used to identify buildings (e.g., at street-level instead of regional level), the smaller the sample of buildings with comparable price observations that can be used to construct property price indices. In the literature, location attributes at state or regional level are often used to group buildings together (e.g., Reusens et al. (2022), Taruttis and Weber (2022)), aiming to mitigate selection bias regarding location-based price effects in terms of potential differences in purchasing power or demand and supply effects. The property risk analysis in this section groups buildings at the level of municipalities.

229. To maintain liquidity in the price observations used to construct the property price indices, only those municipalities of the data sample are considered that offer a number of price observations above the total number of theoretically different combinations of all building characteristics selected for the analysis. The total number of theoretically different combinations of the building characteristics is determined for the entire sample by the product of (i) the number of years in the data sample, (ii) the number of months in the data sample (i.e., 12), (iii) the number of age attributes (i.e., 3: young, medium, old) and (iv) the number of categories of energy performance certificates (i.e., 9: A+ to H). Only municipalities that have a number of price observations higher than 75% of the total number of theoretically different observations are included in the sample.

230. The property price index for each class of energy efficiency (A+ to H) is constructed as follows: Comparable buildings in terms of building type (e.g., single-family house), age (young, medium, old) and location (municipality) form samples of buildings assumed to be

homogeneous, on which respectively the mean price per square meter (deflated) is calculated per month and correspondingly the monthly growth rate of the average building prices. The consideration of property prices at monthly level is intended to reduce selection bias in terms of seasonality effects of real estate transactions influencing the market value of buildings (Reusens et al. (2022)). The series of monthly growth rates are then aggregated across municipalities by means of the fraction of the municipality-depended observations to total observation in a given month. The outcome is then a time series of monthly growth rates of building prices per age category and energy performance certificate over all municipalities considered.

231. The index value at the first month of the time series is set to 100, and the index value is calculated for each month based on the monthly weighted growth rates of building prices. On this basis, annual returns of the index values are calculated in terms of a 12-month rolling window, and the 99.5%-Value-at-Risk of the annual index returns per month is determined over the entire time series to constitute the parameter for property risk.

Data

232. The disclosure and reporting requirements of Solvency II do not foresee undertakings to report the energy performance of their invested properties. Therefore, the analysis needs to be conducted by means of external data sources. However, the availability of sufficiently granular data covering a building's market value and its energy efficiency is very limited across the EEA. EIOPA conducted multiple exchanges with relevant stakeholders such as the European Mortgage Federation (EMF), the Energy Efficiency Financial Institutions Group (EEFIG), the European Real Estate Association (EPRA) and the German Sustainable Building Council (DGNB). These exchanges have been very valuable regarding the discussion of valuation aspects in the real estate market and how a building's energy efficiency might influence a building's market value. However, it was not possible for EIOPA to retrieve data relevant for the analysis. Moreover, the public consultation of EIOPA's discussion paper also did not reveal further relevant data sources for the analysis in addition to the data sample discussed.

233. Throughout the process, EIOPA identified a data set provided by the RWI-Leibniz Institute for Economic Research and ImmobilienScout24 in terms of the "RWI-GEO-RED"-data set. The data covers the German housing market based on advertisements for residential buildings on Germany's largest internet platform for properties (ImmobilienScout24), and includes various building characteristics collected on the platform, such as price, size and energy performance certificates. EIOPA has been granted access to this data set for the purpose of this analysis, and focuses on the data covering houses offered for sale.[81]

[81] RWI and ImmobilienScout24 (2022): RWI-GEO-RED: RWI Real Estate Data (Scientific Use File) – houses for sale. Version: 6.1. RWI – Leibniz Institute for Economic Research. Dataset. http://doi.org/10.7807/immo:red:hk:suf:v6.1.

234. Although the data does not contain the final transaction price of a building, property advertisement data can be informative about the potential influence of energy efficiency on a building's value as shown in relevant literature, e.g., on the Irish housing market by Carroll, Denny and Lyons (2020), or on the German housing market by Taruttis and Weber (2022).

Descriptive Statistics

235. Several data cleaning steps have been undertaken. The data is cleaned for missing values regarding energy performance certificates and advertised sales prices. Moreover, the data also includes buildings under construction while advertised. Price observations related to unfinished buildings have been excluded from the sample as corresponding price observation might deviate more materially from the final transaction price compared to the case of already existing buildings. Buildings in the sample with a total living area of less than or equal to 10 square meters are removed as related price observations appear to be implausible for residential buildings, and corresponding observations for the price per square meter would constitute extreme outliers.[82] To control for differences in the price effect due to the building's type, the sample is restricted to the following categories assumed to be relatively comparable: single-family house (detached and non-detached), semi-detached house and terraced house (beginning, middle, end unit). After data cleaning, the time window of available data is from 2014 to 2021. Finally, price observations are deflated by means of the German annual consumer price index, and extreme outliers at the 1% lower and upper bound of the deflated price observation per square meter are removed.[83]

236. Table 18 shows the descriptive statistics of the final sample of the German housing market from 2014 to 2021, with 30,021 observations. The median purchase price, adjusted for inflation, is €393,035, while the mean is €470,340. Regarding the price per square meter, the median price per square meter is €2,949.6, with a mean of €3,108, suggesting overall a positive skewness in the sample. The average building in the sample is 50 years old, with a size of the living area around 151 square meters. Relatively young buildings in the sample have an average age of 3 years, buildings categorized to be in a relatively middle age have a mean age of 37 years, and relatively old buildings in the sample show an average age of 90 years.[84]

Table 18: Descriptive Statistics

Variable	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Sales Price (deflated, EUR)	25,000	276,382	393,035	470,340	572,134	9,152,216

[82] For instance, in one observation, the price per square meter would have been 20 million Euro.

[83] Destatis: Consumer price index: Germany, years [61111-0001].

[84] The minimum-maximum age span for relatively young buildings in the sample ranges from 1 year to 8 years. For middle-aged buildings, the age span ranges from 9 years to 62 years. For relatively old buildings, the age span ranges from 63 years (minimum) to 937 years (maximum).

Sales Price (sqm) (deflated, EUR)	297.8	2,182	2,949.6	3,108	3,840.2	7,399.8
Size (Living area, sqm)	40	111	135	150.7	170.3	1,311
Age	1	25	47	50	66	937

Source: Own Table. Data stems from the "RWI-GEO-RED, houses for sale"- data set from RWI and ImmobilienScout24 (2022). Time window is from 2014 – 2021, the number of price observations is 30,021, stemming from six municipalities in Germany. 1st Qu. and 3rd Qu. denote the first and third quantile, and sqm stands for "square meter".

237. Table 19 shows the number of observations for each category of energy performance certificate (EPC), ranging from A+ (most energy efficient) to H (least energy efficient). The fractions of each EPC category in the entire sample are also presented. The most frequently observed EPC category in the sample is category F with 17% of the total observations. The least frequent category is A+, with only 2% of the total observations. Most of the observations are associated with less energy efficient buildings (E to H), which together account for around 58% of the total observations.

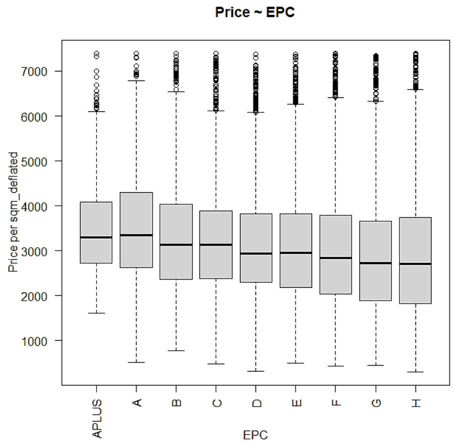
Table 19: Distribution of Energy Performance Certificates

EPC	N	Fraction
A+	714	0.02
A	1,340	0.04
B	2,308	0.08
C	3,421	0.11
D	4,663	0.16
E	4,923	0.16
F	4,991	0.17
G	3,669	0.12
H	3,992	0.13

Source: Own Table.

238. Figure 8 shows the boxplot of the deflated price per square meter of all buildings in the sample differentiated across the categories of energy perform certificates, indicating a small relative differential in the mean price between energy efficient and inefficient buildings in the sample.

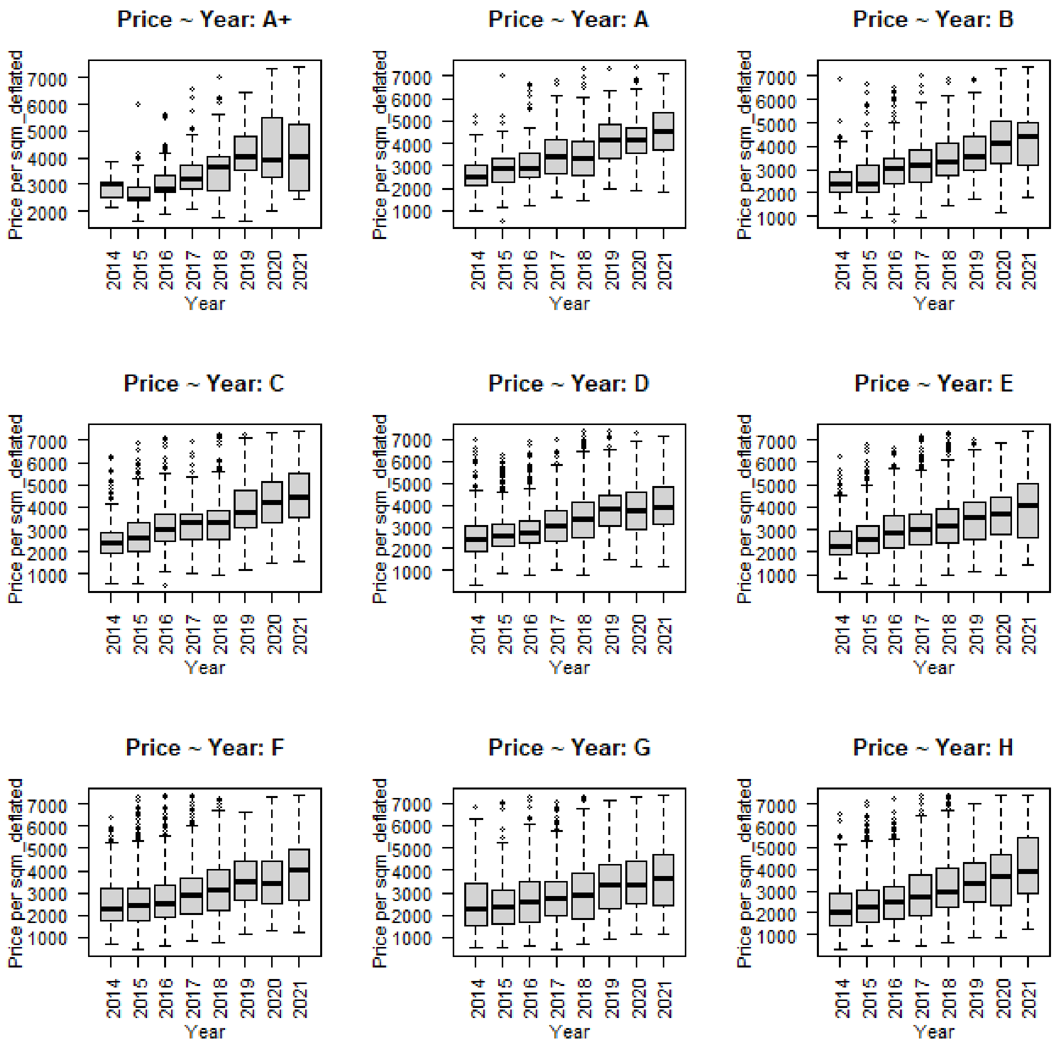
Figure 8: Boxplot of Price and EPC



Source: Own Figure.

239. Figure 9 shows the boxplots of the deflated price per square meter of all buildings in the sample differentiated across time and per category of energy perform certificates. Overall, the price distribution underlines the general upwards trend of the housing prices in the German real estate market over the last decade and highlights the absence of material stress periods on the housing market.

Figure 9: Boxplots: Price and Year per EPC



Source: Own Figure.

2.5.4. PROPERTY RISK: BACKWARD-LOOKING ANALYSIS

Results of the Regression Analysis of Average Price Effects

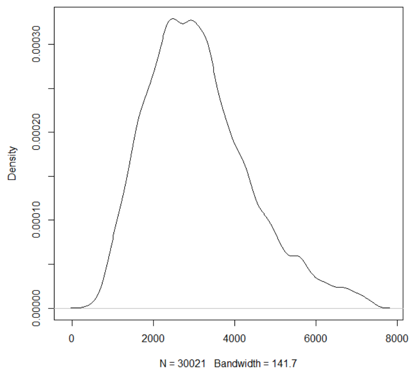
240. To start assessing whether the level of a building's energy efficiency could affect its market value, a linear regression model is used. As the price per square meter of a building appears to be skewed (Figure 10), a semi-log model used. Empirical models as, e.g., in Reussens et al. (2022) or Taruttis et al. (2022), typically control for a building's characteristics in terms of (i) a broad location variable, (ii) the building's age, (iii) house type and (iv) living size. The following regression model is estimated:

$$Y_i = \beta_0 + \beta_1 EPC_i + \beta_2 Age_i + \beta_3 CV_i + \varepsilon_i \quad (1)$$

241. Y_i denotes the logarithmic advertised price per square meter (deflated) of the building in advertisement i, EPC_i describes the category of the building's energy performance certificate in advertisement i, ranging from A+ to H, as the main variable of interest. In a second model specification, the energy performance of the building is measured by its annual energy consumption per square meter of living area (kWh/sqm). Age_i denotes the age of the building in advertisement i defined as the difference between the building's advertisement year and the building's construction year. CV_i denotes the vector of hedonic control variables, comprising the building's number of rooms, and dummy variables for the building's location at municipality level as well as dummy variables for the year and month of the building's advertisement.

242. As the sample for the analysis is already limited to comparable house types, a dedicated control variable on the house type is not necessary. Moreover, instead of measuring size in terms of the living area's size, the number of rooms in the building is used. Since the building's price per square meter is already scaled by the size of the living area, an inclusion of a variable for the living area's size would otherwise raise the scope for multicollinearity.

Figure 10: PDF of the price per square meter (deflated)



Source: Own Figure.

243. Table 20 provides the results of the regression analysis. Similar to existing evidence in the literature (e.g., Reusens et al. (2022)), less energy efficient buildings are associated, on average, with lower prices. Only the differentiation of buildings with an energy performance level of A+ and A does not show a statistically significant difference, which could be related to the lack of price observations for A+ buildings in the sample. Compared to the most energy efficient building (A+), a less energy efficient building with an energy performance certificate of B shows, on average, a decline in the logarithmic price per square meter of 5.4%. Comparing the least energy efficient building (EPC H) with the most efficient building (A+), an average decline in the logarithmic price per square meter of 10% is found. Measuring the energy performance of a building by means of its energy consumption underlines the general effect that a higher energy

consumption (i.e., lower energy performance) is, on average, associated with a decline in the logarithmic price of a building.

Table 4: Regression Results for Equation (1)

	Dependent Variable: Log Price per sqm	
Explanatory Variables	*(1)*	*(2)*
Age	-0.001***	-0.001***
	(< 2e-16)	(< 2e-16)
Number of Rooms	-0.010***	-0.010***
	(< 2e-16)	(< 2e-16)
EPC: A	-0.015	
	(0.30)	
EPC: B	-0.054***	
	(3.96e-05)	
EPC: C	-0.047***	
	(0.000223)	
EPC: D	-0.048***	
	(0.000120)	
EPC: E	-0.064***	
	(3.29e-07)	
EPC: F	-0.073***	
	(5.84e-09)	
EPC: G	-0.097***	
	(4.88e-14)	
EPC: H	-0.100***	
	(7.11e-15)	
Energy Consumption (kWh/sqm, p.a.)		-0.0003***
		(< 2e-16)
Time-fixed effects (year, month)	Y	Y
Location-fixed effects	Y	Y
Observations	30,008	29,698
R2	0.502	0.504
Adjusted R2	0.502	0.504

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Own Table. The Table shows the output of the regression analysis. EPC-coefficients are relative to the most energy efficient buildings (A+). P-values are provided in parentheses.

244. In line with empirical findings in the literature, the price discount to be expected for energy inefficient buildings is an important element to consider for insurers from a risk management perspective, implying to reflect appropriately the energy performance of the buildings in their investment portfolio, for instance in the ORSA.

245. Moreover, a building's age and its number of rooms are statistically significant predictors of the building's logarithmic price per square meter in both models, with negative coefficients.

However, the effect of a change in the building's age by one year on the building's logarithmic price per square meter is, on average, very low (0.1%). In this regard, grouping buildings along the proposed age categories for constructing the house price indices to study property risk does not appear to materially bias the results.

Results of the VaR-Analysis of Property Risk

246. The regression analysis shows a positive link between energy efficiency and property value based on average effects. The following section provides the findings of the VaR analysis of the monthly series of annual index returns of the property price indices (Section 2.5.3). Firstly, the VaR is determined by house price indices differentiating only across the EPCs in the sample, and secondly, by house price indices additionally differentiating across the age category of the houses (young, medium, old) to gain further insights.

247. Table 21 shows the values of the annual 99.5-% Value-at-Risk (VaR) based on the annual index returns grouped by energy performance certificates. The findings overall show an inconsistent effect of the level of energy efficiency on the VaR. For instance, very energy efficient buildings with high energy performance levels of A and B show a similar loss potential in terms of the VaR as very energy inefficient buildings with EPCs of E, G and H (-0.47, -0.57 vs. -0.52, -0.56, -0.51). A similar indication of the potential effect of energy efficiency on property risk is shown by the standard deviation of the annual index returns. The parameters are relatively similar for energy efficient buildings with an energy performance level of A and for inefficient buildings with a performance level of H (0.47 vs. 0.52).

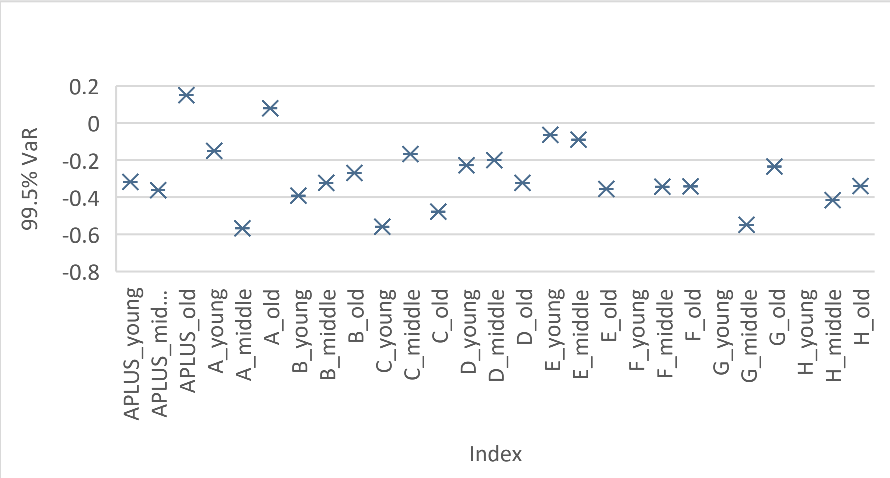
Table 21: VaR of the Property Price Indices grouped by EPC

Index (EPC)	99.5%-VaR	Mean return (p.a.)	STD return (p.a.)
APLUS	-0.39	0.15	0.31
A	-0.47	0.21	0.47
B	-0.57	0.17	0.34
C	-0.29	0.31	0.49
D	-0.36	0.30	0.38
E	-0.52	0.20	0.34
F	-0.31	0.19	0.30
G	-0.56	0.12	0.30
H	-0.51	0.11	0.52

Source: Own Table.

248. A more granular perspective differentiating across the energy performance and the age of buildings is provided in Figure 11. The figure shows the individual values of the 99.5% Value-at-Risk of the property price index returns per energy performance certificate category and age group. While most indices show instances of major annual price drops, in two sub segments, i.e., relatively old buildings with a very high level of energy efficiency (APLUS and A), the corresponding price indices do not show any losses in the time window analyzed. Moreover, for relatively young buildings with a very low level of energy performance (F, G, H), the VaR cannot be estimated due to a lack of corresponding price observations. As building codes typically become stricter over time regarding the requirements on energy efficiency, it is plausible that relatively young buildings are hardly associated with low levels of energy performance.

Figure 11: VaR of the Property Price Indices grouped by EPC and Age Category



Source: Own Figure.

249. The dispersion of the VaR figures across EPCs and taking the age of a building into account (Figure 11) shows inconclusive evidence, i.e., buildings in the sample with a better energy performance do not show a consistently differentiated level of property risk relative to less energy efficient buildings.

250. The findings however should be treated with caution due to potentially biasing effects. The price observations of the buildings are based on advertisement data, which might not be a robust indicator for the real market value of a building.[85] In particular, a residential building is typically infrequently sold during its lifetime, making an over- or underestimation of its real market value in terms of advertisement prices more likely. As a building's track record is relatively short, the potential for major price fluctuations when advertised may increase. Henger and Voigtländer (2014) show on basis of the German housing market that

[85] Henger and Voigtländer (2014) show that the average price differential between asking and transaction prices on the German housing market (on the example of Hamburg) is around 7%.

advertisement prices are subject to adjustments during the advertisement period, and that those prices tend to be over-estimated in stressed periods and under-estimated in growth periods. Moreover, Zhou and Haurin (2010) show that the volatility of owner-reported house prices increases the more a house differs from the average house in a market. Since the majority of the houses in the VaR sample show an EPC in the range of C to F, it is likely that the price observations of the very energy efficient (A+ to B) and the least energy efficient (G, H) buildings are subject to elevated levels of volatility, which biases the corresponding VaR estimates.

251. In addition, the grouping of comparable buildings into homogeneous samples can be generally subject to an omitted-variable bias and therefore lead to an over- or underestimation of the actual VaR. Also, due to aggregating the house prices at municipality-level for the index construction, it might be that in a certain month of two consecutive years, house prices with very different price levels within the municipality are compared, increasing technically the volatility in the index returns.

252. Since the findings suggest an inconsistent effect of the level of a building's energy performance on property risk, EIOPA cannot conclude based on the backward-looking analysis whether a building's level of energy efficiency affects property risk from a prudential perspective.

2.5.5. PROPERTY RISK: FORWARD-LOOKING ANALYSIS

Monte Carlo Simulations, Transition Shocks and Other Assumptions

253. The transition scenarios of ACPR, DNB, ESRB/ECB and IAIS do not contain information on the price impact on property with different energy efficiency levels. To assess forward-looking transition risk differentials in terms of value at risk for property with different energy labels, the development of property values would have to be projected in the eight climate scenarios. This requires estimates of property price elasticities regarding changes in energy prices to provide a linkage to the development of carbon/energy prices in these climate scenarios.

254. A study by Copenhagen Economics (2015) provides estimates of the sensitivity of house prices with different energy labels to changes in energy costs. A drawback of the Copenhagen Study is that it only analyses the residential market in Denmark and does not consider the commercial real estate sector.

255. Using information in the report on house prices and energy consumption for the different energy labels, the forward-looking impact of higher energy prices on the value of residential and commercial property with different energy labels is estimated. Subsequently, the estimates can be used to illustrate property price differentials for buildings with different energy labels (relative to the D label) in the transition scenarios considered by ACPR, DNB, ECB and IAIS, taking into account the development of carbon/energy prices in these scenarios (see last section of Annex 5.2).

256. The property shocks on commercial property are larger than on residential property (see Figures 12A and B). It is assumed that users of commercial property pay the energy generation price and users of residential property a retail price, the latter having a larger distribution cost and tax component. The rise in carbon prices in most scenarios results in a relative price increase of energy-efficient property (label A-C) and price decrease of inefficient property (label E-G). Due to the lower energy prices in DNB's technology shock scenario, the price of energy-efficient property (label A-C) declines, while the price of inefficient property increases.

FIGURE 12A: COMMERCIAL PROPERTY SHOCKS BROKEN DOWN BY ENERGY LABEL, % RELATIVE TO D LABEL

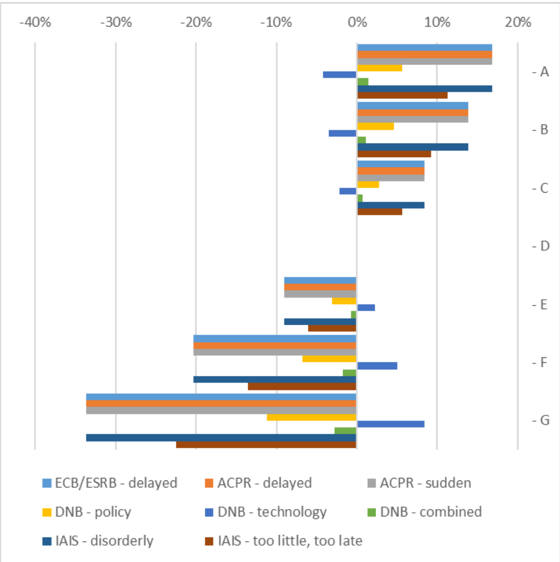
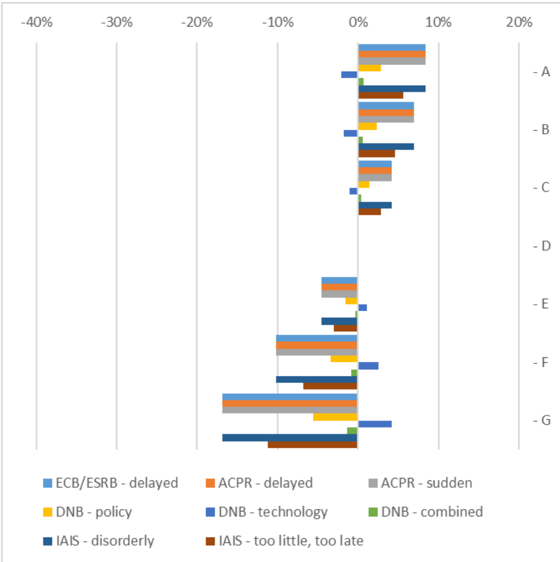


FIGURE 12B: RESIDENTIAL PROPERTY SHOCKS BROKEN DOWN BY ENERGY LABEL, % RELATIVE TO D LABEL



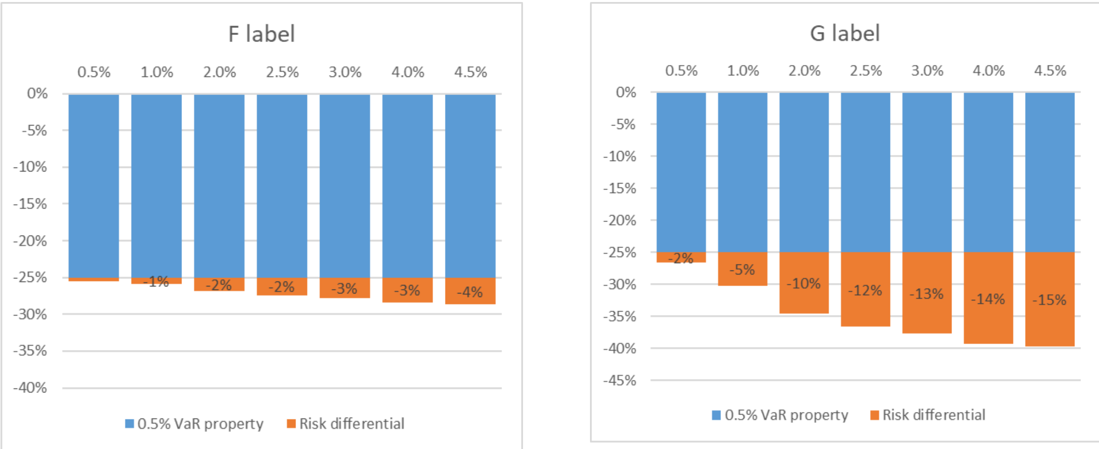
Source: EIOPA calculations.

Property Risk Differentials

257. Material risk differentials in terms of 0.5% VaR are found for commercial property with the least efficient energy labels F and G (see Figure 13). No material risk differentials are found for labels A – E. The price declines for energy label E are too small to have a material impact on the 0.5% VaR. Commercial properties with energy labels A-C experience price increases in most of the transition scenarios (relative to label D), but this does not translate into a reduction of the risk differential in terms of 0.5% VaR.

258. The size of the risk differentials for commercial property with energy ratings F and G depends on the annual probability of occurrence of the disorderly scenario. The risk differentials for the F label range from 0% for low probabilities to -4% for higher probabilities. For the G label the risk differentials are between -2% and -15%.

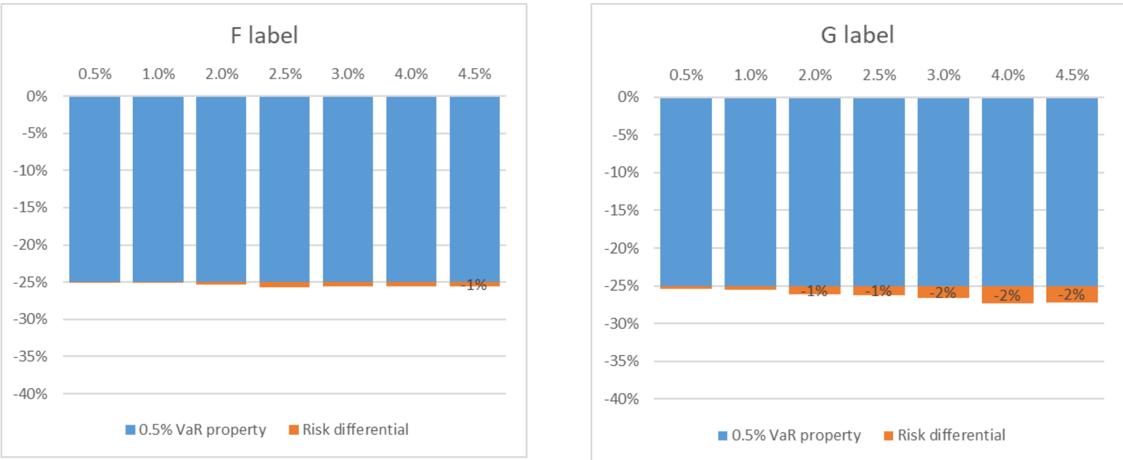
FIGURE 13: ENERGY LABELS WITH MATERIAL COMMERCIAL PROPERTY RISK DIFFERENTIALS IN TERMS OF 0.5% VALUE AT RISK BROKEN DOWN BY ANNUAL PROBABILITY OF DISORDERLY TRANSITION



Source: EIOPA calculations.

259. Similar conclusions can be drawn when considering residential instead of commercial property. Material risk differentials in terms of 0.5% VaR are found for residential property with an F and, in particular, G energy label (see Figure 14). No material risk differentials are found for the A-E labels.

FIGURE 14: ENERGY LABELS WITH MATERIAL RESIDENTIAL PROPERTY RISK DIFFERENTIALS IN TERMS OF 0.5% VALUE AT RISK BROKEN DOWN BY ANNUAL PROBABILITY OF DISORDERLY TRANSITION



Source: EIOPA calculations.

260. Still, the size of the risk differentials is significantly lower for residential property than for commercial property. The risk differentials for residential property with an F label range from 0% to -1% at the 4.5% annual probability of occurrence. The risk differential for G-labelled

residential property lies between 0% at the lowest probabilities and -2% at the highest probabilities of occurrence. The reason for the lower risk differential is that a given increase in carbon/energy prices is expected to have a smaller percentage impact on energy costs for residential property due to the higher price-component of distribution costs.

261. Overall, material forward-looking risk differentials are found for property with energy labels F and G, i.e. the two least energy-efficient classes of property. The estimated risk differentials for residential property are smaller than for commercial property as a consequence of the larger share of fixed distribution costs in the energy price. The size of the estimated risk differentials is subject to considerable uncertainty, depending among others on the annual probability of a disorderly scenario materialising.

2.6. PROPERTY RISK: CONCLUSION AND POLICY IMPLICATIONS

262. To study the effect of a building's level of energy efficiency on property risk from a backward-looking perspective, energy performance-specific property price indices based on the German residential housing market and advertisement data have been constructed.

263. The findings show an inconsistent effect of the level of energy efficiency on property risk in terms of the 99.5% Value-at-Risk of annual property returns. In contrast, the forward-looking analysis finds an increase in the riskiness of properties with energy labels F and G, i.e. the two least energy-efficient classes of property.

264. Since the quantitative findings from a backward- and forward-looking perspective show mixed evidence, EIOPA cannot conclude whether a dedicated prudential treatment of energy efficiency under the property risk sub-module in Solvency II's Standard Formula could be justified.

265. As the analysis is subject to various data limitations that could not have been overcome by means of the public consultation of EIOPA's discussion paper in 2022, EIOPA suggests a repetition of the analysis, particularly in the context of the developments of the Energy Performance of Buildings Directive (EPBD), which aims for a consistent assessment of the energy efficiency of buildings in the EU and for improving corresponding data availability. It can therefore be expected that more data suitable for a property risk analysis as regards energy efficiency will be available in future.

EIOPA Recommendations

EIOPA does not recommend changing the prudential treatment of property risk in context of energy efficiency.

EIOPA suggests a future repetition of the analysis provided the availability of property-related data in context of buildings' market prices and their energy performance has improved.

3. NON-LIFE UNDERWRITING AND CLIMATE CHANGE ADAPTATION

266. Climate change is a global challenge posing material risks to the society and economy. Its consequences are becoming increasingly apparent, for instance in terms of rising physical risk exposures associated with an increasing frequency and severity of natural disasters and extreme weather events, such as floods, droughts or wildfires, among others. Regarding Europe, EIOPA's dashboard on the insurance protection gap for natural catastrophes shows that currently only 23% of the total economic losses caused by extreme weather and climate-related events are insured, leading to a substantial insurance protection gap.[86]

267. 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. Moreover, the increased frequency and severity of natural disasters and extreme weather events associated with climate change can make it more difficult for insurers to predict the likelihood of future losses accurately and to price insurance products appropriately.

268. If no countermeasures are taken, the protection gap is expected to widen given the current trajectories of climate change. In this regard, the environmental objective of climate change adaptation becomes increasingly important, and the insurance industry has a unique role to play by making the society and economy more climate resilient through developing innovative insurance products that could incentivize climate-related risk prevention, consistent with actuarial risk-based principles. In this regard, the EU Taxonomy refers to non-life insurance as activity to be eligible for contributing to the objective of climate change adaptation in the EU.[87]

269. As outlined in EIOPA's discussion paper in 2022, such climate-related adaptation measures, for example anti-flood doors or early warning systems against severe weather events, can reduce the policyholders' physical risk exposures and insured losses associated with climate change.[88] As such, adaptation measures can be considered a forward-looking tool to maintain the long-term availability and affordability of non-life insurance products with coverage against climate-related hazards. In this regard, an increased implementation of climate-related adaptation measures in insurance products can help to reduce the insurance protection gap for

[86] EIOPA (2023b).

[87] Annex II, Commission Delegated Regulation (EU) 2021/2139.

[88] EIOPA (2022a).

natural catastrophes in Europe and to contribute to the environmental objective of climate change adaptation.

270. With its concept of impact underwriting, EIOPA aims to foster the development of insurance products implementing climate-related adaptation measures in Europe. To better understand the industry's current underwriting practices regarding the objective of climate change adaptation, EIOPA has conducted a pilot exercise with volunteering insurance undertakings in 2022.[89] EIOPA's report highlights that progress is being made to increase the policyholders' resilience against climate change by implementing dedicated adaptation measures in insurance products and offering premium-related incentives, consistent with actuarial risk-based principles, but the overall EU insurance market appears to be at an early stage.

271. Since the implementation of climate-related adaptation measures influences the loss distribution of underwriting pools, the question arises to what extent the current requirements under Solvency II are sensitive to capture corresponding effects on underwriting risks from a prudential perspective. If a difference in the prudential risks for insurance products with and without climate-related adaptation measures exist, risk-based capital requirements should recognize the difference properly and thereby reduce potential obstacles for a widespread implementation of adaptation measures in insurance products. In this chapter, EIOPA builds on its work on impact underwriting and focuses, as outlined in its discussion paper in 2022, as a starting point for the analysis on the potential effects of climate-related adaptation measures on underwriting risks in terms of premium risk.[90]

3.1. DEFINITION OF CLIMATE-RELATED ADAPTATION MEASURES IN NON-LIFE INSURANCE

272. The adaptation of the society and economy to climate change to prevent and reduce physical risk exposures and insured losses constitutes an important environmental objective in light of climate change. For instance, the EU Taxonomy refers to non-life insurance as a taxonomy eligible activity.[91] Therefore, the analysis in this chapter focuses on the potential impact of risk prevention measures associated with the environmental objective of climate change adaptation on prudential non-life underwriting risks.

273. Climate-related hazards for this analysis are based on Appendix A of the Commission Delegated Regulation (EU) 2021/2139, as outlined in Annex 5.3 of this report. Climate-related adaptation measures are defined as structural and non-structural measures and services that

[89] EIOPA (2023a).

[90] EIOPA (2022a).

[91] Commission Delegated Regulation (EU) 2021/2139.

are implemented by (re)insurance undertakings or policyholders ex-ante to a loss event, which reduce the policyholder's physical risk exposure to climate-related hazards through (i) lowering the frequency of climate-related losses or (ii) lowering the intensity of climate-related losses in an underwriting pool.

274. Climate-related adaptation measures can differ substantially regarding their form and ability to protect against climate-related hazards. Specific examples of climate-related adaptation measures discussed in the insurance context comprise: measures related to a building's structure like water-resistive walls, windows and doors or non-return valves on main sewer pipes against flood risk, external building measures such as sandbags against flood risk, heat- and fire-resistive construction materials for buildings against exterior fire exposures, the irrigation of crop fields against drought risk and heat waves and non-structural measures such as forecasting and warning systems (e.g., SMS) to enable policyholders to protect their goods in advance of severe weather events.[92]

275. The definition of climate-related adaptation measures for this study focuses on private measures that can be directly implemented and maintained by policyholders or insurance undertakings on their own without any intermediate party. The risk-based effects of such adaptation measures can be easier reflected and incentivized in the terms and conditions of a private insurance contract than in the case of public adaptation measures, such as, for instance, dikes against flood risks, which are not under the legal control of policyholders, or the insurance undertakings, as regards their construction and maintenance.

276. From a risk-based perspective, a clear link between climate-related adaptation measures and insurance premiums is given, as adaptation measures aim to reduce the policyholders' physical risk exposures and insured losses associated with climate change, and thereby contribute directly to reducing the actuarial fair premium of an insurance contract. In contrast, climate-related mitigation measures focus on actions to reduce greenhouse gas emissions, for which a direct risk-based link to the actuarial fair premium does not necessarily exist For instance, while motor insurance products focusing on electric vehicles contribute to reducing the emission levels associated with an underwriting pool, the lower emission levels do not directly affect the loss profile of the underwriting pool in terms of the frequency and intensity of claims. Therefore, climate-related mitigation measures are excluded from the scope of this analysis.

277. The exact quantitative impact of climate-related adaptation measures on physical risk exposures typically depends on multiple factors, e.g., the type of adaptation measure implemented, the targeted climate-related hazard to protect against or the spatial characteristics of the object insured. Evidence in the literature however underlines that overall climate-related adaptation measures can be an effective tool to reduce climate-related risk

[92] EIOPA (2023a).

exposures, and thereby provide a forward-looking protection mechanism against the potential of increasing physical risk exposures associated with climate change.

278. For instance, Poussin et al. (2015) assess the cost-effectiveness of flood-related adaptation measures in France. Their findings demonstrate the potential of various measures, such as the use of water-resistive materials, elevated power sockets, and sandbags, to effectively mitigate flood risk while maintaining cost efficiency. Particularly for moderate loss events that occur relatively frequently, these measures seem to be advantageous in terms of cost-effectiveness compared to the case of less frequent but more severe loss events. Hudson et al. (2014) also present similar evidence on the cost efficiency of flood-related adaptation measures, exploring aspects such as modified building use (e.g., storing valuable goods on higher floors), interior fittings that employ resistive materials, adjustments to the building's structure (e.g., raised foundations), and external water barriers (e.g., sandbags). Furthermore, Kreibich et al. (2011) and Kreibich et al. (2005) corroborate these findings while emphasizing the significant impact that small-scale adaptation measures, like external water barriers such as sandbags, can also have on reducing flood-related damages during extreme tail events, i.e. the occurrence of severe natural catastrophes.

3.2. ADAPTATION MEASURES AND PRUDENTIAL NON-LIFE UNDERWRITING RISKS

279. As a starting point to discuss the potential impact of climate-related adaptation measures on prudential underwriting risks, EIOPA outlined in its discussion paper several case studies, showing that climate-related adaptation measures can materially reduce potential damages, and therefore should also influence prudential underwriting risks.[93]

280. The literature however provides little insights how and to what extent climate-related adaptation measures could exactly influence non-life underwriting risks from a prudential perspective (particularly premium risk, reserve risk and natural catastrophe risk). Moreover, as confirmed by respondents to EIOPA's discussion paper in 2022, it appears that internal models of, at least European insurance undertakings, do not explicitly take the effect of climate-related adaptation measures on the SCR for non-life risk into account. Thus, those models could not be used to assess the general relevance and effect of climate-related adaptation measures on prudential underwriting risks. In EIOPA's pilot exercise on impact underwriting, most respondents stated not to have explicitly assessed the potential impact of climate-related adaptation measures on the solvency capital requirements for non-life underwriting risk.[94]

[93] EIOPA (2022a).

[94] EIOPA (2023a).

281. As it is unclear how climate-related adaptation measures could influence prudential underwriting risks for non-life insurance, EIOPA decided to conduct an own quantitative analysis to assess the potential for a dedicated prudential treatment of climate-related adaptation measures on non-life underwriting risks in Solvency II's Standard Formula. If climate-related adaptation measures lead to a difference in the prudential underwriting risks for insurance products with and without these measures, risk-based capital requirements should recognize the resulting risk differential. A potential lack of sensitivity of the capital requirements to reflect climate-related adaptation measures might function as a hindering factor for a widespread implementation of those measures in insurance products.

282. The prudential requirements for non-life underwriting risks in Solvency II's Standard Formula comprise three main modules: (i) the premium and reserve risk module, (ii) the catastrophe module and (iii) the lapse risk module. Particularly the first two modules can be considered materially sensitive to climate change and its impact on the frequency and intensity of severe weather- and natural catastrophe events.

283. EIOPA's pilot exercise on impact underwriting suggests that current insurance products associated with the objective of climate change adaptation usually implement "small-scale" adaptation measures with limited costs to the policyholders (e.g., anti-flood doors).[95] These types of adaptation measures are typically more effective in preventing and reducing damages related to small and medium loss events occurring at a regular frequency than damages related to natural catastrophes. The premium and reserve risk module in Solvency II's Standard Formula, which focuses on small and medium loss events from a prudential perspective, is therefore considered an appropriate starting point to conduct a quantitative analysis in this report. Extreme loss events occurring rarely, typically severe natural catastrophes, are treated in the natural catastrophe risk module. The potential impact of adaptation measures on the solvency capital requirements for natural catastrophes is studied qualitatively in this analysis to provide a basis for potentially future work in this regard.

3.2.1. PREMIUM RISK

284. Premium and reserve risk reflect the risks of an unexpected deviation in the level of claims and expenses compared to the undertaking's projected figures. While premium risk generally refers to future claims arising during and after the period of the solvency assessment (covered but not incurred, e.g., in relation to the provision for unearned premiums), reserve risk generally refers to past risks and claims that have already materialized (provision for outstanding claims). Solvency II's Standard Formula covers premium risk and reserve risk in a joint sub-module but applies different prudential parameters to determine the corresponding solvency capital requirements. Since premium risk is present at the time the insurance policies are issued, before

[95] EIOPA (2023a).

any loss events occur, and also during the lifetime of insurance policies, it may be affected by unexpected changes in the physical risk pattern associated with climate change. The focus of the quantitative analysis is therefore on the prudential parameters for premium risk, as reserve risk is expected to be only marginally affected by climate change due to its focus on already materialized claims.

285. Insurance premiums are determined prior to the sale of insurance products and held constant over a given time period, which is typically one year for non-life insurance contracts. The premium level should be set to ensure sufficient premium income for the insurance undertaking to pay out the underwriting pool's claims incurring plus operational and other expenses. If the claims occurring in a given year are unexpectedly higher than the premiums earned, a mispricing of the insurance policies sold happened, and premium risk materialized.

286. Premium risk in the Standard Formula is treated by means of a factor-based approach. In particular, the standard deviation of the underwriting pool's loss ratio, which basically relates to the ratio of claims incurred to premiums earned, is driving the premium risk from a prudential perspective. The capital charge is determined to be consistent with the 99.5% percentile of the loss ratio's distribution to cover unexpected shocks to the claims and premiums of the insurance undertaking in a given year.

287. In that regard, climate change could influence the potential for unexpected premium-related shocks as the claims materializing in a given year could have become more volatile than expected based on past data, since unexpected changes in the frequency, severity and correlation of weather- and climate-related loss events might have occurred.

288. Changes in the frequency, severity and correlation of weather- and climate-related loss events can raise the dispersion of the claims occurring in an underwriting pool and thereby increase the volatility of the pool's loss distribution. The higher the volatility of the loss distribution, the more likely it is that claims realizing in a given year could deviate materially from the expected outcome on which the premium level of the underwriting pool has been set before, and the risk of a mispricing of the insurance policies sold increases (i.e., premium risk).

289. To account for uncertainties in the loss distribution related to climate change and to mitigate premium risk, insurance undertakings typically add a climate-related trend component to the historically observed risk parameters to determine a premium level expected to be sufficient to cover the future incurring claims.

290. However, model- and parameter risk, i.e., the uncertainty associated with the appropriateness of the stochastic claims model as well as with estimating the parameters of a model based on (scarce) historic data, constitute major drivers for premium risk in context of climate change. Since climate change and its impact on physical risks materializes dynamically over time, for instance due to the dependance on changes in (global) temperature levels which in turn depend on greenhouse gas emission levels, historic data might not be an appropriate predictor of future trends, making it difficult for insurers to accurately predict the likelihood of

future claims. For instance, the OECD (2023) illustrates the materially varying level of technical uncertainty in the impact of climate change on the frequency of several climate-related perils, differentiated between small to medium and extreme loss events.[96] If the consideration of climate-related trends in the projections of future premiums and claims of an underwriting pool is inappropriate, the risk of an unexpected shortfall in the coverage of incurring claims through the earned premium income increases.

291. Climate-related adaptation measures can reduce the frequency and severity of weather- and climate-related losses in an underwriting pool and thereby smooth the claim's distribution and lower the standard deviation of the loss ratio. In that regard, the risk of mispricing insurance policies due to climate change could be reduced, as the adaptation measures limit the potential for claims realizing in a given year to deviate materially from the expected outcome on which the premium level of the underwriting pool has been set before. A potentially prudential analogy for the effect of adaptation measures on premium risk might be the risk reduction in terms of non-proportional reinsurance, which is considered to reduce premium risk by limiting the underwriting pool's claim distribution to be covered by the ceding undertaking.[97]

292. The volume measure in terms of the net premiums earned is the second factor in the Standard Formula to determine premium risk from a prudential perspective and can be interpreted as a measure to scale the overall level of premium risk and the corresponding capital charge for the individual insurance undertaking. As the premium level of an underwriting pool is based on the expected volume of claims in a given year, the volume measure covers the expected losses. In context of climate-related adaptation measure, the volume measure can be expected to decrease due to an expected lower level of physical risk exposures and claims. However, the volume measure is not informative about the magnitude of the variation of the claims around their expected value, which is the determinant for unexpected shocks as regards premium risk from a prudential perspective.

3.2.2. RESERVE RISK

293. Reserve risk captures the risk that the absolute level of claims provisions for an underwriting pool could be mis-estimated, i.e., that reserves are not sufficient to settle down the claims that occurred already in the past. As for premium risk, reserve risk is supposed to cover small to medium loss events and not tail events.

294. The prudential reserve risk is measured by means of a volume measure (net provisions for claims outstanding) and a parameter for standard deviation for the claim payments. Climate-related adaptation measures are expected to reduce the volume measure in terms of the net

[96] OECD (2023).

[97] Solvency II provides a corresponding volatility adjustment factor for premium risk in certain non-life lines of business (Art. 117, Delegated Regulation 2015-35).

provisions for claims outstanding. Hence, the expected effect of adaptation measures on insurance reserves will be captured by the volume measure. The variation of costs to settle down claims that have already occurred in the past, however, does not seem to be materially affected by the fact of implementing climate-related adaptation measures in insurance products. Therefore, it is not expected that climate-related adaptation measures will have an impact on the standard deviation parameter driving reserve risk and is therefore studied only qualitatively.

3.2.3. NATURAL CATASTROPHE RISK

295. Natural catastrophe risk is covering potential losses from extreme and rare tail events, which are expected to happen more frequently and becoming more intense due to climate change. Within the Solvency II framework, undertakings can choose to use the Standard Formula or an internal model if the Standard Formula would not accurately represent the risk. The capital charge in the Standard Formula is determined to reflect an average condition for the prescribed country-peril combinations (earthquake, flood, hail, subsidence, and windstorm).[98]

296. Under Solvency II, undertakings can take the risk reducing effect of climate-related adaptation measures into account when applying a suitable internal natural catastrophe model for estimating the corresponding capital requirements, but not under the Standard Formula. However, the effects of climate-related adaptation measures on the solvency capital requirements for natural catastrophe risk are difficult to predict, as they depend substantially on the catastrophe model used, the climate-related hazard considered, the risk characteristics of the adaptation measure modelled and the localisation of the risk exposure. Moreover, for example large-scale and expensive adaptation measures like flood-resistant walls might raise materially the value of a building, and thereby raise the sum insured, which in turn will raise the corresponding solvency capital requirement for natural catastrophe risk.

297. Given the early stage of the EU insurance market regarding the implementation of adaptation measures in insurance products,[99] particularly since current measures usually implemented are rather small-scale measures less effective against tail events captured by the natural catastrophe risk charge, but more effective against small and medium loss events captured by the premium risk charge EIOPA focuses its quantitative analysis on premium risk. Reserve risk and natural catastrophe risk are studied by means of qualitative questions that have been raised in the data collection with insurance undertakings in 2022. Future work could look more deeply into the quantitative influence of adaptation measures on the solvency capital requirements for natural catastrophe risk given further market progress in implementing

[98] For more details, see EIOPA (2021b).

[99] EIOPA (2023a).

adaptation measures in insurance products has been achieved providing sufficient data as regards their impact on claims related to tail events.

298. The public feedback to EIOPA's discussion paper in 2022 outlining the scope and rationale of the analysis showed broad support for the analysis, with respondents expecting stronger effects of adaptation measures on natural catastrophe risk than on premium risk.

3.3. DATA COLLECTION

299. EIOPA conducted a dedicated underwriting data collection in the second quarter of 2022.[100] The suggested basis for the insurer sample has been the sample of undertakings that have participated on a voluntary basis in EIOPA's pilot exercise on climate change adaptation in non-life pricing and underwriting in 2022.

300. Each national competent authority was asked to aim at selecting at least two (re)insurance undertakings likely to be able to submit data for insurance products with and without climate-related adaptation measures. There was no restriction on the country-specific maximum number of participants.

301. The participation of an EEA-wide sample of solo undertakings (of all legal types and sizes) was strongly encouraged to ensure that the data collected is reflecting country-specific differences in climate-related underwriting exposures.

3.3.1. DATA REQUEST

302. The data request has been similar to previous data collections regarding the calibration of the non-life premium risk parameters of the Standard Formula, but with the extension to collect information about the undertaking's implementation of climate-related adaptation measures.

303. (Re)Insurance undertakings were asked to split premium and loss data up to 10 years as requested in the data template per line of business into comparable pairs of underwriting pools: one treatment pool of insurance policies with climate-related adaptation measures and one reference pool without climate-related adaptation measures. For example regarding property insurance and flood risk: the insurance pool could be split between insurance policies with climate-related adaptation measures, e.g. buildings with water-resistive external walls, and similar insurance policies without such measures against flood risk.

304. The (re)insurance undertakings were invited to submit as many pairs of comparable underwriting pools with and without climate-related adaptation measures as possible, and to specify their data samples and adaptation measure in the relevant text field of the spreadsheet. The (re)insurance undertakings were not expected to submit data if climate-related adaptation

[100] EIOPA (2022e).

measures were not implemented in the underwriting pools or if an overall underwriting pool could not be split into comparable sub-pools in terms of the treatment group with adaptation measures and the reference group without adaptation measures.

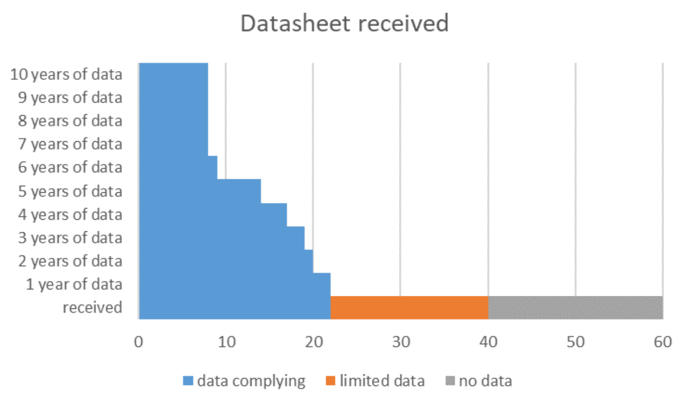
305. Furthermore, if the split of suitable pairs of underwriting pools required that data from different business lines needed to be aggregated regarding premiums and losses, then the (re)insurance undertakings were strongly encouraged to provide this aggregated data and to provide corresponding information on the aggregation. This situation could emerge, for example, if the (re)insurance undertaking expected that a specific adaptation measure could have a different impact on the risks covered by an insurance policy. For example, regarding property insurance: a specific climate-related adaptation measure might have a different impact on the losses related to physical building damages and on the losses related to business interruption.

306. To the extent possible, (re)insurance undertakings were expected to exclude from the data submitted all contracts/risks which were not relevant to the objective of the data request.

3.3.2. OVERVIEW OF THE DATA COLLECTED

307. EIOPA received data submissions from twenty-one countries, submitted by thirty-three undertakings belonging to twenty-five insurance groups (up to five undertakings belong to the same group), leading to an overall number of sixty underwriting datasheets. Out of these sixty sheets, twenty-one datasheets contain largely the underwriting data requested, nineteen datasheets contain data not materially complying with the data request (e.g., missing data, no distinction of data between with and without the use of adaptation measure) and twenty datasheets are empty. Figure 15 provides an overview of the datasheets submitted for the analysis.

Figure 15: Data Submissions



Source: Own Figure.

308. The twenty-one datasheets suitable for the analysis cover twelve countries:

- Italy – four datasheets,
- Austria – three datasheets,
- Belgium, Finland, Germany and Slovenia – two datasheets each,
- Croatia, Cyprus, France, Malta, Netherlands and Spain – one datasheet each.

309. The datasheets relate mainly to three different lines of business (LoB):

- Fifteen datasheets are in the LoB “fire and other damage”, the adaptation measures implemented refer to hail protection (either nets or tempered glass) in five cases, weather warning systems in four cases, and other adaptation measures (e.g. building codes) in the residual six cases.
- Five datasheets are in the LoB “other motor”, the adaptation measures implemented refer to garages in three cases and weather warning systems in two cases.
- One datasheet is in the LoB “miscellaneous financial loss”, the adaptation measure is a weather warning system.

3.3.3. DESCRIPTIVE STATISTICS

310. For the descriptive analysis of the submitted data, it is grouped into three main categories of climate-related adaptation measures for illustrative reasons:

- Hail nets, tempered glass and garages, which have a conceptually similar effect against hail risk – referred to as the “Hail protection”-group
- Weather warning systems (e.g. SMS, e-mail, etc.) - referred to as the “Warning systems”-group
- Other adaptation measures (e.g. building codes) - referred to as the “other adaptation”-group

Number of Policyholders

311. The data for the analysis covers 15.2 million policyholders in total as of end-2021, whereof 38% implement an adaptation measure. Hence, the underwriting pools without adaptation measures tend to be larger than the underwriting pools with adaptation measures, which naturally affects the standard deviation of claims in the respective underwriting pools, with larger pools tending to show lower dispersion of claims.

312. The data stems mainly from retail insurance. The number of policyholders within each datasheet is varies materially: the smallest portfolio has ten policyholders while the largest has 3,394,606. Likewise, the relative share of the policyholders in the underwriting pool with adaptation measure to the aggregated (“mixed”) underwriting pool comprising both the policyholders with and without adaptation measures, shows a large spread across the data submitted, ranging from 1% to 81% per underwriting pool.

313. Table 22 provides an overview of the number of policyholders in the data submitted. Within the three adaptation groups: 43% of the policyholders implement a hail protection, 42%

implement a weather warning system and 32% implement some other form of adaptation measures. For the hail protection group, on average, around 9 years of data have been submitted, for the warning system group around 4 years of data and the residual adaptation measures show around 8 years of data.

Table 22: Number of Policyholders

Adaptation measure	Number of policyholders with adaptation measure	Number of policyholders without adaptation measure	# Datasheets	Average number of years	Ratio of policyholders with adaptation measure
Hail protection	2,192,989	2,912,020	8	8.8	43%
Weather warning system	1,899,563	2,661,496	7	4.1	42%
Other	1,731,712	3,765,210	6	8.0	32%
Total	**5,824,264**	**9,335,726**	**21**	**7.0**	**38%**

Source: Own Table.

Earned Premiums

314. The average annual premium paid by policyholders within each portfolio in 2021 ranges from twenty-five € to 195,000 €. However, for most policyholders, premiums are relatively small: 66% of policyholders pay less than an average premium of 825 € p.a. for insurance coverage.

315. With regards to the most expensive average annual premiums per policyholder, participants indicated in the qualitative part of the data request or confirmed on request that the corresponding underwriting portfolios relate to commercial insurance (esp. agricultural business), making high average premiums plausible.

316. Given the assumption that climate-related adaptation measures reduce physical risk exposures, a reduction in the average premium level per policyholder should be expected. However, the average annual premiums per policyholder in 2021 show an equal split regarding the effect of adaptation measures on the level of premiums: One half of the sample shows a premium reduction in case the policyholders implemented an adaptation measure, whereas the other half of the sample shows an increase in premiums. Requests to the undertakings clarified in several cases that the increase in premium is largely driven by higher values insured of the policyholders with adaptation measures. However, due to limitations in the data submitted, it was not possible to assess this influence exactly.

317. Overall, the mixed effect of adaptation measures on the level of insurance premiums seems to contradict the expectation that the volume measure for premium risk under Solvency II's Standard Formula declines due to the implementation of climate-related adaptation measures.

Loss Ratio

318. In order to study the influence of climate-related adaptation measures on premium risk, the annual loss ratios are calculated, both for portfolios with and without adaptation measures.

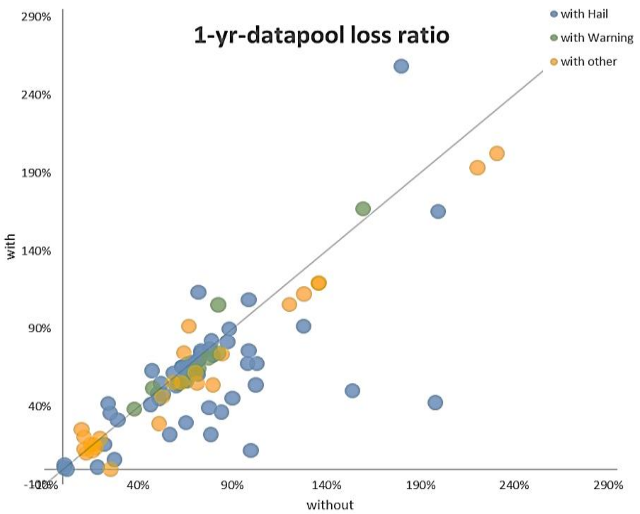
319. Figure 16 plots the annual loss ratios. Each underwriting pool with and without adaptation measure is represented as a bubble in the scatter graphs according to the following principle:

- the value of the data "without" adaptation measure is on the x-axis
- the value of the data "with" adaptation measure is on the y-axis
- the colour of the bubble is the type of adaptation measure implemented in the dataset "with", i.e. either "Hail protection" (blue), "Warning system" (green) or "other adaptation measures" (orange).

320. If the bubbles are randomly scattered all over the graph, this shows that the data plotted is not impacted by the implementation of adaptation measures. All the way round, if the bubbles aggregate in an area or follow a trend, this is an indication that the adaptation measures can have an impact on the loss ratio.

321. When plotting the loss ratios, 76% of the loss ratios are below the diagonal, indicating that underwriting portfolios with adaptation measures seem to be more profitable for the insurance undertaking, i.e. having a lower loss ratio per year, than the portfolios without adaptation measures.

Figure 16: Plot of the Annual Loss Ratios



Source: Own Table.

322. The analysis of the average loss ratio per datasheet over all time periods for which data was submitted suggests that insurance undertakings, in the majority of cases, realize a higher profitability in terms of a lower loss ratio for policyholders that implement climate-related adaptation measures.

323. Under the assumption that the policyholders' exposures to climate-related hazards in both underwriting pools, i.e. with and without climate-related adaptation measures, are comparable, the differences in the loss ratios between both underwriting pools suggest a different risk behaviour of these underwriting pools due to the use of adaptation measures, which might lead to a differential in the standard deviation parameter of the loss ratio as determinant for premium risk.

3.4. ANALYSIS

3.4.1. METHODOLOGY

324. For the purpose of assessing the potential effect of climate-related adaptation measures on premium risk in Solvency II's Standard Formula, EIOPA uses the methodology underlying the approach to determine undertaking specific parameters (USP). The Delegated Regulation 2015/35 sets out in its annex XVII a methodology to calibrate undertaking-specific parameters for adapting the Standard Formula to a specific portfolio of an undertaking, if the undertaking is authorized to use USP.

325. The corresponding requirements set out how the standard deviation of the loss ratio should be determined, as described in the paragraphs B (3) to (6) of the related annex XVII. The approach requires a minimum length of annual observations of the loss ratio for at least five years, which reduces materially the number of datasheets eligible for the analysis. The respondents to EIOPA's discussion paper in 2022 supported the use of this methodology for the purpose of the analysis.

326. When the underwriting pools with and without adaptation measures do not have the same number of years, only the most recent and overlapping years in both datasets are kept for the analysis.

327. For each treatment underwriting pool with adaptation measure and its reference underwriting pool without adaptation measure, the respective annual loss ratios are estimated. The approach leads to a time series of loss ratios, on which then the standard deviation parameters are determined. A comparison of the standard deviation parameters across the with-without-pairs at the undertaking level provides evidence on the potential effect of adaptation measures on premium risk.

328. To avoid a double counting of a potential effect of adaptation measures with natural catastrophe risk, the analysis is conducted on both, gross data including natural catastrophe--

related exposures and on adjusted data excluding the claims and premiums related to natural catastrophe events.

329. Adjusting the data for natural catastrophe-related claims and premiums, however, constituted a difficult challenge for this analysis. Similar issues already arose in the case of the Standard Formula's original calibration exercise, mainly in terms of a strong heterogeneity in the approaches conducted by the undertakings to identify and remove catastrophe-related observations from the data submitted:

- Under normal conditions, undertakings rarely experience loss events related to natural catastrophes or rarely perceive those events as tail events with a dominating impact on their revenue account. Therefore, some undertakings provided the same data including and excluding catastrophic loss events.
- Some undertakings followed expert judgement to remove natural catastrophe-related claims and premiums without explaining the approach how the tail events have been defined.
- Some undertakings adjusted the claims for potential natural catastrophe-related events, but not the corresponding earned premiums in the underwriting pools. This leads to a technical bias in estimating the standard deviation parameter as only the numerator reacts to the effects of adaptation measures.
- Only one undertaking removed both cat-related claims and premiums from the data submitted.

330. Given the strong heterogeneity in the data adjustments for cat-exposures taken by the undertakings, the adjusted data submitted shows a relatively low level of comparability. Therefore, a separate adjustment process has been conducted on basis of the submitted gross data to get a more comparable set of cleaned data. A pragmatic approach as in the Standard Formula's original calibration exercise is followed: Observations in a given year that show an extreme value of the loss ratio (i.e., higher than the value of the mean loss ratio plus two times the standard deviation) are removed from the time series, and the loss ratio's standard deviation parameter is re-assessed on the remaining time series of loss ratios.

3.4.2. RESULTS

331. Table 23 shows the findings regarding the impact of the climate-related adaptation measures on the standard deviation of the loss ratio for each dataset with at least five years of data, separated into analyses in terms of gross data and natural catastrophe adjusted data.

332. In most cases, the adaptation measures implemented reduce the standard deviation parameter, both in case of gross data including natural catastrophe exposures and adjusted data excluding natural catastrophe exposures. The magnitude of the reduction in the standard deviation parameter does not change materially when excluding the natural catastrophe

exposures, suggesting the measures implemented seem to be more effective against small to medium loss events than against tail events. The stronger effect on small and medium loss events seems plausible, given the measures implemented are typically small-scale measures (e.g., hail protection nets) which show a declining potential of risk prevention and reduction for increasing levels of hazard intensity.

333. On average, the underwriting pools in the data sample with adaptation measures show a reduction in the standard deviation parameter of 18% compared with the underwriting pools without adaptation measures, across all types of adaptation measures assessed. This suggests a moderately lower premium risk level for those underwriting pools compared to the corresponding underwriting pools without adaptation measures.

Table 23: Standard Deviation Parameters for Premium Risk

Adaptation measure	Obs.	#years	gross σ "with"	gross σ "without"	Rate of change:	σ "with" (*adj. data)	σ "without" (*adj. data)	Rate of change:
Hail protection	#1	10	24.3%	63.9%	-62%	16.4% *	26.9% *	-39%
	#2	10	49.4%	177.2%	-72%	28.3% *	161.5% *	-82%
	#3	10	5.5%	6.2%	-12%	4.9% *	4.9% *	2%
	#4	6	4.6%	6.5%	-29%	4.6%	6.5%	-29%
	#5	10	13.1%	15.5%	-15%	10.2% *	15.0% *	-32%
Warning system	#6	5	7.0%	7.3%	-4%	7.0%	7.3%	-4%
	#7	5	7.4%	42.5%	-83%	7.4%	42.5%	-83%
	#8	5	4.9%	6.5%	-25%	4.9%	6.5%	-25%
Other adaptation measures	#9	10	52.6%	63.0%	-16%	52.6%	63.0%	-16%
	#10	10	5.8%	5.3%	10%	3.1% *	3.1% *	0%
	#11	5	14.1%	6.8%	108%	14.1%	6.8%	108%
				Average	**-18%**		Average	**-18%**

Note: Own Table. Rate of change = (σ "with" - σ "without") / σ "without". Data with * refers to data adjusted for nat cat-related observations.

334. Most respondents to EIOPA's discussion paper in 2022 did not provide evidence on a potential effect of climate-related adaptation measures on premium risk, which however is not surprising, as participants in EIOPA's pilot exercise on impact underwriting mentioned usually not to look at the effects of adaptation measures from a prudential perspective.[101] One respondent, however, mentioned to experience a reduction in the volatility of losses due to the implementation of a hail protection measure, which could reduce premium risk.

[101] EIOPA (2023a).

3.4.3. QUALITATIVE QUESTIONNAIRE

335. The qualitative questionnaire as part of the data request focused on collection additional qualitative information about the adaptation measures implemented and their potential effect on premium risk, reserve risk and natural catastrophe risk.

336. The responses by the undertakings are very heterogeneous regarding the implementation and assessment of adaptation measures. While some undertakings report the implementation of adaptation measures in their insurance products (e.g., hail protection nets, early warning systems, etc.), most of these undertakings report material difficulties in accurately tracking the effects of adaptation measures on risk exposures and corresponding underwriting-related cash flows.

337. In terms of prudential risks (premium, reserve and natural catastrophe risk), some undertakings report to expect an impact on premium and natural catastrophe risk but not on reserve risk, while most respondents do not conclude on these aspects. Regarding the undertakings implementing adaptation measures in their insurance products, most undertakings report not to have sufficient data, particularly regarding the time series of claims and premiums for determining loss ratios, to assess a prudential impact quantitatively. The sum insured as important determinant in the solvency capital requirements for natural catastrophe risk, is not considered to be sensitive to the implementation of adaptation measures by most of the respondents.

338. Overall, the outcome of the questionnaire suggests a material lack of granular data for most respondents implementing adaptation measures to conclude whether a robust effect of adaptation measures on prudential underwriting risks exists.

3.4.4. DISCUSSION

339. While the findings suggest a moderate effect of adaptation measures on premium risk, the figures should be interpreted with caution:

- The sample for the analysis is very small, as it comprises only eleven underwriting pools. The EU insurance market is at a relatively early stage regarding the implementation of climate-related adaptation measures as defined in this exercise, which naturally limits the amount of potential data to be studied.[102] In this regard, the Standard Formula's requirement of at least five years of data for the assessment of the standard deviation parameter further constrained the scope of underwriting pools eligible for the analysis. Therefore, it is likely that the data sample studied does not fully capture the effects of adaptation measures, particularly in context of potential variations in terms of adaptation measures, climate perils, spatial exposures, etc.

---

[102] EIOPA (2023a).

- The treatment and reference underwriting pools, with and without adaptation measures respectively, might be subject to a potentially large unobserved heterogeneity in their exposure to climate change (e.g., distance to a river for flood risk, etc.). Given the lack of granularity in the data submitted in terms of exposure, hazard and vulnerability at a high spatial resolution, it is difficult to control for all potential effects of other risk factors on the standard deviation parameter, which can bias the results.
- Particularly the effectiveness of risk prevention measures in terms of warning systems depends materially on the policyholder's behaviour, i.e. the policyholder's immediate reaction to protect the insured object in case a severe weather event is expected to occur. As it is difficult to collect data on the policyholder's behaviour, the effectiveness of this measure to prevent risks is difficult to quantify.

340. The prudential recognition of the effects of adaptation measures is another challenging task. The Standard Formula needs to balance the trade-off between simplicity and risk sensitivity. On the one hand, averaging the effects on premium risk across different adaptation measures to receive a uniform factor comprising the effects could be an efficient way forward from a prudential perspective, as it captures an overall risk reducing effect of adaptation measures. On the other hand, individual adaptation measures can vary materially in their effectiveness regarding risk prevention, particularly in context of the climate-related perils and the spatial characteristics of the insured object. A more precise solvency capital allocation could be achieved when differentiating the prudential effects across climate-related perils and adaptation measures. To reach such granularity, and to get a more comprehensive overview of the potential range of effects of adaptation measures on premium risk, more data for an empirical analysis is needed, which is currently however not available given the early stage of the insurance market regarding climate-related adaptation measures.

341. The analysis conducted has been the first attempt to quantify the potential impact of adaptation measures on premium risk from a prudential perspective. To raise the robustness of the analysis, the adequate calibration of the standard deviation parameter would require a larger number of observations. Currently, Solvency II reporting requirements do not cover quantitative aspects about the implementation of climate-related adaptation measures in non-life insurance products. Therefore, to derive are more robust empirical calibration on the topic, future work on this topic could consider developing further the reporting requirements of undertakings to collect on a regular basis corresponding data, which could help to improve the quality of the calibration performed on the following aspects:

  - Broader scope of implemented climate-related adaptation measures to quantify the effects on prudential underwriting risks.
  - Inclusion of additional lines of business for which adaptation measures are implemented.

- Increase in the number of annual observations of the loss ratio to stabilise the calibration.
- Wider geographical spread across Europe, as climate change affects countries differently across Europe.

342. Moreover, as highlighted by several respondents to the discussion paper, future quantitative work could also be done as regards the influence of adaptation measures on the solvency capital requirements for natural catastrophe risk, which, however, would require a dedicated data collection materially different from the one for premium risk and a more complex calibration process.

3.5. CONCLUSION AND POLICY RECOMMENDATIONS

343. Climate change adaptation is an important objective to maintain the future availability and affordability of non-life insurance products in context of climate change. Although the European insurance sector is at a relatively early stage in this regard, several undertakings were able to provide data for EIOPA's quantitative assessment of the influence of climate-related adaptation measures on premium risk under Solvency II.

344. The findings suggest that climate-related adaptation measures seem, on average, to reduce premium risk by moderate levels. The data sample on which the assessment has been conducted is, however, small. Therefore, the estimation of the loss ratio's standard deviation parameter can be subject to an unobserved bias in the data, e.g., the spatial characteristics of the insured objects influencing physical risk exposures, which was not possible to sufficiently control for based on the data collected.

345. At this stage of the analysis, the derived effect of climate-related adaptation measures on premium risk cannot be considered robust to justify a dedicated prudential treatment.

EIOPA Recommendations

At this stage, EIOPA does not recommend changing the prudential treatment of premium risk in context of climate-related adaptation measures.

Due to the importance of climate-related risk prevention to ensure the long-term availability and affordability of non-life insurance products, EIOPA suggests a repetition of the analysis, provided that the availability of data has improved resulting from further market developments in this regard. In addition, an extension of the prudential analysis to the solvency capital requirements for natural catastrophe risk is suggested.

4. SOCIAL RISKS AND IMPACTS FROM A PRUDENTIAL PERSPECTIVE

346. Social risks, as a specific sub-set of sustainability risks, are being increasingly discussed in a prudential context: a firm's misalignment with commonly accepted social objectives can potentially result in social risks materializing in the assets and liabilities of insurers. Starting with the identification of social risks and objectives, EIOPA discusses how social risks can translate into prudential risks on undertakings' balance sheets. In light of the Commission's mandate to be expected, EIOPA provides an initial analysis of the Pillar II and III requirements under Solvency II, to identify potential areas for further work. Given the material lack of social-related data and risk models regarding the social aspects of investment and underwriting activities of insurers, EIOPA did not conduct a Pillar I-related assessment in response to the mandate.

4.1. DEFINITION AND SOURCES OF SOCIAL RISKS AND IMPACTS

347. **Social sustainability factors.** Social sustainability factors are commonly referred to in respect of "social and employee matters, respect for human rights, and anti-corruption and anti-bribery matters".[103]

348. The EU Taxonomy Regulation (hereafter: the EU Taxonomy) refers to the social dimension of sustainability through minimum social safeguards[104], which aim to ensure alignment of an economic activity with the social aspects of the OECD Guidelines for Multinational Enterprises and UN Guiding Principles on Business and Human Rights, including the principles and rights set out in the eight fundamental conventions identified in the Declaration of the International Labor Organisation (ILO) on Fundamental Principles and Rights at Work and the International Bill of Human Rights.[105]

349. Social factors are typically work-force related, such as working conditions and living standards, community related, such as economic, social, cultural, civil and political rights or

[103] Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector (SFDR). Matters referred to under 'anti-corruption and anti-bribery' are more likely to be included in elements of 'governance'.

[104] Article 18 EU Taxonomy Regulation. The EU Taxonomy does not further specify social screening criteria for economic activities, as it does for environmental aspects. The Platform on Sustainable Finance published a report in 2022 with the aim of advising COM on a potential future social taxonomy (the Social Taxonomy Report), PSF (2022b).

[105] The Bill includes the Universal Declaration of Human Rights, the International Covenant on Economic Social and Cultural Rights and the and the International Covenant on Civil and Political Rights.

consumers / end-user related, such as information, personal health and safety and social inclusion. To date, the most comprehensive compilation of social-related sustainability factors in EU regulation can be sourced from the European Sustainable Reporting Standards[106] and the Sustainable Finance Disclosure Regulation (SFDR). A summary typology of social-related factors can be found in the Annex (Table 36).

350. **Social impacts**. An economic or financial activity can positively or negatively impact social factors related to working conditions and living standards, communities and consumers / end-users.

351. To assess adverse social impacts of economic activity, so-called socially harmful activities can be identified based on three sources: (a) internationally agreed conventions, (b) research on the detrimental social effects of certain activities and (c) the list of social adverse impacts listed in Annex I of the SFDR Delegated Regulation.[107]

352. The SFDR social adverse impacts include aspects as gender pay gaps between female and male employees, lack of workplace accident prevention policies, human rights policy or of a diligence process to identify, prevent, mitigate and address adverse human rights impacts.

353. The Social Taxonomy Report issued by the Platform on Sustainable Finance identifies as examples of socially harmful economic activity the involvement with certain kinds of weapons or the production and marketing of cigarettes. Based on the NACE industrial classification system one could further classify sectors according to their impact on social factors. For example, related to working conditions, 'high risk sectors' related to decent work can include sectors with prevalence of contingent workers (seasonal) or sectors with skill shortages, or with high incidence of occupational health and safety accidents according to e.g., ILO standards. Such sectors can include mining and quarrying, construction or transportation. Economic activities that are typically associated with negative impacts on living standards and well-being for end-users include, for example, activities associated with high income inequality, or not providing quality products to consumers and discriminating certain parts of society.

354. **Social risks**. Social risks refer to (financial) risks including those deriving from dependencies on human and social resources and those affecting working conditions and living standards, communities and consumers / end-users.

355. Social risks can arise from (macro-level) socio-economic developments as well as from entities or individual behaviour. They can transmit into society directly (e.g. events causing unemployment, health or security issues (such as pandemics, cyber threats)), indirectly ('second order', e.g. rising price levels leading to financial distress, the risk of unemployment spreading into health or safety risks) and through spill-over impacts ('contagion') affecting, for example,

[106] COM Delegated Regulation supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards (C(2023)5303 final), Annex 1.

[107] Annex 1 of Commission Delegated Regulation (EU) 2022/1288.

the financial system (e.g. unemployment leading to mortgage defaults, resulting in increased mortgage insurance pay outs and causing potential financial sector stability issues). These risks can then transmit into risks for (re)insurance activities. For example, economic difficulties could lead to a decrease in the ability of citizens and companies to insure themselves or to pay their premiums.

356. **Social transition and physical risks.** The same typology of transition and physical risks applied to climate-related risks can be applied to social risks. Climate-related transition risks are risks that arise from a rapid transition to a low-carbon and climate-resilient economy, resulting in financial losses for entities that are not aligned with the new developments. Conceptually similarly, social transition risk can result from the misalignment of economic activities with changes in policy, technology, legal requirements or consumer preferences which aim at addressing social negative impacts, such as for example inadequate working conditions or discrimination. Climate-related physical risk is defined as the risk that arises from the physical effects of climate change (physical effects include acute weather-related events such as floods, storms or heatwaves, as well as chronic longer-term changes such as temperature change or rising sea levels). While social risks are primarily non-physical in nature, they can also give rise to physical / mental health consequences, especially when they affect working, safety and living conditions. Social risks related to inequality, discrimination, or human rights abuses can also for example lead to social conflicts which may have physical consequences in the form of property damage resulting from violence.

357. Sectors at elevated risk of negatively impacting social factors ('high risk sectors' as described above), may face high social transition risk. Economic activities that are most reliant on human capital, i.e., the well-being of workers, communities and consumers as part of their business activity, are most likely to be exposed to social physical risk.

4.2. SOCIAL RISKS FOR INSURERS FROM A PRUDENTIAL PERSPECTIVE

358. Conform with Article 1, 55c of Commission Delegated Regulation (EU) 2015/35 ("Solvency II" Delegated Regulation) which defines 'sustainability risk' as "an environmental, social or governance event or condition that, if it occurs, could cause an actual or a potential negative impact on the value of the investment or on the value of the liability".

359. Social risks can indirectly affect (re)insurers as they are transmitted through the (re)insurer's investments and liabilities. For example, by investing in or providing insurance coverage to companies that are dependent on human capital (and hence potentially exposed to social physical risk) or are not well aligned with social objectives (and hence exposed to social transition risk), (re)insurers can face indirect social physical or transition risks. Social risks can also arise directly from the (re)insurer's so-called own (business) operations (human resources, safety at work, remuneration structure, etc.).

360. Social risks can translate into prudential risks in the form of underwriting, market, operational (incl. legal) or reputational risks, as outlined in Table 24.

Table 24: Translation of Social Risks into Prudential Risks

Prudential risk	Social risk
Underwriting risk	Social physical risk can affect (re)insurer's non-life (premium and reserve, catastrophe risk) and life (mortality, longevity, disability-morbidity, expense, lapse and catastrophe) underwriting activity across various lines of business, such as: • Workers' compensation insurance: for workplaces with high incidence of occupational health and safety accidents / poor workplace safety standards. • Health and life insurance: arising from mortality, morbidity or hospitalization costs caused by socio-economic developments, lifestyle behavior[108], pandemics. • Credit and mortgage insurance: arising from counterparty default increases because of socio-economic developments (e.g., increased cost of living, increased unemployment, …) Social transition risk, particularly in conjunction with litigation risk, can affect (re)insurers' premium and reserve risk in liability insurance, such as D&O liability insurance due to claims arising from 'social injustice' actions brought against corporate boards related to diversity and inclusion, gender equality, etc.[109]
Market risk	Social risks can affect (re)insurers' market risk exposures, for example transmitted by investments in sovereign bonds of states violating human

[108] General lifestyle and consumption habits, which translate into higher morbidity, mortality or hospitalization underwriting costs, can also be identified as social risks attached to the policyholder and to his/her living conditions. The PSI ESG Underwriting Guide for Life and Health Insurance (UNEP FI (2022)) categorizes, among others, health capabilities (regular health checks, screening, vaccination) or lifestyle behavior (alcohol/drug abuse, smoking, hazardous sports, obesity) as social factors impacting - directly - on the potential underwriting losses.

[109] For example, lawsuits concerning the violation of legal duties regarding diversity on corporate boards. This can be considered as a social risk against the objective of achieving inclusive and sustainable communities and societies, and may be enforceable under certain (sectoral, national or European) regulation. For example, CRD IV requires Member States to ensure diversity in the composition of management bodies of credit institutions, and the setting of a target to ensure representation of the underrepresented gender (Art. 88). In the United States, Assembly Bill 979 specifies targets for board membership from underrepresented communities of companies headquartered in California.

	rights or investments in equities or bonds of 'high risk sectors' which may face asset price volatility or lower market value (social transition risk).
Operational, incl. legal risk and reputational risk	The (re)insurer's own operating conditions negatively impacting on its employees or community (lay off employees or tightened social policy (e.g., relocation of call centers, elimination of social benefits), can cause operational risk. Reputational risk can arise, irrespective of the nature of the insured risk, by underwriting risks for a policyholder involved in socially harmful activity or known for negatively impacting working conditions (of its own work force or throughout the value chain), communities or consumers. For example, underwriting property insurance against fire and damage for a policyholder with harmful social economic activity or impacting negatively on working conditions. Unfair treatment of diverse consumers/vulnerable consumers can result in operational and legal risks. Depending on the applicable regulatory framework, (re)insurers may face legal risk when failing to disclose or report on social adverse impacts of their investment or underwriting activity, or failing to perform due diligence on social impacts of their investees or policyholders. If (re)insurers' systems or staff are not able to act on signals on social risks in their investments / underwriting due to inadequate or failed internal processes, personnel or systems to identify social risks, this can increase operational or legal risks. Such risks can amount to a loss of confidence of (existing or potential) policyholders or shareholders in the (re)insurer, resulting in potential loss of business or loss of market value (operational risk).

Source: Own Table.

4.3. THE PRUDENTIAL TREATMENT OF SOCIAL RISKS

4.3.1. THE TREATMENT OF SUSTAINABILITY RISKS IN SOLVENCY II

361. The Solvency II Delegated Regulation requires the integration of sustainability risks, i.e., environmental, social and governance risks into (re)insurers' governance and risk management.[110]

Table 25: The Prudential Treatment of Sustainability Risks in Solvency II

According to the Solvency II Delegated Regulation:

- Insurers' investment and underwriting policies shall refer to actions taken to assess and manage the risk of loss resulting from inadequate pricing and provisioning assumptions due to sustainability risks, and to actions taken to ensure sustainability risk relating to the investment portfolio are properly identified, assessed and managed (Art. 260).
- The risk management function shall identify and assess sustainability risks, and this shall form part of the (re)insurers own risk and solvency assessment (ORSA) (Art. 269).
- The actuarial function shall consider sustainability risks in its activities (Art. 272(6)).
- The remuneration policy shall include information on how it considers the integration of sustainability risks in the risk management system (Art. 275 (4)).
- As part of the prudent person principle on investment strategy and decisions (Art. 275a):
  - When identifying, measuring, monitoring, managing, controlling, reporting and assessing risks from investments, (re)insurance undertakings shall take into account sustainability risks.
  - (Re)insurance undertakings shall take into account the potential long-term impact of their investment strategy and decisions on sustainability factors.
  - Where relevant, the investment strategy and decisions shall reflect the sustainability preferences of the insurer's customers taken into account in the product approval process.

362. Based on the Solvency II Delegated Regulation, all sustainability risks, be it social or environmental risks, should therefore be treated in a similar manner. As a result, (re)insurers shall ensure that social risks in their underwriting and investment activities are properly assessed and managed as part of their governance and risk management, including as part of their ORSA. Consistent with the principle of double materiality, (re)insurers shall include the assessment of risks as well as impacts and take into account the potential long-term impact of

[110] Commission Delegated Regulation (EU) 2021/1256 of 21 April 2021 amending Delegated Regulation (EU) 2015/35.

their investment strategy and decisions on sustainability factors as part of prudent risk management.

363. The prudential treatment of social risks could to a certain extent be inspired by the prudential treatment of climate-related risks. Mapping the similarities and differences between climate-related risks and social risks can therefore contribute to identifying the appropriate prudential treatment of social risks.

Table 26: Similarities and Differences between Climate-Related Risks and Social Risks

Similarities	Differences
• Climate and social risks are sustainability risks which can transmit to (re)insurers' balance sheets through physical- and transition-related channels. • Climate and social risks are potential drivers of prudential risk on both sides of the (re)insurers' balance sheet, i.e., assets and liabilities. • Climate and social risks translate in (financial) risks through existing risk categories, such as underwriting, market, counterparty default or operational risk as well as reputational risk or strategic risk.[111] In other words, they are not a separate risk class but drivers to existing risk categories, which need to be integrated in the existing risk management framework. • They can materialize beyond a one-year time horizon over the medium-to-long term, as well as have sudden and immediate impacts and can lead to potential secondary effects or indirect impacts.	• The establishment of common 'science-based' risk indicators and targets for social risk is less straightforward than for climate. This is due, among others, to the fact that: • Social factors depend on national social legislation, industry relations or societal values. Social and labour law are not within EU competence as such, but under national competence. Hence many aspects of social factors, such as working conditions, are not defined at EU level and national rules might diverge. • Potential scenario analysis on social risks may differ from climate risk scenario analysis. In comparison to scenario analysis for climate change based on 'science-based' targets for climate mitigation involving targets on GHG emissions across the globe, social risk and impact indicators may involve having regard to local and regional social indicators and be of a more qualitative nature.

[111] See EIOPA (2019), para 22.

• The exposure to climate or social risks can vary across regions, sectors and lines of business. • Adaptation measures can be taken to reduce losses arising from climate or social risks.	• The exposure to social risks also varies across communities or certain vulnerable parts of society. Hence, addressing social risks may require more targeted community engagement in some cases.

Source: Own Table.

364. Further, it has been noted that climate change acts as a crisis multiplier, which stresses the need for a socially 'just transition' as noted in the EU COM Green Deal.[112] The (sole) pursuit of environmental objectives can amplify social risks, if no due consideration is given to a 'just transition' to a green economy. Also, the 17 Sustainable Development Goals (SDGs) recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve oceans and forests.[113]

365. Therefore, beyond commonalities and particularities, it is important to identify the 'nexus' between social and climate / environmental risks and impacts, as they can be mutually reinforcing, and their respective adverse impacts can be mitigated through similar preventive measures.[114]

Table 27: The social – Climate/Environmental Nexus

Environmental risks can exacerbate social risks. Global warming can be a driving factor of migration, amplifying existing motivations for migration such as income inequality, lack of human rights or civil wars.[115] Expected future technological and regulatory changes regarding the transition to a decarbonized economy may have an impact on labour markets or amplify social risks, for example in certain economic sectors (e.g., coal mining industry). As a result of increased environmental risks, an insurer may reconsider its exposure to climate change-related weather hazards and withdraw cover from (increasingly) vulnerable areas or

[112] The Just Transition Mechanism (JTM) aims to provide targeted support to help mobilise around €55 billion over the period 2021-2027 in the most affected regions, to alleviate the socio-economic impact of the transition. The operationalisation of the JTM is based on the implementation of (i) a Just Transition Fund to mobilise investments, (ii) an InvestEU "Just Transition Scheme" providing a budgetary guarantee under the InvestEU Programme and an InvestEU Advisory Hub that will act as a central entry point for advisory support requests, and (iii) a Public Sector Loan Facility combining grants from the EU budget with loans from the European Investment Bank.

[113] United Nations (2022).

[114] See for example the Council of the European Union recommendation on ensuring a fair transition towards climate neutrality aiming to address employment and social aspects linked to the transition. Council Recommendation of 16 June 2022 on ensuring a fair transition towards climate neutrality 2022/C 243/04.

[115] See EIOPA (2022c) p. 30.

risks. The resulting lack of insurance coverage can increase vulnerability by exposing citizens to financial risk (property value depreciation) or lack of means for recovery after natural catastrophes, adding to housing precarity, further increasing risks to health and employment. (Re)insurers' divesting from environmentally non-sustainable economic activities could have an adverse social outcome for investees' employees and their livelihoods. Or increased investment by large institutional investors in land for carbon capture can drive up land prices, threatening local jobs in farming.

Environmental objectives can support social objectives.

Reducing pollution can contribute to the health of society – and as consequence positively impact health and life insurance activity.

Insurance products that help improving climate-risk resilience, for example through premium credits for fortifying homes against natural disasters or for resilience-enhancing measures after the occurrence of a damage, can improve post-disaster recovery and with it, strengthen social resilience by limiting further negative coping strategies for handling the impact of disaster (e.g., disposal of economic assets or reduce business activity).

Investment in new technology for mitigating or adapting to climate change may create new employment opportunities.

4.3.2. PILLAR I PRUDENTIAL TREATMENT

366. Similar to work undertaken in the previous chapters for climate-related risk, a Pillar I prudential treatment of social risks could involve considering to potentially calibrate dedicated capital charges based on the performance of the investments for certain underlying sectors or economic activities having regard to social factors, in line with risk- and evidence-based factors. It could also involve quantifying the impact of risk mitigation measures, to be reflected in premium or reserve risk.

367. There are some examples regarding economic activities which can out- or underperform by pursuing or violating certain social objectives: affirmative action on social objectives, e.g. improving working conditions for the entity's own work force or value-chain workers, as well as end-users/consumers or affected communities (directly or through the value chain) can lead to increased market demand for products or better ability to recruit and retain workers, strengthened competitive advantage or brand value. Observations have been made of the stock price of companies associated with such high social sustainability credentials to have outperformed those with poor social sustainability profiles in the initial months of the Covid-19 pandemic, e.g., by protecting employees against unemployment (avoiding lay-offs, paying sick leave), managing supply chain risk to avoid disruptions in production or re-purposing operations

to provide solutions.[116] Other examples show that gender-balanced workforces would outperform their least-balanced peers.[117]

368. Other reported cases include examples of firms that treat their workforce poorly and suffer negative consequences, including weaker access to human capital and decreased trust and innovation, as well as drops of share value. Conflict with local communities can result in lost opportunities for future projects, expansions, or sales.[118]

369. To perform a quantitative analysis to assess the potential for dedicated capital charges related to social risks, in line with risk- and evidence-based principles, would however require large (international) consensus on appropriate definitions of risk channels as well as comprehensive and granular data on social risk factors in conjunction with appropriate risk models, which are not available to date. Hence, EIOPA does not conduct a Pillar I-related analysis in response to the mandate.

4.3.3. PILLAR II PRUDENTIAL TREATMENT

370. Considering that a social risk assessment shall form part of the overall governance and risk management requirements as part of sustainability risks, including the ORSA, the question arises how (re)insurers can conduct such risk assessments and what type of risk management strategies can be applied to mitigate the risks.

Social Risk Materiality Assessment

371. For climate risks, EIOPA has issued an Opinion and supporting application guidance for undertakings to perform a 2-type scenario analysis on material climate change risks. Considering the nature of social risks as described above in comparison to climate risks, and the lack of comparable data, it seems appropriate, in a first instance, to advise on a qualitative social risk materiality assessment. Potential elements for such a qualitative social risk materiality assessment in the ORSA can be based on the following questions:

Table 28: Questions for a Qualitative Social Risk Assessment

• Vision and strategy: (how) does the undertaking aim to develop and strengthen its business having a forward-looking approach to social risks in society, the undertaking's activities and lines of business?

[116] See BlackRock (2020). The analysis also noted the incipient shift in preferences for sustainable investment has been accelerated by the crisis.

[117] BlackRock (2023).

[118] O'Connor and Labowitz (2017).

- Risk appetite and risk profile: based on the potential strategy, (how) does the undertaking identify social risks when setting its risk appetite and risk profile for investments and underwriting?
- Scenario analysis: what socio-economic scenarios as well as interrelation between social and environmental risks does the undertaking consider in its business planning?
- Risk assessment: (how) does the undertaking see social risks potentially translating into financial risk, and what is the potential magnitude of investment or underwriting losses?
- Risk management: what possible mitigating actions does the undertaking considers taking to reduce the eventuality or impact of social risks on the undertaking's assets or liabilities? How does the undertaking, for example, ensure its underwriting practices are not discriminatory towards certain specific consumer characteristics?

372. Table 29 summarizes key approaches for conducting a high-level social risk materiality assessment. Insurers could start considering mapping the geographical exposure of their assets or liabilities to countries that are (most) vulnerable to (systemic) social risk. Insurers could proceed to identifying the sectoral exposures of their assets or liabilities to economic activities in 'high social risk sectors'. Finally, specific lines of business which may be particularly exposed to social risks can be further identified. Sustainability rating agencies that provide social ratings for investments can be also sourced for an initial exposure assessment.

Table 29: Approaches for High-Level Social Risk Materiality Assessment

High level social risk materiality assessment

(Re)insurers can conduct a high level (qualitative) social risk materiality assessment based on exposure to geographies, sectors or lines of business. The materiality of the exposure would form a proxy to vulnerability and materiality of the risk, in a first step of a risk materiality assessment.

i. **Social risk – geographical exposure**. For example, the Allianz social risk index[119] identifies countries that are most vulnerable to systemic social risk. Indicators providing measures for social inequality or development can also provide indications on geographical exposure to social risks, such as the World Bank's World Development Indicators[120] featuring among others social indicators on labor, health, gender; the Gini index[121] measures the distribution of income across a population; the UNDP human development

[119] Allianz (2020).

[120] The World Bank (2023a).

[121] The World Bank (2023b).

indicator[122] summarizes achievement in key dimensions of human development across countries.

ii. **Social risk - sectoral exposure.** The exposure of assets or liabilities to economic activities in 'high social risk sectors'. For example, the Business and Human Rights Navigator (UN Global Compact)[123] can help mapping exposure to sectors at high risk of relying on child labour, forced labour, or sectors negatively impacting on equal treatment (incl. restrictions to freedom of association) or on working conditions (inadequate occupational safety and health, living wage, working time, gender equality, heavy reliance on migrant workers) or have negative impacts on indigenous people. For these issues, the Navigator identifies industry-specific risk factors, aiming to illustrate the issue for certain sectors such as agriculture, fashion & apparel, mining, travel & tourism. The navigator also identifies due diligence steps that companies can take to eliminate the specific social risks in their operations and supply chains. Information on the social sustainability of the economic activity the insurer is underwriting or investing in, can be sourced from companies' corporate reporting on social risks and impacts under the Corporate Sustainability Reporting Directive (CSRD), as will be implemented by the European Sustainability Reporting Standards.

iii. **Social risk – insurance lines of business exposure.** Some insurance lines of business may be particularly exposed to social risks. For example, the PSI ESG Underwriting Guide for Life and Health Insurance[124] and the Geneva Association's heat map of potential ESG risks in property and casualty underwriting[125] identify social factors that may (negatively/positively affect) health or life and non-life insurance risks. Social adversity and lifestyle behaviour is known to affect health and with it, potential health insurance claims. Workers' compensation claims are likely to be at risk of an employer's poor work force policies. Other social/societal factors, such as housing insecurity or lack of education can influence (in)directly the outcome of workers' compensation claims.

Social Risk Management

373. Based on a materiality assessment, as part of their risk management strategy, (re)insurers can consider implementing social risk mitigating strategies through their underwriting and investment decisions.

[122] UN DP (2023).

[123] UN Global Compact (2023).

[124] UNEP FI (2022).

[125] Geneva Association (2022).

374. The Solvency II Prudent Person Principle requires undertakings to consider the potential long-term impact of their investment strategy and decisions on sustainability factors (Solvency II Delegated Regulation, Art. 275a) as part of their risk management strategy. This reflects the reasoning that misalignment of the investment strategy with sustainability factors may cause prudential risks.

375. By reducing their exposure to socially non-sustainable activities or promoting adaptation measures as part of their investment or underwriting strategy and decisions, (re)insurers can limit social risks to their assets or liabilities.

Table 30: Practices for Mitigating Social Risks & Impacts: The Investment Strategy and Decisions

<u>Limiting investment in or divesting from socially non-sustainable activities/companies</u>

The exclusion of an investee harming social objectives from the investment portfolio can follow the identification of a socially harmful activity, based on two sources: internationally agreed conventions (e.g., certain kinds of weapons) or research on the detrimental effects of certain activities (e.g., detrimental effect of tobacco use). Thresholds for investments in such companies can be set, or exclusions from investments in these sectors pursued. Minimum social safeguards can serve as a guiding principle.

<u>Impact investing and stewardship</u>

The (impact) investment strategy would direct investments at economic activities aiming to achieve explicitly social goals. For example, the funding of health research, through targeted investments in dedicated undertakings or investment in financial literacy programs may contribute to social objectives to improve living standards or access to relevant products to secure financial safety.

Engagement and voting on sustainability matters (as part of a stewardship approach) can aim to influence firms of which (re)insurers are shareholders. This supposes the (re)insurer can persuade the investee to act on social objectives and requires a certain degree of influence or leverage that the (re)insurer can reasonably exercise. (Re)insurers can use their engagement and voting rights to improve performance of those companies against the social objectives.

A ‘best-in-class strategy’ would consist in selecting investee companies with excellent social performance, regardless of the sector which they belong to. Such an investment approach can support companies to transition to a more socially sustainable business model. (Re)insurers can seek to ensure that those firms they invest in measure up to social objectives, especially in ‘high risk’ sectors, ensuring, for example that they provide appropriate wages, or that they operate safe working environments.

Such risk mitigating or adaptation actions can be informed by considering the SFDR principal adverse impacts of the investee companies' activities. The so-called 'minimum social safeguards' as referred to in the Taxonomy Regulation can also provide a minimum standard for implementing a social prudent person principle for investments, in line with Solvency II.

Table 31: Practices for Mitigating Social Risks & Impacts: The Underwriting Strategy and Decisions

Limiting underwriting of socially non-sustainable activities

Similar to investments, insurers could opt not to insure companies (belonging to a sector) known for unsustainable or harmful social practices in its own operations or value chain, or negatively impacting communities or consumers.

Impact underwriting and services

Through targeted underwriting activity, products and services, insurers could bring additional social benefits that directly contribute to the realization of social objectives for end-users and consumers as well as for affected communities (directly or through the value chain). There may be scope for insurers, through their underwriting strategy and decisions, to incentivize policyholders to manage losses arising from social risks. This may be through the provision of services or the potential reduction of premia for risk reducing measures taken by the policyholder, consistent with actuarial risk-based principles. Via underwriting, insurers could also ensure their product offerings and distribution practices consider the demands and needs of a diverse range of clients. Through their underwriting they need to ensure exclusions do not unfairly target and discriminate consumers with non-normative traits and/or vulnerable consumers.

For example:[126]

- The integration of social risk mitigants into, for example, surety bond underwriting for infrastructure projects can also contribute to reducing losses from underwriting due to social risks.
- Risk mitigants can be part of underwriting conditions for workers' compensation policies requiring companies to impact on the health of their workers through the pay they provide, the security of contracts they offer, and through the provision of benefits such as sick pay, parental leave, health insurance and other health-related schemes.
- The establishment of sectoral risk sharing capacities at local, regional or national level, where applicable with government involvement, can contribute to social risk mitigation, for example

[126] See UN Global Compact (2015).

by improving risk assessment for communities and societies and reducing losses from socio-economic risk events.

376. Social risks and objectives can be addressed as part of product oversight and governance. By aiming for fair treatment of consumers in the product life cycle, the insurer can contribute to ensuring the products adequately and sufficiently serve consumers with non-normative traits. This can also prevent bias against socially vulnerable consumers and/or minorities and traditionally discriminated consumers, enhancing the value for money of insurance products. For example:

- As part of the target market assessment, the insurer should ensure the staff working on the target market assessment considers diversity, equity and inclusion. The insurer could enhance access by considering the needs of consumers with non-normative traits, minorities or socially vulnerable (groups of) consumers. Insurers can target specific types of products to vulnerable parts of society or specific sectors (e.g., through micro-insurance, expanding health or life insurance coverage in developing markets to reduce the risk that children are absent from school due to untreated medical conditions, or that they are withdrawn from school to care for a sick relative or to undertake livelihood activities to supplement household income[127]).
- Complex contractual exclusions may disproportionately discriminate some consumer categories with low levels of financial literacy. As part of the product testing insurers should assess whether terms and conditions unfairly discriminate against these consumers. In 2022, EIOPA issued a supervisory statement on exclusions to promote clarity on exclusions including when defining target market and communicating to consumers.[128]
- The use of certain datasets and new technologies in pricing and underwriting can prevent vulnerable populations from having access to affordable and effective insurance products. This can be due to outcomes of mathematical models, including from AI systems, as well as impacts of rating factors such as credit scores, location, income, occupation, level of education in the outcomes of the systems, which can be closely correlated with protected attributes such as ethnicity, nationality, etc. but do not present a causal link with the insured risk. These can cause unfair treatment of consumers who are vulnerable/underserved/minority/diverse, compared to consumers who fit in a dominant/normative group. Hence the use of non-discriminatory data and tools addressing such data bias is important. In 2021, EIOPA's expert group on digital ethics in insurance provided several data governance recommendations to insurance

[127] See UN Global Compact (2015).

[128] EIOPA (2022h).

undertakings to develop ethical and trustworthy AI systems as part of their corporate and social responsibility. In 2023, EIOPA developed a Supervisory Statement on differential pricing practices in non-life insurance lines of business.[129] Practices by which a consumer may be charged higher price based on its low propensity to shop around should be avoided as these have a high-risk of negatively impact vulnerable consumers such as the elderly. Further analysis is ongoing on so-called "poverty premiums" in MTPL business, to assess whether low-income populations/consumers from certain nationalities and/or ethnicity pay higher premiums than higher-income populations.

- Leveraging technological innovation can create more efficient and effective operating and distribution models for insurance, reducing social risks by extending financial inclusion. For example, products with reduced payout timescales and improved support can increase resilience to secondary shocks (e.g., financial duress after a natural catastrophe or other risks) - and further reduce underwriting or reputational risks.

Governance Structure

377. The (re)insurers' governance structure can support and enable the identification and management of sustainability risks. The consideration of sustainability factors in management structures, employee relations and executive remuneration can contribute to including sustainability considerations in the undertaking's decision-making process.[130]

Applied to social aspects, an appropriate corporate governance framework which sets guidelines and incentives for behavior benefitting the company's own social performance (e.g., the undertaking's employee satisfaction, safety and well-being) can support awareness for social risks and contribute to social objectives within the undertaking as well as in its investment and underwriting activity, through:

- <u>Remuneration strategy</u>: e.g., by balancing the gender pay gap and CEO pay ratios in its own remuneration practices;
- <u>Board composition</u>: e.g., by considering diversity in the composition of the AMSB or appointment of key functions;
- <u>Measures for workplace accident prevention and safety policies</u>: e.g., by ensuring whistle blower protection or measures for health and accident prevention.

[129] EIOPA (2023c). Differential pricing practices are defined as non-risk and non-cost related practices used by some insurance undertakings to price insurance products on top of traditional risk-based pricing practices.

[130] EC (2022b).

4.3.4. PILLAR III PRUDENTIAL TREATMENT

378. Solvency II currently does not require quantitative or qualitative prudential reporting or public disclosure on social risks, however, other legislative frameworks and corporate reporting requirements are being implemented in this regard.

379. The Sustainable Finance Disclosure Regulation (SFDR) requires from life insurers within the scope of the Regulation to disclose principal adverse impacts of their investments on social factors. Among the mandatory indicators are the share of investments in companies in violation of the UNGC or OECD MNE guidelines as well as the investee companies' board gender diversity, average gender pay gap and investments' exposure to controversial weapons. Among the opt-in indicators are, for example, the investee companies' rate of accidents, insufficient whistle-blower protection, incidents of discrimination, lack of human rights policies, child labor, and lack of anti-corruption policies. The European Supervisory Authorities are currently proposing additional social indicators such as the share of employees of investee companies earning less than the adequate wage.[131]

380. The Corporate Sustainability Reporting Directive, specified by the European Sustainability Reporting Standards requires from (re)insurers the disclosure of social risks (impacts and opportunities) to its own workforce, workers in the value chain, affected communities, consumers and end-users. The (re)insurer will have to report on how it manages material risks and disclose related targets.

381. At international level, the International Sustainability Standards Board issued its first two standards which do not address yet social risks but focus on general requirements for disclosure of sustainability-related financial information (IFRS S1) and on climate-related disclosures (IFRS S2).

4.4. CONCLUSION AND POLICY RECOMMENDATIONS

382. EIOPA does not advise on a dedicated Pillar I prudential treatment of social risks and impacts at this stage. The lack of corresponding data and risk models today limits the potential for such a proposal. As ORSA analysis and corporate reporting on social risks and impacts improve over time, more evidence may become available on the potential effects these risks may have on the (re)insurers' balance sheets, allowing for a quantitative Pillar I assessment at later stages.

383. In the meanwhile, further application guidance can be developed for supporting the social risk materiality assessment for the purpose of (re)insurers' ORSA, as part of Pillar II requirements, given the emerging relevance of social risks for prudential risks in the insurance sector.

[131] ESAs Final Report on Joint amending SFDR RTS – November 2022.

384. Considering the nascent reporting requirements on social risks and impacts under SFDR and CSRD, EIOPA is not proposing at this stage to develop additional (prudential Pillar III) reporting or disclosure requirements regarding social risks and impacts in Solvency II. Further analysis would be required as to whether quantitative prudential reporting requirements could inform the corresponding prudential treatment of (re)insurers assets and liabilities.

EIOPA Recommendations

EIOPA does not recommend changes in Solvency II related to a dedicated Pillar I treatment of social objectives and risks.

EIOPA suggests continuing work on this topic in terms of developing an application guidance to support the social risk materiality assessment for the purpose of (re)insurers' ORSA.

5. ANNEX

5.1. SUMMARY OF THE FEEDBACK TO THE DISCUSSION PAPER

385. EIOPA follows a step-by-step approach regarding the analysis under the mandate stated in Article 304c of the Solvency II Directive. Prior to this report and the 2023 consultation paper, EIOPA published in December 2022 a discussion paper outlining the methodologies and data sources for public consultation from December 2022 to March 2023.

386. In total, 84 respondents submitted feedback, ranging from various national and international insurance and financial market associations, insurers, NGOs, consultancy/advisory firms, and private persons.

387. Overall, the responses to the discussion paper showed large public interest in the topic and broadly supported the methodologies and data sources proposed for the analysis. There is large agreement that a prudential analysis needs to be risk- and evidence-based, and support for the consideration that sustainability risks are drivers of traditional prudential risks. Different perspectives among respondents exist particularly on conceptual aspects, for instance, (i) whether Pillar I, i.e., capital requirements, or Pillar II, i.e., risk management, would be the appropriate way to treat sustainability risks on the asset side, or (ii) to what extent forward-looking findings can be considered evidence.

Assets and Transition Risk: General Perspective

388. Some respondents expressed doubts on the general existence or materialization of transition risks in asset prices, thereby questioning the necessity for a Pillar I- based risk assessment. However, most respondents considered transition risks to be a relevant and material risk source, with potential implications on asset prices.

389. Regarding the use of backward- and forward-looking risk assessments, some respondents argued that historic data might not appropriately capture transition risks, justifying the use of forward-looking and model-based analysis for assessing the potential for a dedicated prudential treatment. Other respondents, in contrast, highlighted forward-looking assessments could be subject to (material) model errors due to the technical assumptions made for these models and findings related to forward-looking assessments should be carefully treated as evidence to justify a dedicated prudential treatment of risks.

390. Regarding the time window to be assessed for the backward-looking analysis, many respondents supported the rationale that rather recent periods are better candidates to find evidence, if existing, for a materialization of transition risks in asset prices.

Assets and Transition Risk: Classification of Stocks and Bonds

391. Overall, respondents expressed a preference for a sectoral classification approach over a firm-level approach. Some concerns raised related to the sectoral approach referred to treating all firms within a sector similarly regarding their transition risk exposures might treat firms being idiosyncratically in a net-zero transition pathway inappropriately, which also holds at the distinction of sectors at the sub-sector level (e.g., renewable energies in context of the energy sector). Concerns related to the firm-level approach referred particularly to the general lack of high-quality data, e.g. GHG-emission levels, for an appropriate firm-level classification approach of assets in terms of transition risks exposures as well as the higher complexity that would be added to the Standard Formula in Solvency II. Some respondents mentioned the appropriateness of the sectoral approach particularly since Solvency II's Standard Formula is aiming for an average prudential treatment of risk exposures.

Assets and Transition Risk: Risk assessment

392. Respondents generally supported the methodologies and data sources presented to assess transition risks from a prudential perspective, i.e. in context of the VaR-analyses and the data sources for stocks, bonds and property. Some respondents expressed the need, and their clear support, for introducing a dedicated prudential treatment for fossil fuel-related investments. Overall, neither further data nor VaR-related evidence from a prudential perspective has been shared with EIOPA in this regard.

Non-Life Underwriting and Climate Change Adaptation

393. Overall, respondents expressed a strong support for the importance of climate change adaptation for insurance markets. In general, there was broad support for the presented hypotheses on premium risk, reserve risk and natural catastrophe risk as well as the methodology presented to study the potential impact of climate-related adaptation measures on premium risk.
394. Some respondents suggested to include public adaptation measures in the definition of climate-related adaptation measures and to extend the risk assessment on the capital requirements for natural catastrophe risk. Some respondents suggested to add further explanations of certain technical aspects (e.g., calibration of parameters) and raised some concerns that data related to adaptation measures might not yet be sufficiently available in the EU insurance market making the analysis generally difficult.

Social Risks and Impacts from a Prudential Perspective

395. Broadly, respondents supported EIOPA's analysis on the social risks and impacts, and the approach for addressing these risks and impacts from a Pillar II and III perspective, rather than a Pillar I approach at this stage.

396. Conceptually, respondents agreed that all sustainability risks are to be treated in a similar manner. Social risks need to be identified and managed beyond mere reputational risks. In that regard, respondents supported to treat climate and social similarly and the interrelation between both should be considered, from a perspective of a 'just transition'. Support for addressing the governance aspects to ensure adequate management of social risks was expressed – while noting that this should not lead to additional governance requirements.

397. As part of Solvency II and for the purpose of sustainability reporting, insurers will be expected to conduct a materiality assessment of social risks and impacts. respondents `stressed the limitations attached to measuring and addressing social risks and impacts in insurance underwriting and investing. Hence, respondents supported to further improve on the identification and measurement of social risk and impacts, and future voluntary application guidance on embedding social risk management into governance and, (qualitative) materiality assessment of social risks as part of ORSA could be an important aspect to be developed in this regard.

5.2. ASSETS AND TRANSITION RISK EXPOSURES

Table 32: Sectoral NACE Code Classification – Overview

NACE Code	Activity	NACE Code	Activity
A01	Crop and animal production, hunting and related service activities	G46	Wholesale trade, except of motor vehicles and motorcycles
A02	Forestry and logging	G47	Retail trade, except of motor vehicles and motorcycles
A03	Fishing and aquaculture	H49	Land transport and transport via pipelines
B05-B09	Mining and quarrying	H50	Water transport
C10-C12	Manufacture of food products, beverages and tobacco products	H51	Air transport
C13-C15	Manufacture of textiles, wearing apparel and leather products	H52	Warehousing and support activities for transportation
C16	Manufacture of wood and of products of wood, cork, straw and plaiting, except furniture	H53	Postal and courier activities
C17	Manufacture of paper and paper products	I55-I56	Accommodation and food service activities
C18	Printing and reproduction of recorded media	J58	Publishing activities

C19	Petrochemical (manufacture of coke and refined petroleum products)	J59-J60	Motion picture, television program production, sound recording and music publishing
C20	Manufacture of chemicals and chemical products	J61	Telecommunications
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	J62-J63	Computer programming, consultancy and information service activities
C22	Manufacture of rubber and plastic products	K64	Financial service activities, except insurance and pension funding
C23	Manufacture of other non-metallic mineral products	K65	Insurance, reinsurance and pension funding, except compulsory social security
C24	Manufacture of basic metals	K66	Activities auxiliary to financial services and insurance activities
C25	Manufacture of fabricated metal products, except machinery and equipment	L68	Real estate activities
C26	Manufacture of computer, electronic and optical products	M69-M70	Legal and accounting activities; activities of head offices; management consultancy
C27	Manufacture of electrical equipment	M71	Architectural and engineering activities; technical testing and analysis
C28	Manufacture of machinery and equipment	M72	Scientific research and development
C29	Manufacture of motor vehicles, trailers and semi-trailers	M73	Advertising and market research
C30	Manufacture of other transport equipment	M74-M75	Other professional, scientific and technical activities; veterinary activities
C31-C32	Manufacture of furniture; other manufacturing	N77-N82	Administrative and support service activities
C33	Repair and installation of machinery and equipment	O84	Public administration and defence; compulsory social security
D35	Utilities (electricity, gas, steam, and air conditioning supply)	P85	Education
E36	Water collection, treatment and supply	Q86-Q88	Human health and social work activities
E37-E39	Sewerage; waste management services, treatment and disposal activities	R90-R93 S94-S96	Other service activities
F41-F43	Construction	T97-T98	Activities of households as employers; production activities of households for own use

G45	Wholesale and retail trade and repair of motor vehicles and motorcycles		

Source: Own Table.

Table 33: NACE Codes of the CPRS

CPRS	NACE codes
1-fossil-fuel	05, 06, 08.92, 09.10, 19, 35.2, 46.71, 47.3, 49.5
2-utility|electricity	35.11, 35.12, 35.13
3-energy-intensive	07.1, 07.29, 08.9, 08.93, 08.99, 10.2, 10.41, 10.62, 10.81, 10.86, 11.01, 11.02, 11.04, 11.06, 13, 14, 15, 16.29, 17.11, 17.12, 17.24, 20.12, 20.13, 20.14, 20.15, 20.16, 20.17, 20.2, 20.42, 20.53, 20.59, 20.6, 21, 22.1, 23.1, 23.2, 23.3, 23.4, 23.5, 23.7, 23.91, 24.1, 24.2, 24.31, 24.4, 24.51, 24.53, 25.4, 25.7, 25.94, 25.99, 26, 27, 28, 32
4-buildings	23.6, 41.1, 41.2, 43.3, 43.9, 55, 68, 71.1
5-transportation	29, 30, 33.15, 33.16, 33.17, 42.1, 45, 49.1, 49.2, 49.3, 49.4, 50, 51, 52, 53, 77.1, 77.35
6-agriculture	01, 02, 03

Source: University of Zurich – Finexus: Center for Financial Networks and Sustainability: Climate Policy Relevant Sectors.

Table 34: NACE Codes included in the Analysis of the Fossil Fuel-Related Portfolio

NACE Code
B5.1 - Mining of hard coal
B5.2 - Mining of lignite
B6 - Extraction of crude petroleum and natural gas
B6.1 - Extraction of crude petroleum
B6.2 - Extraction of natural gas
B8.9.2 - Extraction of peat
B9.1 - Support activities for petroleum and natural gas extraction
C19.1 - Manufacture of coke oven products
C19.2 - Manufacture of refined petroleum products
D35.2 - Manufacture of gas; distribution of gaseous fuels through mains
H49.5 - Transport via pipeline

Source: Own Table.

Forward-Looking Assessment: Risk Mapping

398. Although the DNB transition stress test built customised scenarios and did not follow the scenarios of the Network for Greening the Financial System (NGFS), it does produce transition vulnerability factors (TVFs) to map the macro-economic developments in the scenarios to asset prices at the sectoral level. The TVFs describe the heterogeneity of each economic sector regarding transition risk, depending on the carbon intensity of the sector. In this regard, a forward-looking assessment based on TVFs connects well with the sectoral backward-looking assessment.

399. The advantage of the TVFs is that they can be interpreted as beta factors in a capital asset pricing model (CAPM). The TVFs capture the sensitivity of stock returns to forward-looking scenario-specific excess market returns, for instance in case of a rise in carbon prices or a technological shock. Another interesting feature of the TVFs is that due to their nature, they can be seen as more time-stable than direct asset price elasticities. These relative measures are also a useful tool to cascade-down aggregate shocks, or to aggregate up granular shocks in a weighted-average manner.

400. To get both a forward-looking and stable measure of transition risk for economic sectors in light of different climate trajectories, the TVFs can be mapped onto the orderly and disorderly transition scenarios as well as the hot-house-world scenarios of the NGFS. The NGFS has emerged to a prominent role, providing a framework of different future climate scenarios, encompassing a set of risk factors, in order to generate different plausible future transition pathways.

401. Climate risks mainly stem from a combination of policy and technological factors, differentiated across the economy's transition pathways orderly, disorderly or hot house world (see Figure 17). Within every scenario, each risk factor is rated as carrying lower, moderate or higher risk levels. Policy risk is translated through policy reaction combined with its geographical fragmentation (i.e. regional policy variation), while technological risk is conveyed via the combination of technology change (transforming economic activities) and the capacity to actively remove CO_2 from the atmosphere.

FIGURE 17: NGFS CLIMATE SCENARIOS AND RELEVANT RISK DRIVERS

		Physical risk	Transition risk			
Category	**Scenario**	**Policy ambition**	**Policy reaction**	**Technology change**	**Carbon dioxide removal**	**Regional policy variation+**
Orderly	Net Zero 2050	1.5°C	Immediate and smooth	Fast change	Medium use	Medium variation
	Below 2°C	1.7°C	Immediate and smooth	Moderate change	Medium use	Low variation
Disorderly	Divergent Net Zero	1.5°C	Immediate but divergent	Fast change	Low use	Medium variation
	Delayed transition	1.8°C	Delayed	Slow/Fast change	Low use	High variation
Hot House World	Nationally Determined Contributions (NDCs)	~2.5°C	NDCs	Slow change	Low use	Low variation
	Current Policies	3°C+	None – current policies	Slow change	Low use	Low variation

Colour coding indicates whether the characteristic makes the scenario more or less severe from a macro-financial risk perspective^

- Lower risk
- Moderate risk
- Higher risk

Source: NGFS (2021).

402. To achieve a forward-looking and stable perspective on transition risk, the TVFs per specific economic activity are mapped onto the NGFS climate scenarios in a parsimonious and pragmatic manner.

403. The TVFs are provided per 2-digit NACE code, differentiated across three transition shock scenarios (technology shock, policy shock and a double shock, i.e. a combination of technology and policy shock). Concurrently, the NGFS scenarios consider transition risk as a combination of four risk factors, i.e. policy reaction, technology change, carbon dioxide removal and regional policy removal. The risk factors i) policy reaction and ii) regional policy variation can be grouped together to constitute the risk drivers for a policy shock within the TVF framework, and the risk factors iii) technology change and iv) carbon dioxide removal can be grouped together to constitute the risk drivers for a technology shock within the TVF framework.

404. Since within each scenario the NGFS framework attributes a certain risk level to the four risk factors (i.e. lower, moderate or higher risk), the scenario-specific risk level for the policy and technology risk drivers is subsumed by means of the maximum value of the risk levels of the corresponding individual factors. Pragmatically, the risk level for the double risk driver is established as the simple average of the risk levels of the policy and technology risk drivers.

$$\text{Policy Risk Driver}_{\text{RISK LEVEL}} = \text{MAX}_{\text{RISK LEVEL}}\,[\text{Policy reaction; Regional policy variation}]$$

$$\text{Technology Risk Driver}_{\text{RISK LEVEL}} = \text{MAX}_{\text{RISK LEVEL}}\,[\text{Technology change; }CO_2\text{-Removal}]$$

$$\text{Double Risk Driver}_{\text{RISK LEVEL}} = (\text{Policy Risk Driver}_{\text{RISK LEVEL}} + \text{Technology Risk Driver}_{\text{RISK LEVEL}}) / 2$$

405. To implement the mapping of the TVFs onto the NGFS scenarios, each risk level (lower, moderate or higher risk) is associated with a coefficient (e.g. 0.5, 0.75 and 1), respectively, to portray a subdued, intermediate or full effect of the risk driver. This final step is important to

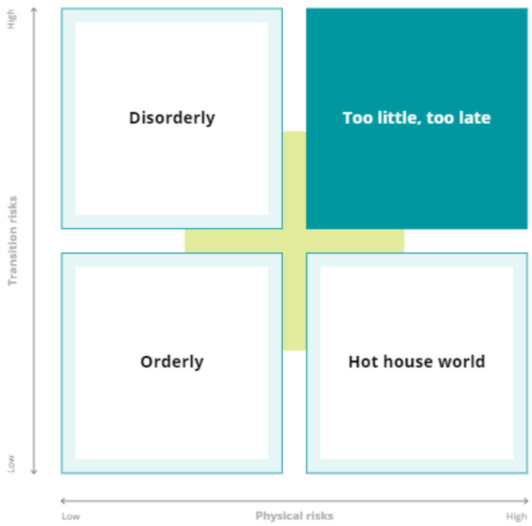
link quantitatively the TVFs in a given shock scenario (e.g. policy shock) with the risk levels of the corresponding NGFS risk drivers (policy reaction, regional policy variation).

406. For the scenarios within the disorderly transition context, the risk level for the double shock was corrected to a minimum coefficient of one, due to confidence disruption considerations. A disorderly transition is seen as more likely to generate confidence disruption among investors, companies, or households, to invest or consume.[132]

407. The TVFs should be considered a risk-oriented metric, measuring the vulnerability of 55 NACE activities to transition risk. As such, the TVFs do not imply a binary green versus non-green classification of economic activities.

408. The analysis shows the forward-looking sector specific TVFs conditional on the NGFS disorderly transition scenarios and certain shock scenarios (policy shock, technology shock and double shock). A disorderly economic transition to a low-carbon environment which can be expected to cause the maximum level of transition risks in the real economy (Figure 18), since it results in generally higher vulnerability of firms due to higher economic costs related to divergent and stronger climate policies than in other scenarios. Therefore, the orderly and the two Hot House World scenarios are not assessed. Such scenarios will expose insurers to increasing physical risk, most notably in Hot House World scenarios and both on the asset- and liability-side, but not or only limited to transition risk.

Figure 18: NGFS Scenarios



Source: NGFS - Scenarios Portal.

[132] The EIOPA (2022) discussion provides an example of the mapping of TVFs onto the 'Net zero 2050' scenario.

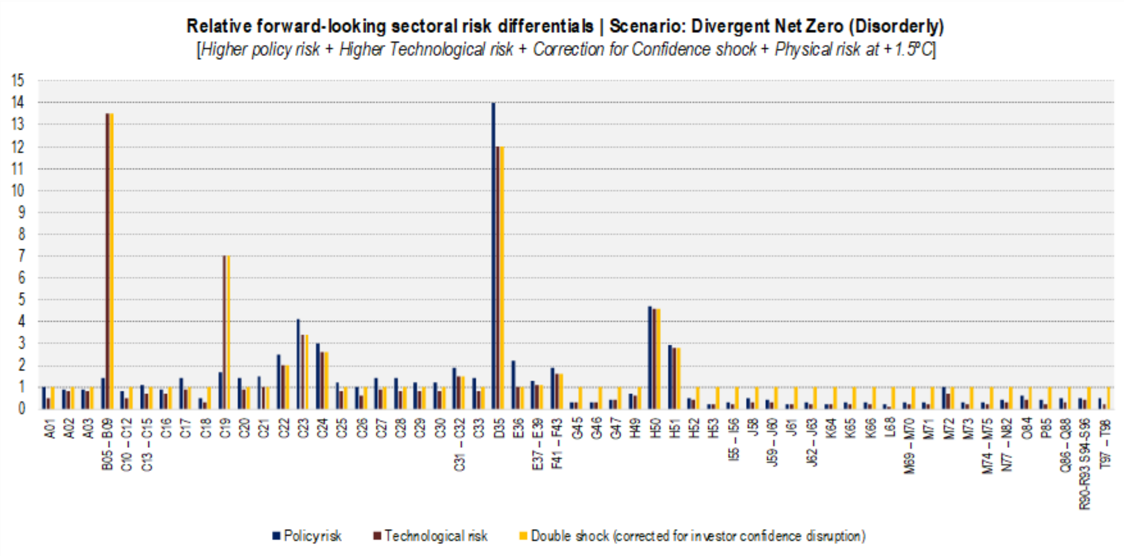
409. Figure 19 shows the forward-looking transition risk exposures of economic activities in case of a disorderly transition scenario by means of the Divergent Net Zero scenario and the Delayed transition scenario.

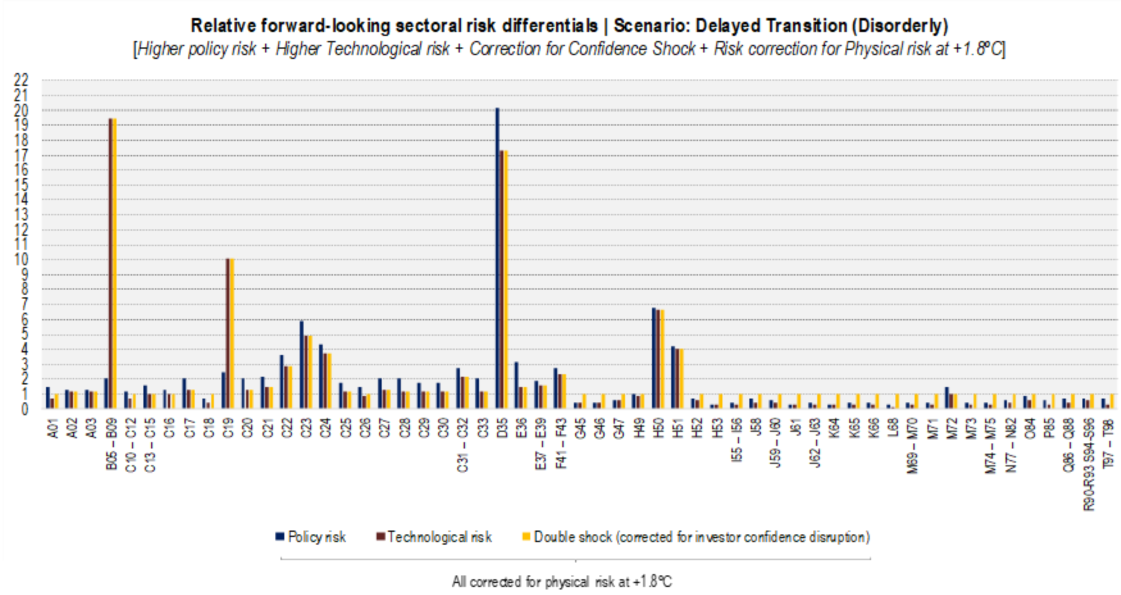
410. In the disorderly scenarios, a transition can still be witnessed, yet it occurs in a more fragmented context, which tends to entail further transition risks in comparison to orderly circumstances. Moreover, to make full use of the insights conveyed by the TVFs, a confidence shock (to investors and/or consumers) is applied within both scenarios of this subset, to account for the additional uncertainty motivated by circumstances of disorderly transition.

Forward-Looking: Divergent Net Zero Scenario

411. In this scenario, global warming is contained at +1.5ºC, due to relevant policy and technological action. Nonetheless, due to the disorderly context of occurrence, both risk drivers – policy and technology – are quoted at maximum level. Due to the disorderly transition the policy component of transition risk is classified at a higher level than – for example – the orderly "Net Zero 2050" scenario.

FIGURE 19: RESULTS FOR VULNERABILITY TRANSITIONS, PER ECONOMIC ACTIVITY, WITHIN THE DIVERGENT NET ZERO (A) AND DELAYED TRANSITION (B) SCENARIOS





Source: Own Figure.

Forward-Looking: Delayed Transition Scenario

412. In this scenario, the context of disorderly transition delays its effectiveness. Thus global warming reaches levels beyond +1.5ºC (hence warranting a risk correction for the effect of aggravated physical risks), but the temperature rise is still kept below +2ºC. As, despite the disorder and fragmentation, there is a transition occurring, both risk drivers are also quoted at maximum level within this scenario.

413. The outcome of the mapping shows several economic activities to be predominantly exposed to transition risk from a forward looking perspective, on the condition of an disorderly transition of the economy towards a low-carbon economy: B05-09 (Mining and Quarrying – coal, lignite, crude petroleum, natural gas, etc.), C19 (Petrochemical - manufacture of coke and refined petroleum products), C22 (Manufacture of rubber and plastic products), C23 (Manufacture of other non-metallic mineral products), C24 (Manufacture of basic metals), D35 (Utilities: electricity, gas, steam, and air conditioning supply), H50 (Water transport) and H51 (Air transport). These economic activities show a substantial forward-looking financial risk exposure due to transition risk, as their business models appear to be misaligned with the disorderly transition of the economy towards a low-carbon economy. The ranking of the mostly affected economic activities is in line with findings by Battiston et al. (2017) in terms of the Climate Policy Relevant Sectors (CPRS).[133]

[133] Battiston et al. (2017).

Forward-Looking: Assumptions on Property Shocks in the context of Energy Efficiency

414. The real estate sector is, measured by equity prices, less sensitive to the transition scenarios of ACPR, DNB, ECB and IAIS than the overall economy. Equity prices are based on value added within the real estate sector, which typically does not take into account the impacts on property prices. However, the ECB scenario also exhibits marginal positive impacts on prices of commercial (0.4%) and residential (0.8%) property in the euro area.

415. Since this report considers risk differentials, differences in exposure to transition risk within the property universe are of most interest. Studies from Denmark, Ireland, Netherlands and the UK show that house prices tend to increase with the energy efficiency of houses measured by energy labels. Compared to the average energy label (D), very high (A) and very low (G) energy labels increase and decrease the sales prices by 5-10%.[134]

416. These conclusions are conditional on current energy prices during the time of the study. It is to be expected that an increase in energy prices in a transition scenario will widen the price gap between energy-efficient and -inefficient property. The study from Copenhagen Economics not only explores the relationship between house prices and energy efficiency, but also the impact of an increase in energy prices on house prices in relation to their energy efficiency. The study uses both an empirical and a theoretical approach:

- The empirical approach is based on current data on sales prices of houses with different energy efficiency and energy prices;
- The theoretical approach is based on the present value of future energy savings due to a higher energy efficiency.

417. The house price effects found using the different approaches differ significantly. The empirical approach finds that an increase in energy prices by EUR 0.135 per kWh (DKK 1 per kWh) increases the price of a 100 m2 house by EUR 5,000 (DKK 39,200) for every 10 MWh in energy savings, whereas the theoretical approach finds a price effect of EUR 29,000 (DKK 216,000) for every 10 MWh in energy savings. The energy price increase of EUR 0.135 represents a 150% price increase compared to the baseline level of energy prices of EUR 0.09 per kWh (DKK 0.69 per kWh).

[134] See for an overview chapter 6 of Copenhagen Economics (2015).

418. Using information in the report on house prices and energy consumption for the different energy labels, the forward-looking impact of the higher energy prices on house prices with different energy labels can be estimated:[135]

- Under the empirical approach, and relative to houses with a D label, the 150% energy price increase results in a price increase of 3% for houses with an A label and -5% for houses with a G label;
- Under the theoretical approach, and also relative to houses with a D label, the 150% energy price increase results in a price increase of 12% for houses with an A label and -23% for house with G label.

419. The estimates under the theoretical approach are used to illustrate property price differentials for buildings with different energy labels (relative to the D label) in the transition scenarios considered by ACPR, DNB, ECB and IAIS. This is done for both residential property and commercial property, assuming that the price impacts shown above are the same. The Electric Power Research Institute (EPRI) estimates for the US that an increase in the carbon price by about 50 USD/tCO2 leads to an increase in the average electricity generation price by 34% and roughly 17% for the average residential retail price, which includes distribution costs.[136]

420. The policy shock scenario of DNB assumes an increase of carbon prices by 100 USD/tCO2 and the delayed transition scenario of ESRB / ECB an increase by about 300 USD/tCO2. The delayed and sudden transition scenarios of ACPR are based on a gradual increase in carbon prices to respectively 700 and 900 USD/tCO2 in 2050 (starting respectively in 2030 and 2025). Similar to the ESRB/ECB scenario, an (average) increase in the carbon price by 300 USD/tCO2 is assumed in both ACPR scenarios for the purpose of projecting property price differentials. The same increase is assumed for the disorderly scenario of IAIS, while for the 'too little, too late' scenario of IAIS an increase of 200 USD/tCO2 is considered. The technology shock scenario of DNB does not include a rise in carbon prices but assumes that renewable energy prices decrease by around 50% due to a technological breakthrough.

421. Applying the EPRI elasticities of energy prices to the rise in carbon prices and, subsequently, the sensitivity of house prices to energy prices, yields the price change for property broken down by energy labels in the transition scenarios.

---

[135] Table 4 of Copenhagen Economics (2015) provides the average sales price per square meter for a house with energy label D. Table 9 provides the price differences for houses with higher and lower labels relative to the D label, allowing the calculation of 'theoretical' house prices for the labels higher and lower than D. The prices are theoretical in the sense that the houses are assumed to have a surface area of 100 m^2 and price differences only reflect differences in energy efficiency. Table 1 provides information on the average energy consumption of 100 m^2 houses with different energy labels and, hence, the energy savings accompanying the move to a higher energy label. Combining the information on house prices and energy consumption with the empirical and theoretical elasticities with regard to the price effect of an increase in energy prices for every 10 MWh in energy savings, it is straightforward to calculate the impact on house prices for the different energy labels relative to energy label D.

[136] See EPRI (2021).

5.3. NON-LIFE UNDERWRITING AND CLIMATE CHANGE ADAPTATION

Climate-related Hazards

Table 35: Classification of Climate-Related Hazards

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

Source: Appendix A of the Commission Delegated Regulation (EU) 2021/2139.

Loss Models

422. EIOPA presents, as it its discussion paper, several case studies that provide valuable insights on the risk reducing effect of climate-related adaptation measures on the potential loss that could arise from climate-related hazards.

Case study 1 - Study on Flood Risk, 2022, RMS

In 2021, RMS ran a three-part webinar series about past, present, and future flood risk in five key European cities (Cologne, London, Paris, Prague, and Zurich). The third part focused on flood risk management and with a focus on examples of how climate-related adaptation measures help reduce potential damage from fluvial and pluvial flooding. EIOPA will focus in this case study on the impact of climate-related adaptation measures as demonstrated in that study for Zurich and Paris.

The analysis presented in the study is based on the latest version of the RMS Europe Inland Flood HD Models, released in 2020. The models cover fourteen countries in Europe, across a single probabilistic event set, allowing us to capture the complete flood risk correlation across territories.

The RMS models are based on physical risk modelling, starting with precipitation, which allows for capture of all sources of inland flooding, including fluvial (i.e., river) and pluvial (i.e., flash flood and small river system). This is a critical element as over 50 percent of insurance claims happen outside the main flood plains in Europe.

Physical risk modelling also enables climate conditioning of the event set to reflect different future climate scenarios. Unlike static scenarios and simpler risk scoring, using probabilistic modelling for reflecting climate change allows for the quantification of future climate risk, providing similar metrics traditionally used in the insurance industry, such as average annual loss (AAL), return period loss, and impact on frequency.

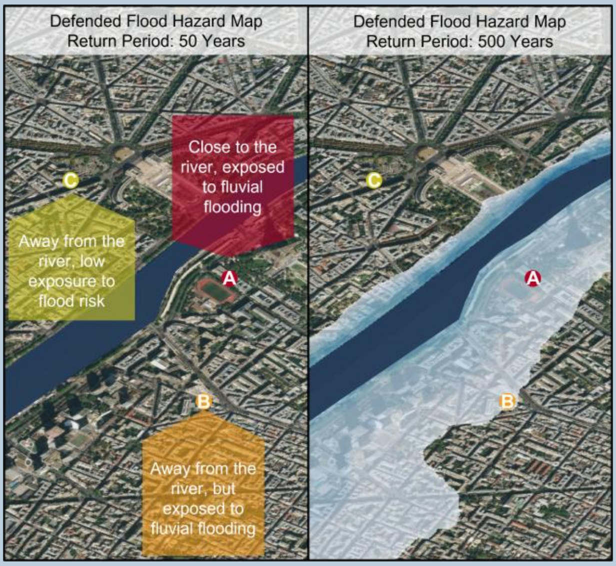
In addition, this study uses a functionality of the RMS model: Both the location-level flood defence assumptions, known as property flood resilience (PFR), and standards of protection of the large fluvial defence systems can be adjusted. This will be illustrated in the Zurich and Paris examples.

For both examples one near- and one long-time horizon were chosen: 2030 and 2050. Two Representative Concentration Pathway (RCP) scenarios were chosen to reflect the uncertainty in future greenhouse gas (GHG) emissions: RCP2.6 and RCP8.5. RCPs are the commonly used scenarios that describe different climate futures depending on the volume of GHG emitted in the years to come. RCP2.6 assumes active climate change mitigation measures are applied and GHG emissions start declining from 2020 onward. RCP8.5 represents a “business as usual” behaviour and is considered a worst-case scenario with rising GHG emissions throughout the end of the century.

All analyses show that climate-related adaptation measures clearly reduce potential property-damage loss in areas exposed to flood risk.

Paris

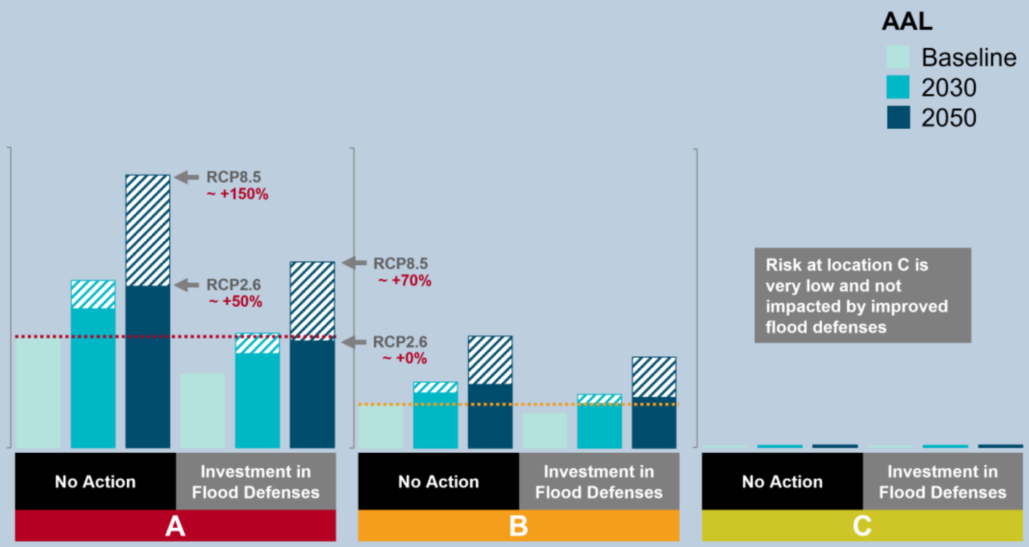
Three Paris locations – A, B, and C – with different flood risk profiles were chosen, as shown on the map. Locations were coded as multi-family dwelling, masonry, and with a basement. Similar other building attributes as well as insured values (building and contents) were used to allow comparison between locations.



Looking at the 1-in-50-year flood hazard map (left), none of the three locations appear to be exposed to significant flood risk at the lower return periods. Nevertheless, the situation is different for rarer events, that is, at higher return periods. Indeed, in the 1-in-500-year map (right), we can see the impact of the primary flood defences being overwhelmed in locations A and B.

To demonstrate the impact of adaptation measures on potential property losses, the RMS Europe Inland Flood HD Models and corresponding RMS Climate Change Models were leveraged to simulate the impact of improved fluvial flood protection. In addition, it is assumed that the standard of protection (SoP) had increased by 50 percent. SoP is a model parameter that can be adjusted by the user and represents the level up to which exposed assets are protected by fluvial flood defences in today's climate conditions. SoP is represented as a return period (e.g. a design standard equal to one hundred years means that the defence is designed to hold up against a 100-year discharge of water level at today's levels).

The following graph illustrates the results of the simulations for each location.



For location A, which is most exposed to fluvial risk, the investment in improved flood defences substantially reduces today's flood risk. Under scenario RCP8.5 in 2050, the losses driven by climate change were reduced from around +150 percent, relative to the current risk, to approximately +70 percent if defences are improved. Under scenario RCP2.6, despite increasing precipitation leading to a 50 percent increase in loss by 2050 with no adaptation measures, the defence improvements shown here almost entirely mitigate this increase and contain losses to current levels.

The effect is less remarkable for location B but is still significant as evident by the clear reduction of AAL displayed in the graph. Since Location C is not affected by fluvial flooding from the Seine, it does not benefit from the improved flood defences.

Zurich Case Study

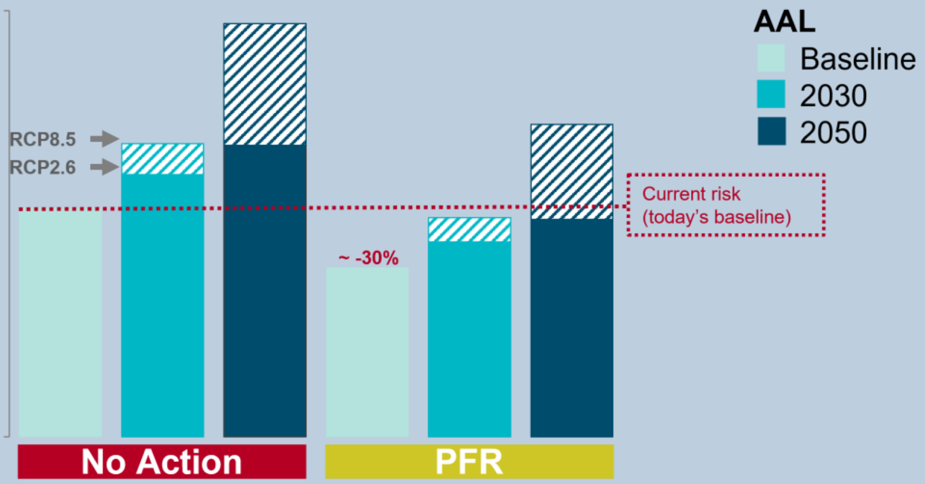
RMS models allow us to assess the impact of many different PFR measures such as sandbags, floodwalls, raised ground floors, dry- and wet-proofing, etc. For the Zurich case study, RMS:

- Assessed the impact of flood protection measures at the property level, as opposed to the impact of investments in large river protection measures (e.g. heightening of dams and levees)

- Analyzed the effects of installing a 0.5-meter floodwall (a PFR measure) at every commercial property in the city of Zurich because the largest portion of the potential losses are from commercial buildings

- Did not apply any adaptation measures to residential and industrial properties

The following graph illustrates the results of the simulations.



Implementing the specific adaptation measure at the property level, the floodwall, reduces today's flood risk by almost 30 percent. Losses under both RCPs in 2030 are lower than current levels when defences are improved. That is, risk adaptation from defence improvements outweighs the increase in risk due to climate change over this time horizon and also at the 2050-time horizon for RCP2.6 (but not for RCP8.5). Similar analyses can be performed to examine what level of defence improvements are required to limit future losses to current levels under any given RCP and time horizon.

Case study 2 - UK study on property flood resilience considering climate change adaptation, 2022, JBA Risk Management

JBA Risk Management has led a preliminary study to determine the level of Property Flood Resilience (PFR) uptake on residential properties that might mitigate the effect of climate change on property losses in the UK under different climate scenarios. PFR includes the use of flood gates, waterproof plaster, solid concrete floors and tiled floor coverings, raised electric sockets or simply moving paperwork and valuables to higher levels to protect a property.

For the purpose of this study, RCP 4.5 and RCP 8.5 were the future scenarios used and a time horizon of 2050 was chosen. JBA considered two types of vulnerability for the analysis, a set of assumptions with no PFR and one that was adapted to include protective measures.

The following table shows the result of the simulation using JBA's UK market residential exposure. This clearly illustrates the mitigation power of climate- related adaptation measures on the average annual losses:

Scenario	Loss (£) - No PFR	Properties Updated	*Loss Mitigation (£)	Loss Mitigation (%)
Baseline	487,058,630	-	-	-
RCP4.5	838,541,312	238,994	365,391,958	43.57
RCP8.5	909,087,658	323,471	453,066,154	49.84

**The loss mitigation brings the combined flood loss slightly below the present-day (baseline) view. This is a legacy of the method employed in this study.*

The table can also be interpreted as follows:

- Properties Updated refers to the number of properties that have had PFR measures applied

- Under RCP4.5, PFR measures at only 3% (238 994 properties out of the total number of properties) of UK properties would mitigate the climate change affected loss to residential properties

- Under RCP8.5, PFR measures at only 4.1% (323 471 properties out of the total number of properties) of UK properties would mitigate the effect of climate change on loss to residential properties

The Flood Re Build Back Better scheme is a UK privately led initiative designed to reduce the cost and impact of future floods by including property resilience measures as part of flood repairs, up to the value of £10,000.** Based on the simple assumptions of this preliminary study, JBA calculate an estimated payback period for the Build Back Better scheme under RCP8.5: An initial investment of £3.2 Billion (£10,000 for 323,471 properties) could lead to an annual loss mitigation of £453m. A conservative payback period is therefore only 7.1 years when assuming no interest rates effect and assuming flood risk exposure and costs of rebuild are kept at present day levels.

***It has been understood that the FloodRe 10k incentive is intended to cover varying levels of PFR depending on the size and location of a property and inflation. In this study the £10,000 is used based on Flood Re's 'Build Back Better' scheme but JBA have not performed any cost analysis on this figure.*

Case study 3 - Verisk analysis on improvements on flood risk metrics when adaptation measures are in place compared to present-day scenarios

Verisk conducted loss analyses to estimate improvements on flood risk metrics when mitigation measures are in place compared to present-day scenarios. The cases examined involved (1) increasing local public protection measures against riverine flooding and (2) implementing building-level flood mitigation measures.

(1) Impacts of Riverine Protection Measures on Flood Risk Metrics

This study was made on 1006 postal codes in the region in the west of Germany that was most affected by the flooding in July 2021 caused by the low-pressure system "Bernd".

Analyses were carried out using a model, where standards of protection such as levees, dikes, and flood walls are explicitly included. The method used also provided the flexibility of coding a custom standard of protection at the location level and could be defined as either a height of water depth or a return period, up to which a location is protected from on-floodplain losses (where "on-floodplain" is defined from all rivers with a catchment area of 10 km^2 or greater).

Scenarios analysed looked at increasing the standard of protection return period by 25% (i.e. locations with a standard of protection up to one hundred years received protection for on-floodplain events corresponding to up to a 125-year return period; Scenario 1) and at implementing a minimum standard of protection of 200 years throughout the case study domain (Scenario 2).

Results from the detailed loss analyses conducted on the different scenarios were aggregated by postal code and are presented in the graph below:

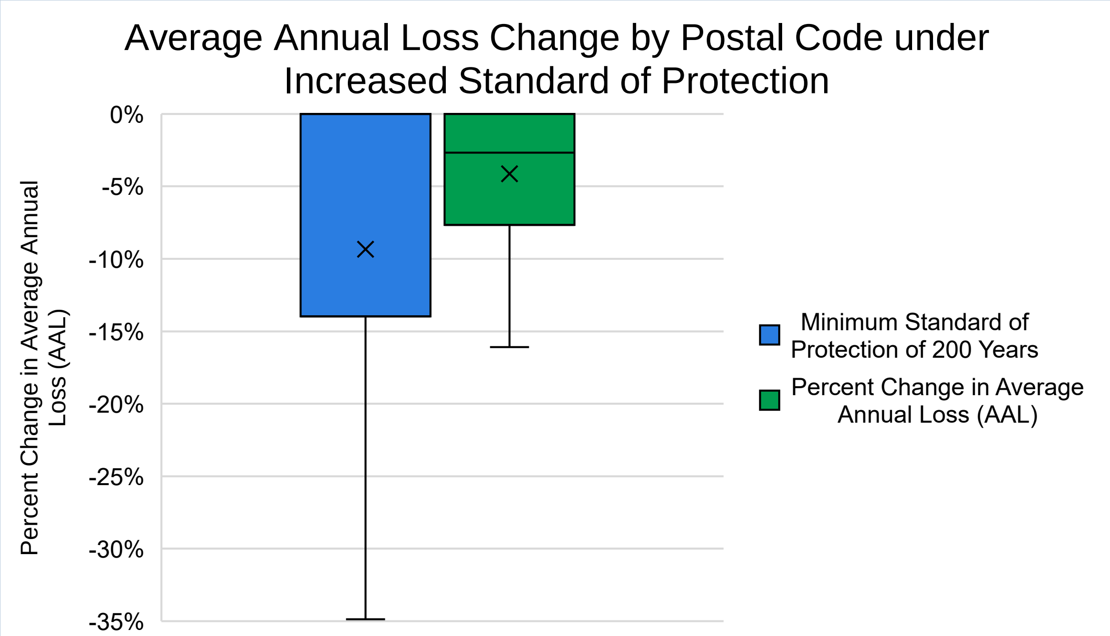


Figure: Distribution of AAL change by postal code under scenarios 1 and 2 (X indicates mean value, solid line is median).

Generally, the proportional increase in defence from the on-floodplain component (Scenario 1) resulted in a decrease in both average annual flood loss (AAL) and 100-year tail value at risk (TVaR) on the order of 2-5% by postal code, with a maximum impact on certain postal codes on the order of 15%. Aggregated over the entire modelled exposure, an AAL as well as 100-year TVaR reduction of 6% was achieved.

Moreover, the scenario of implementing a standard of protection at all streams against floods of at least a 200-year return period (Scenario 2) achieved a reduction of up to 35% for some postal codes, amounting to an overall AAL reduction of 7% and a 100-year TVaR reduction of 3% for the entire modelled domain. The following factors contribute to the only moderate reduction of loss over the entire modelled exposure:

- Exposure is concentrated in regions which already have high protection in place against riverine flooding

- Residual risk from pluvial/off-plain flooding and from events which exceed high protection levels contributes a significant portion to overall flood risk.

At the same time, individual postal codes could be identified in both scenarios where risk reduction was substantial in absolute terms. This highlights that the cost versus benefit relationship of additional protection investments can be favourable and how modelling tools can support such analyses.

(2) Building-Level Flood Mitigation Measures

In addition to examining impacts of generalized increases to standards of protection, catastrophe models are well-suited for examining flood risk metric differences when mitigation measures are implemented in construction practices at an individual location. Some examples of mitigation measures that can be modelled at this time in available models from Verisk include “wet flood-proofing” of structural components of a building and raising or protecting service equipment (e.g. heating, electrical, or plumbing).

Using a sample exposure in the United States, consisting of 250,000 locations exposed to various levels of flood hazard and consisting of a typical exposure mix of commercial, residential and industrial locations, Verisk examined impacts by looking at differences in flood risk metrics after implementing various levels of service equipment protection and wet flood-proofing (up to 1 m).

The combined impact of wet flood-proofing and high service equipment protection (up to 1 m elevation) typically ranges from an AAL reduction for individual buildings of 6% to 15% (25% and 75% quantiles) and in the most impactful scenarios, AAL reduction of up to nearly 30% was achieved.

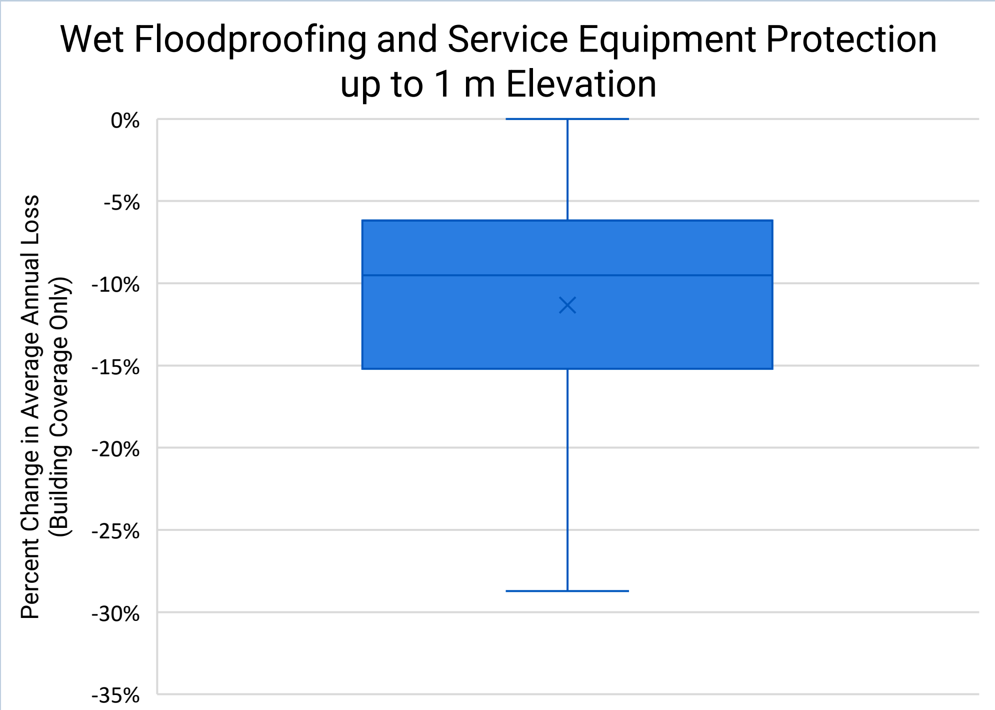


Figure: Range of building average annual loss (AAL) reduction when wet flood-proofing and service equipment protection of 1 m elevation is implemented (X indicates mean value, solid line is median).

5.4. SOCIAL RISKS AND IMPACTS FROM A PRUDENTIAL PERSPECTIVE

Table 36: Factors and Indicators for Assessing the Materiality of Social Risks and Impacts

Minimum Social Safeguards (based on the Taxonomy Regulation): • International Bill of Human Rights • Declaration of the International Labor Organisation on Fundamental Principles and Rights at Work • OECD Guidelines for Multinational Enterprises • UN Guiding Principles on Business and Human Rights

<table>
<tr>
<td>Workforce related social factors (own work force or value chain workers): working conditions and living standards (based on ESRS Annex I, S1-S4)

- Adequacy of remuneration
- Social security / secure employment
- Working time
- Work-life balance
- Health and safety
- Water and sanitation
- Training and development
- Equal opportunities/non-discrimination: Equality incl. gender equality and equal pay for equal work; Diversity incl. gender, race, age, disability, …; Measure against violence and harassment at the working place
- Other work-related: freedom of association and collective bargaining, social dialogue, child labour forced, labour, privacy, adequate housing</td>
<td>Community related social factors (directly or through the value chain): economic, social, cultural, civil and political rights (based on ESRS Annex I, S1-S4)

- <u>Economic, social and cultural rights</u>: adequate housing, adequate food, water and sanitation, land-related impacts, security
- <u>Civil and political rights</u>: freedom of expression, freedom of assembly, human rights defence
- <u>Particular rights of certain (indigenous) communities</u>: free, prior and informed consent, freedom of expression, cultural rights</td>
<td>Consumers / end-user related social factors: information, personal safety and social inclusion (based on ESRS Annex I, S1-S4)

- <u>Information</u>: privacy, freedom of expression, access to (quality) information
- <u>Personal safety</u>: health and safety, security of person, protection of children
- <u>Social inclusion</u>: non-discrimination, equal access to products and services, responsible marketing practice</td>
</tr>
<tr>
<td colspan="3"><u>Indicator(s) of adverse impacts to minimum social safeguards (based on SFDR mandatory indicators [137]):</u>
Violations of /lack of processes and compliance mechanisms to monitor compliance with OECD Guidelines for Multinational Enterprises or the UN Guiding principles including the principles and rights set out in the eight fundamental conventions identified in the ILO Declaration and the International Bill of Human Rights</td>
</tr>
<tr>
<td><u>Indicator(s) of adverse impacts on workforce (based on SFDR mandatory indicators)</u>

- Gender pay gap between female and male employees
- Lack of management and supervisory board gender diversity
- Share of employees of investee companies earning less than the adequate wage
- Interference in the formation of trade unions or elections of worker representatives</td>
<td><u>Indicator(s) of adverse impacts on communities (based on SFDR mandatory indicators):</u>

- For investments in sovereign bonds /supra-nationals: investee countries subject to social violations
- Amount of accumulated earnings in non - cooperative tax jurisdictions</td>
<td><u>Indicator(s) of adverse impacts on consumers / end users (based on SFDR mandatory indicators and reflected in ESRS Disclosure Requirement SBM-1 – Strategy, business model and value chain:</u>

- Exposure to companies involved in the cultivation and production of tobacco
- Exposure to controversial weapons</td>
</tr>
</table>

[137] As amended by the draft ESA RTS on the Review of SFDR Delegated Regulation regarding PAI and financial product disclosures, 12 April 2023. TBC with final RTS.

Other indicator(s) of adverse impacts on workforce (based on SFDR voluntary indicators) - Companies without workplace accident prevention policies or management systems - Rate of recordable work-related injuries - Number of days lost to work-related injuries, accidents, ill health and fatalities - Lack of a supplier code of conduct - Lack of grievance/complaints handling mechanism to report alleged cases of discrimination related to employee matters - Insufficient whistleblower protection - Incidents of discrimination and incidents of discrimination related to any type of discrimination leading to monetary and non-monetary sanctions in investee companies - Excessive CEO pay ratio - Excessive use of non-guaranteed-hour employees in investee companies - Excessive use of temporary contract employees - Excessive use of non-employee workers - Insufficient employment of persons with disabilities within the workforce	Other indicator(s) of adverse impacts on communities (based on SFDR voluntary indicators): - Lack of human rights policies - Lack of due diligence - Lack of processes and measures for preventing trafficking in human beings - Operations and suppliers using workforce qualifying as child labour - Operations and suppliers at significant risk of forced or compulsory labour - Number of identified cases of severe human rights issues and incidents - Lack of remediation mechanism for affected communities relating to the operations of the company Applicable to investments in sovereigns and supranationals: - Average income inequality score - Average freedom of expression score - Average human rights performance - Average corruption score	Other indicator(s) of adverse impacts on consumers / end users (based on SFDR voluntary indicators): - Lack of remediation handling mechanism for consumers/end-users of the company

Source: Own Table based on COM Delegated Regulation supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards (C(2023)5303 final), Annex 1; ESA Joint Consultation Paper on the Review of SFDR Delegated Regulation regarding PAI and financial product disclosures, 12 April 2023; PSF Social Taxonomy Report.

Table 37: Overview of EU Regulation with regard to Disclosure and Reporting on Social Risks and Factors

Non-financial reporting	The Non-Financial Reporting Directive (NFRD) requires certain large companies - including (re)insurers - to disclose information on the way they operate and manage social challenges, including the undertaking's development, performance, position and impact of its activity, relating to, as a minimum, social and employee matters, diversity on company

	boards, respect for human rights, anti-corruption and bribery matters – besides information on environmental issues.[138]
Corporate sustainability reporting	The Corporate Sustainability Reporting Directive (CSRD) amends the scope and existing reporting requirements under the NFRD, incl. on social risks, impacts and opportunities. [139] It clarifies the principle of double materiality, which requires companies to report information necessary to understand how sustainability matters affect them, and information necessary to understand the impact they have on investors, people and the environment. The EU Commission proposal for the European Sustainability Reporting Standards[140] specifies the disclosure requirements, including for social (ESRS S1-4). These include disclosure on general processes for engaging on actual and potential social impacts, remediating negative impacts and managing material risks. The disclosure includes are accompanied by targets and metrics.
Taxonomy reporting	The Taxonomy Regulation[141] introduces a classification system for environmentally sustainable economic activities and imposes reporting requirements for financial market participants', incl. (re)insurers within the scope of the NFRD, about the extent to which their activities are environmentally sustainable according to the Taxonomy. The regulation is in force since July 2020, and is being implemented by the Delegated Regulation on the disclosure of environmentally sustainable economic activities[142] (in force since Jan. 2022) and the Sustainable Finance Disclosure Regulation (in force since 10 March 2021)). ➢ In the absence of a 'social taxonomy', no reporting requirements exist on activities' compliance with a social taxonomy. ➢ The Taxonomy regulation requires however environmentally sustainable activities to comply with minimum social safeguards

[138] Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending Directive 2013/34/EU.

[139] Directive 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting.

[140] COM Delegated Regulation […/…] supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards (C(2023)5303 final).

[141] Regulation (EU) 202/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088.

[142] Commission Delegated Regulation (EU) 2021/2178 of 6 July 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by specifying the content and presentation of information to be disclosed by undertakings subject to Articles 19a or 29a of Directive 2013/34/EU concerning environmentally sustainable economic activities, and specifying the methodology to comply with that disclosure obligation.

<table>
<tr><td></td><td>(Article 18) in order to prevent them from harming fundamental human rights, workers' rights or principles of good governance (such as anti-bribery measures, for example).</td></tr>
<tr><td>Disclosure of sustainability information</td><td>The Sustainable Finance Disclosure Regulation governs how financial market participants, including (re)insurers should disclose sustainability, incl. social, information to end-investors and asset owners, at entity and product level.[143] This includes at entity level, information on sustainability risk policies, adverse sustainability impacts of investment decisions on sustainability factors, information on remuneration policies in relation to the integration of sustainability risks, and on the integration of sustainability risks in investment decisions and impact of sustainability risks on returns of financial products. It requires at product level the disclosure of sustainability characteristics or objectives of financial products.
➢ To date, the SFDR Delegated Regulation requires the disclosure of six mandatory principal adverse impact indicators related to social factors, covering violations of the UN Global Compact (UNGC) principles or the OECD guidelines for multinational enterprises (MNE), gender pay gap, board gender diversity, and exposure to controversial weapons. Additional/opt-in indicators are included in the delegated regulation.
➢ The ESAs have consulted on further principal adverse impact indicators, including on social impacts.[144]</td></tr>
<tr><td>Prudential supervisory reporting (QRT and RSR)</td><td>EIOPA has advised COM to integrate in the quantitative reporting requirements, the reporting on climate-change related risk to investments.[145]
➢ EIOPA has not advised COM yet to amend the Solvency II requirements for reporting on social risks in the quantitative reporting (incl. quantitative reporting templates, SRT) or supervisory reporting (Regular Supervisory Report, RSR).</td></tr>
<tr><td>Prudential disclosure (SFCR)</td><td>As part of its advice to COM on the Solvency II review, EIOPA proposed to include public disclosure requirements on sustainability risks, i.e., including social risks in the Solvency II Delegated Regulation as part of the Solvency and Financial Condition Report ('SFCR', proposed amendments</td></tr>
</table>

[143] EC (2022c).

[144] EIOPA (2022g).

[145] EIOPA (2022f).

	underlined). These proposals are being part of the ongoing negotiations on the Solvency II review.[146] ➢ **Article 293 - Business and performance** 2a. The solvency and financial condition report shall include qualitative and quantitative information regarding the consideration of Environmental, Social, and Governance factors in the underwriting policy of the insurance or reinsurance undertaking, and any activities related to the development of products and services which reduce sustainability risks and have a positive impact on environmental, social, and governance issues. 3. The solvency and financial condition report shall include all of the following qualitative and quantitative information regarding the performance of the investments […]; (d) information on the investment policy, including qualitative and quantitative information regarding the consideration of environmental, social, and governance factors in the investment policy of the undertaking and any stewardship activities related to the investees on account of Environmental, Social, and Governance issues. ➢ **Article 294 - System of governance** The solvency and financial condition report shall include all of the following information regarding the system of governance of the insurance or reinsurance undertaking: […]; (b) (i) principles of the remuneration policy, with an explanation of at least the relative importance of the fixed and variable components of remuneration and deferral of variable component and how the remuneration policy is consistent with the integration of sustainability risks. ➢ **Article 296 - Valuation for solvency purposes** 1. The solvency and financial condition report shall include separately for each material class of assets, following the classification as set out in the solvency balance sheet, the value of the assets, as well as a description of the bases, methods and main assumptions used for valuation for solvency purposes, including, where relevant, the consideration of sustainability risks and factors in the valuation methods. 3. Idem for technical provisions ➢ **Article 297 - Capital management and risk profile (ORSA)** […] 9. The solvency and financial condition report shall include information on how the undertaking has determined its own solvency

[146] EIOPA (2020b), Annex 7.2 – SFCR content proposal for the Delegated Regulation, as part of disclosure to 'other users'.

	needs given its risk profile, including the effect of sustainability risks, and how its capital management activities and its risk management system interact with each other.

Source: Own Table.

5.5. REFERENCES

2 Degrees Investing Initiative [2DII]: PACTA / Climate Scenario Analysis Program

Allianz (2020): Social Risk Index: Structural determinants of social risk

Bank of England [BoE] (2019): Insurance Stress Test 2019

Banque de France (2020): Climate-Related Scenarios for Financial Stability Assessment: An Application to France, Working Paper Series no. 774

Battiston, Mandel, Monasterolo, Schütze, and Visentin (2017): A Climate stress-test of the financial system, Nature Climate Change, 7(4), 283–288

Berenguer, Cardona, and Evain (2020): Integrating Climate-related Risks into Banks' Capital Requirements, I4CE (Institute for Climate Economics)

Berg, Kölbel, and Rigobon (2019): Aggregate Confusion: The Divergence of ESG Ratings, Discussion Paper [forthcoming Review of Finance]

BlackRock (2023): Lifting financial performance by investing in women

BlackRock (2020): Sustainable Investing: Resilience amid Uncertainty

Bolton and Kacperczyk (2021): Do investors care about carbon risk?, Journal of Financial Economics, 142(2), pp. 517-549

Breitenstein, Ciummo, Walch (2022): Disclosure of climate change risk in credit ratings, ECB Occasional Paper Series, No 303/September 2022

Bruxelles Environnement (2019): Stratégie de réduction de l'impact environnemental du bâti existant en région de Bruxelles-Capitale aux horizons 2030-2050

Carbone, Giuzio, Kapadia, Krämer, Nyholm, and Vozian (2021): The low-carbon transition, climate commitments and firm credit risk, ECB Working Paper Series, No. 2631, December 2021

Carroll, Denny and Lyons (2020): Better energy cost information changes household property investment decisions: Evidence from a nationwide experiment, Trinity Economics Papers, No. 1520

Copenhagen Economics (2015): Do homes with better energy efficiency ratings have higher house prices? – Econometric approach

Copiello and Donati (2021): Is investing in energy efficiency worth it? Evidence for substantial price premiums but limited profitability in the housing sector, Energy & Buildings 251

De Nederlandsche Bank [DNB] (2020): Real estate and climate transition risk, Occasional Studies Volume 19-4

De Nederlandsche Bank [DNB] (2018): An energy transition risk stress test for the financial system of the Netherlands, Occasional Studies Volume 16-7

Department of Communications, Climate Action & Environment (2019): Climate Action Plan 2019

Department of the Environment, Climate and Communications (2020): Residential Energy Efficiency

Energy Efficiency Data Protocol and Portal [EeDaPP] (2020): Final report on correlation analysis between energy efficiency and risk (D5.7)

Electric Power Research Institute [EPRI] (2021): How does a carbon price impact electricity prices?, Program 201 Back Pocket Insights

Euractiv (2020): This is the moment to renovate your buildings, EU tells member states

European Banking Authority [EBA] (2022): The Role of Environmental Risks in the Prudential Framework, Discussion Paper

European Central Bank [ECB] (2023): Climate-related financial disclosures of the Eurosystem's corporate sector holdings for monetary policy purposes, March 2023

European Central Bank [ECB] (2021a): ECB economy-wide climate stress test, Occasional Paper Series, No. 281, September 2021

European Central Bank [ECB] (2019): Financial Stability Review, May 2019 – Non-bank financial sector

European Commission [EC] (2023): Commission welcomes political agreement on new rules to boost energy performance of buildings across the EU

European Commission [EC] (2022a): Energy performance of buildings directive

European Commission [EC] (2022b): Overview of Sustainable Finance

European Commission [EC] (2022c): Sustainability-related disclosure in the financial services sector

European Commission [EC] (2021a): European Green Deal: Commission proposes to boost renovation and decarbonisation of buildings

European Commission [EC] (2021b): Energy efficiency – Revision of the Energy Performance of Buildings Directive

European Insurance and Occupational Pensions Authority [EIOPA] (2023a): Impact Underwriting - Report on the Implementation of ClimateRelated Adaptation Measures in Non-Life Underwriting Practices

European Insurance and Occupational Pensions Authority [EIOPA] (2023b): Dashboard on insurance protection gap for natural catastrophes

European Insurance and Occupational Pensions Authority [EIOPA] (2023c): Supervisory statement on differential pricing practices in non-life insurance lines of business

European Insurance and Occupational Pensions Authority [EIOPA] (2023d): Consultation on the Prudential Treatment of Sustainability RisksEuropean Insurance and Occupational Pensions Authority [EIOPA] (2022a): Discussion paper on physical climate change risks

European Insurance and Occupational Pensions Authority [EIOPA] (2022b): Application guidance on climate change materiality assessments and climate change scenarios in ORSA

European Insurance and Occupational Pensions Authority [EIOPA] (2022c): Methodological Principles of Insurance Stress Testing – Climate Change Component

European Insurance and Occupational Pensions Authority [EIOPA] (2022d): Climate stress test for the occupational pensions sector 2022

European Insurance and Occupational Pensions Authority [EIOPA] (2022e): Technical Specifications: Data Collection on the Prudential Treatment of Climate-Related Adaptation Measures in Non-Life Insurance

European Insurance and Occupational Pensions Authority [EIOPA] (2022f): Draft Amended Implementing Technical Standards (ITS) on supervisory reporting and disclosure

European Insurance and Occupational Pensions Authority [EIOPA] (2022g): Mandate to the ESAs to develop SFDR regulatory technical standards on principal adverse impacts indicators

European Insurance and Occupational Pensions Authority [EIOPA] (2022h): Supervisory statement on exclusions in insurance products related to risks arising from systemic events

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

European Insurance and Occupational Pensions Authority [EIOPA] (2021b): Methodological paper on potential inclusion of climate change in the Nat Cat standard formula

European Insurance and Occupational Pensions Authority [EIOPA] (2020a): Sensitivity analysis of climate-change related transition risks: EIOPA's first assessment

European Insurance and Occupational Pensions Authority [EIOPA] (2020b): Background Document on the Opinion on the 2020 Review of Solvency II

European Insurance and Occupational Pensions Authority [EIOPA] (2019): Technical advice on the integration of sustainability risks and factors in Solvency II and the Insurance Distribution Directive

European Insurance and Occupational Pensions Authority [EIOPA] (2014): The underlying assumptions in the standard formula for the Solvency Capital Requirement calculation

European Securities and Markets Authority [ESMA] (2024): Consultation Paper on the Proposed Revisions to Commission Delegated Regulation (EU) 447/2012 and Annex I of CRA Regulation

European Securities and Markets Authority [ESMA] (2022): Text mining ESG disclosures in rating agency press releases

European Systemic Risk Board [ESRB] (2024): ESRB advice to EIOPA on the prudential treatment of environmental and social risks

European Systemic Risk Board [ESRB] (2023): ESRB advice on the prudential treatment of environmental and social risks

European Systemic Risk Board [ESRB] (2022): Climate scenario for the European Insurance and Occupational Pensions Authority's EU-wide pension fund stress test in 2022

European Systemic Risk Board [ESRB] (2021): Climate-related risk and financial stability, July 2021

Eurostat (2022): Development of electricity prices for household consumers, EU, 2008-2021 (EUR per kWh)

Eurostat (2021): Housing in Europe, 2021 Interactive Edition

Federal Government of Germany (2020): Effectively reducing CO2 emissions

French Government (2021): Interdiction à la location des logements avec une forte consommation d'énergie dès 2023

Garcia-Casarejos, Gargallo, and Carroquino (2018): Introduction of Renewable Energy in the Spanish Wine Sector, Sustainability

Geneva Association (2022): The Role of Insurance in Promoting Social Sustainability

German Insurance Association [GDV] (2023): Climate Change Scenarios in ORSA, March 2023

Guin, Korhonen, and Moktan (2022): Risk differentials between green and brown assets?, Economics Letters, Volume 213

Heijmans and Loncour (2019), Impact of the EPC on the property value, Belgian Building Research Institute

Henger and Voigtländer (2014), Transaktions- und Angebotsdaten von Wohnimmobilien – eine Analyse für Hamburg, IW-Trends Nr. 4

Hudson, Botzen, Feyen, and Aerts (2016): Incentivising flood risk adaptation through risk based insurance premiums: Trade-offs between affordability and risk reduction, Ecological Economics 125, pp. 1-13

Ilhan, Sautner, and Vilkov (2021): Carbon Tail Risk, The Review of Financial Studies, 34(3), pp. 1540–1571

Institute for Energy Economics and Financial Analysis [IEEFA] (2023): Can credit rating assessments and sustainability coexist?

Intergovernmental Panel on Climate Change [IPCC] (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability

Intergovernmental Panel on Climate Change [IPCC] (2021): Climate Change 2021: The Physical Science Basis

Intergovernmental Panel on Climate Change [IPCC] (2018): Summary for Policymakers, in: Global Warming of 1.5°C

International Association of Insurance Supervisors [IAIS] (2021): The impact of climate change on the financial stability of the insurance sector, Global Insurance Market Report, GIMAR special topic edition

International Energy Agency [IEA] (2023): Oil and gas industry faces moment of truth – and opportunity to adapt – as clean energy transitions advance

International Energy Agency [IEA] (2022): Household savings

Kreibich, Christenberger, and Schwarze (2011): Economic motivation of households to undertake private precautionary measures against floods, Nat. Hazards Earth Syst. Sci., 11, 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, Nat. Hazards Earth Syst. Sci., 5, 117–126

Landry, Bienert, Schneider, Noach, and Linthorst (2023): Accounting and Reporting of GHG Emissions from Real Estate Operations. Technical Guidance for the Financial Industry VERSION 1.0 - MARCH 2023.

Le Monde (2023): Immobilier : les nouvelles mesures contre les passoires thermiques bousculent le marché

L'Autorité de contrôle prudentiel et de résolution [ACPR] (2021): A first assessment of financial risks stemming from climate change: The main results of the 2020 climate pilot exercise

L'Autorité de contrôle prudentiel et de résolution [ACPR] (2020): Scenarios and main assumption of the ACPR pilot climate exercise

L'Institut Paris Region (2022): Sans travaux de rénovation énergétique, près d'un logement francilien sur deux bientôt interdit à la location

Ministère de la Transition écologique et de la Cohésion des territoires (2022): LE PARC DE LOGEMENTS PAR CLASSE DE PERFORMANCE ÉNERGÉTIQUE AU 1ER JANVIER 2022

MSCI (2022): The Global Industry Classification Standard (GICS)

Netherlands Enterprise Agency (2022): Building regulations in the Netherlands

Network for Greening the Financial System [NGFS] (2022a): Final report on bridging data gaps

Network for Greening the Financial System [NGFS] (2022b): Capturing risk differentials from climate-related risks

Network for Greening the Financial System [NGFS] (2021): NGFS Climate Scenarios for central banks and supervisors, June 2021

Notaires de France (2022): Performance énergétique : la valeur verte des logements

O'Connor and Labowitz (2017): Putting the "S" in ESG: Measuring Human Rights Performance for Investors, NYU Stern Center for Business and Human Rights

Organisation for Economic Co-operation and Development [OECD] (2023): Enhancing the insurance sectors contribution to climate change adaptation

Organisation for Economic Co-operation and Development [OECD] (2021): Challenges of ESG data

Platform on Sustainable Finance [PSF] (2022a): The Extended Environmental Taxonomy: Final Report on Taxonomy extension options supporting a sustainable transition, March 2022

Platform on Sustainable Finance [PSF] (2022b): Final Report on Social Taxonomy

Principles for Sustainable Investing [PSI] (2022): ESG Underwriting Guide for Life & Health Insurance (Version 1.0), Managing environmental, social and governance risks in life & health insurance business

Reusens, Vastmans, and Damen (2022): The impact of changes in dwelling characteristics and housing preferences on Belgian house prices, NBB Economic Review 2022/02

RWI and ImmobilienScout24 (2022): RWI-GEO-RED: RWI Real Estate Data (Scientific Use File) – houses for sale. Version: 6.1. RWI – Leibniz Institute for Economic Research. Dataset. http://doi.org/10.7807/immo:red:hk:suf:v6.1

SEI, IISD, ODI, UNEP (2021): The Production Gap Report 2021

Sunderland and Santini (2020): Case studies: Minimum energy performance standards for European buildings

Taruttis and Weber (2022): Estimating the impact of energy efficiency on housing prices in Germany: Does regional disparity matter?, Energy Economics, Volume 105, January 2022

Teske, Niklas, Nagrath, Talwar, Atherton, and Guerrero Orbe (2020): Limit global warming to 1.5 Degrees, Report prepared by the University of Technology Sydney for the UN-convened Net Zero Asset Owners Alliance

The World Bank (2023a): World Development Indicators

The World Bank (2023b): Gini Index

United Nations (2022): The Sustainable Development Goals Report 2022

United Nations Development Programme [UN DP] (2023): Human Development Index (HDI)

United Nations Environment Programme – Finance Initiative [UNEP FI] (2023): Climate Risks in the Real Estate Sector

United Nations Environment Programme – Finance Initiative [UNEP FI] (2022): Managing environmental, social and governance risks in life & health insurance business

United Nations Environment Programme [UNEP] (2021): Emissions Gap Report 2021

United Nations Framework Convention on Climate Change [UN FCCC] (2022): Nationally determined contributions under the Paris Agreement - Synthesis report by the secretariat

United Nations Global Compact (2023): Business & Human Rights Navigator

UN Global Compact (2015): NEW GLOBAL GOALS FOR SUSTAINABLE DEVELOPMENT

Van Tendeloo (2020): Climate-change-related transition risk associated with real estate exposures in the Belgian financial sector, in National Bank of Belgium Financial Stability Report

Zancanella, Bertoldi, and Boza-Kiss (2018): Energy efficiency, the value of buildings and the payment default risk, Joint Research Center

Zhou and Haurin (2010): On the Determinants of House Value Volatility, The Journal of Real Estate Research, 32(4), pp. 377-396

EIOPA

Westhafen Tower, Westhafenplatz 1
60327 Frankfurt – Germany
Tel. + 49 69-951119-20
info@eiopa.europa.eu
https://www.eiopa.europa.eu