BANK OF ENGLAND
PRUDENTIAL REGULATION
AUTHORITY

Life Insurance Stress Test 2019

Scenario Specification, Guidelines and Instructions

FINAL

18 June 2019

Prudential Regulation Authority | 20 Moorgate | London EC2R 6DA

Contents

INTRODUCTION

This document provides instructions for completing the life insurance stress tests, as well as details of additional data designed to assist the PRA in monitoring sector risks. The stress tests and the additional data collection are collectively referred to as the PRA's Life Insurance Stress Test ('LIST 2019').

In 2015 and 2017, the PRA conducted stress testing exercises for general insurers. This year, we will be running a stress test exercise for life insurers concurrently with the exercise for general insurers.

The PRA requests that firms complete the Excel workbook 'LIST 2019 Template.xls' ('LIST Template') to record the numerical results of each stress test and provide the additional qualitative information requested. There is a contents tab in the spreadsheet and this is repeated in Annexe III of these instructions.

PLEASE DO NOT AMEND THE SPREADSHEET. This includes moving information around, inserting or deleting rows or columns. If firms do amend the spreadsheet they will be asked to resubmit information using the original spreadsheet provided.

OBJECTIVES

The PRA's objective in conducting this exercise is to inform our view of sector risks, and it will assist in the supervision of individual firms. For clarity, this is not a pass/fail exercise and it is not designed to set capital buffers.

OBJECTIVES: INSURANCE STRESS TESTING		
Sectoral	**Sector resilience**	Assess losses across the UK insurance industry to severe but conceivable scenarios to inform PRA's view of sector resilience.
	Systemic risks/ Sectoral behaviours	Assist in understanding the extent to which individual firms make business decisions that are appropriate for the firm but, taken across the entire sector, may result in strongly adverse outcomes (eg all switching into one asset class).
	Counterparty dependencies	Identify the extent to which the sector relies on a concentration of reinsurers and/or jurisdictions following an extreme scenario.
	Exploratory risks/ horizon scanning	Assist in exploring and raising industry debate around emerging risks to understand how firms are responding eg in relation to climate change or cyber risks.
Firm supervisory	**Effectiveness of risk management**	Provide an alternative view of balance sheet volatility to specified scenarios that inform our view of how firms are managing their exposures and whether this is in line with their risk appetite.
	View on capital	The PRA stress testing is not used for setting capital, It provides a complementary view on a firm's capital assessment with potential for identifying assumptions or approaches that are optimistic. *Note: The severity of some scenarios may be beyond a firm's one-year change in Own Funds at the 1 in 200 level. Further, one scenario is a reverse stress test intended to identify the point at which the SCR coverage ratio falls below 100%.*
	Assessment of modelling approaches	Assist in understanding how different firms address technical challenges in their assessment of extreme loss events eg severe adverse economic conditions affecting ring-fenced funds.

SCOPE OF EXERCISE

The PRA requests that only life insurers with a significant exposure to annuity products participate in the 2019 stress test.

Where firms have not received a request to participate, they do not need to submit a response. Should life insurance firms wish to be included in the exercise, they should contact their supervisor at the PRA, copying in IST2019@bankofengland.co.uk.

STRUCTURE OF THE LIFE INSURANCE STRESS TEST

This exercise consists of two parts:

1. Sections A and B contain the core stress tests: a downturn in the economic environment, and a set of three life insurance specific scenarios.
2. Section C is not a stress test; instead it is designed to capture information on how different firms are managing difficult-to-assess risks. For life insurers it comprises a climate change exploratory exercise.

Firms are requested to assess their year-end 2018 balance sheet against the following scenarios.

Section A: Deterioration in the economic environment

Scenario 1: A parallel downward shift in risk free interest rates of 100 bps; a widening in corporate bond spreads dependent on their current credit rating (eg 150bps for AAA rated assets); a simultaneous mass downgrade of credit assets; and a fall in other asset values (including equities down 30%, commercial property down 40% and residential property down 30%).

Section B: Deterioration in the economic environment coupled with life insurance specific scenarios

Scenario 2: Scenario 1 plus an additional stress to the assumed Fundamental Spread dependent on credit quality step (eg a 30 bps increase for those assets mapped to a CQS of 2).

Scenario 3: Scenario 1 plus an increase in longevity expectations represented by a 15% fall in base mortality rates. Please note that the longevity stress is only applied to business subject to longevity risk (and so we would not expect this to apply to protection business).

Scenario 4: Scenario 1 plus firms are requested to provide details of what level of percentage fall in the base mortality table for business subject to longevity risk would result in a SCR coverage ratio of 100% (i.e. a reverse stress test).

***Note: The PRA has designed these stress tests, including all parameters and calibrations, for the purpose of this stress testing exercise only. Firms should not interpret them as indicators of a PRA position on risk calibrations or interactions*.**

Section C: Climate change scenario

This section is exploratory in nature and designed to capture information to help understand how different firms are managing difficult-to-assess risks – in this case climate change related risks. We expect that market feedback will enhance developments in this area, increase Board awareness, and will supplement supervisor's knowledge of the firms' overall governance and culture. These findings will also support the climate related activity of the Bank's Climate Hub in assisting the Network for Greening the Financial System (NGFS).

Climate Change: firms are requested to consider the impact of three hypothetical greenhouse emission scenarios on selected metrics of their business models and asset valuations. These scenarios are expressed by their climatic and financial impacts. The set of assumptions underlying each scenario is developed based on our interpretation of available literature and is provided to ensure that firms complete the return on the same basis. Therefore, the set of assumptions presented should not be taken as a precedent for future domestic or international exercises. **The assumptions in Section C do not represent a PRA forecast neither do they represent scenarios that have been built bottom-up by the PRA based on a view of future carbon price.**

We also ask firms to provide qualitative and quantitative information on any climate scenarios that the firms have already developed.

Section C is on a best endeavours basis.

ACCOUNTING AND REPORTING

Accounting Basis

Firms are requested to provide a separate submission, on a Solvency II basis, for each UK solo legal entity within the scope of the exercise. Where firms are uncertain as to the scope of their submission, they should consult with and obtain the agreement of their PRA supervisor.

Opening Balance Sheet

Firms are required to provide their Balance Sheet as at year-end 2018, their Solvency Capital Requirement (SCR) and their available Own Funds to meet the SCR. The LIST Template provides the necessary Solvency II QRT references, where relevant.

Production of the Balance Sheet following each scenario

Life Insurance firms are asked to stress their year-end 2018 balance sheet and provide a breakdown of Own Funds, SCR and SCR coverage ratios, assuming the stress is an instantaneous shock.

Firms are asked to estimate how their SCR would change in the event of each stress, providing a breakdown between the different categories of risk. Firms are not expected to recalculate the biting scenario or re-parameterise their SCR calculation post-stress (i.e. if the strength of 99.5 percentile equity stress is currently –x%, then firms may assume the 99.5 percentile equity stress is –x% post-stress).

Firms may make reasonable assumptions in estimating the SCR and risk margin post stress. Scaling is acceptable where it would not lead to materially different results to a recalculation. Where use is made of proxy models (for example extrapolating proxy models), firms should provide proportionate validation of the post-stress SCR.

The presentation of the SCR results in stress can be provided in one of two ways depending on the level of granularity available. For the firms that can, we ask them to present the results pre-diversification and showing the effect of diversification separately. Where firms cannot do this we have provided an alternate SCR tab which provides a breakdown of SCR by risk post-diversification. If firms complete this alternate SCR tab we ask firms to complete both versions of the SCR tab in base (i.e. both the tab showing pre-diversification risk and diversification separately and the tab showing risk post-diversification).

Firms should expect to take a proportionate approach in calculating post-stress Risk Margin and TMTP but should set out clearly what they have done.

It should be noted that the PRA expects firms to complete this exercise on a ‘best endeavours’ basis and to provide a reasonable estimate of Own Funds, SCR and SCR coverage numbers after each stress scenario. However, we do not expect that firms should use proxy models to estimate the post-stress balance sheet position (i.e. this should be a ‘bottom up’ exercise).If firms do use proxy models to estimate the post-stress balance sheet, they should provide evidence that the proxy model works in the particular area of the risk space for each scenario, as well as demonstrating that (a) the proxy model is capable of modelling the scenario as specified and (b) that material elements of the balance sheet move in a way that is consistent with a more detailed bottom-up calculation.

Management actions

Firms should disclose what management actions they anticipate taking in the various scenarios and how this would impact their Own Funds and estimated SCR.

Non-exhaustively, management actions might include changes to asset allocation, changes to reinsurance programmes, and re-capitalisation plans.

For the purposes of this exercise, firms should only incorporate within the stressed balance sheet those management actions which are anticipated within their SCR calculation.

Some firms may find that they have insufficient management actions within their SCR calculation to restore compliance with MA requirements post-stress. In this case, firms should seek to remove liabilities from the MA portfolio fund so that an MA compliant position can be achieved prior to determining the post-stress SCR. The balance sheet position should be shown post this action, but where this action is taken, firms should clearly set this out and provide details including quantitative information as to the impact of the action. The post-stress SCR should be based on the MA compliant position.

Where firms consider management actions over and above those already anticipated within the SCR calculation these should be practical actions which could be taken following the specified scenario. The impact of the stress pre-management action and post-management action on both the stressed balance sheet and stressed SCR should be provided. We ask that consideration is given as to the timeframe that such actions could be implemented (within 2 months, 2-6 months or beyond 6 months).

Please note that for the purpose of this exercise, firms should not assume any management actions (even if they are allowed for in the SCR calculation) which restore the credit quality of individual assets, within the results presented. Where firms do assume such management actions, these should be included in the 'additional management actions not included within results' part of the template (Scenario Mgmt Act Detail tab).

Materiality

Firms should complete all parts of the template. If firms can demonstrate that, given their specific risk coverage, the impact of any of the scenarios in section B relative to scenario A1 is immaterial, then they may, if agreed with their PRA supervisor, omit templates relating to those particular scenarios.

Firms should include details of exposures to each reinsurer relating to business within the MA fund where the value of the reinsurance asset is more than 5% of the (gross) MA fund Best Estimate Liability (either in base or stress).

Internal Models (IM)

Firms with an approved IM need only provide the IM SCR view. For firms in IMAP and likely to make an IM application before year-end 2019, firms should agree with their Supervisor the basis/bases on which results should be presented. For all other firms on the Standard Formula, including firms intending to make an IM application after 2019, the SCR should be based on the Standard Formula.

Reporting of Ring Fenced Funds

In the LIST Template, the PRA asks firms to provide details of the Balance Sheet, Own Funds, Long Term Guarantee impacts and SCR using the QRT format for the base case and under each scenario. The PRA requests that firms add additional columns to each tab to separate out the reporting of material ring-fenced funds. This is to allow more granular analysis of the stress impacts on each fund. Firms should add an additional column for each material ring-fenced fund, with one column for non-modelled ring-fenced funds and one column for the remainder of the business. The sum of these columns should equal the reported SII value for each QRT once ring-fencing restrictions are taken into account.

PROCESS AND FEEDBACK

Submission template

For each stress scenario, firms are required to submit a number of outputs that are standard across scenarios within the Excel template provided – the LIST Template.

In certain scenarios, we ask for additional information that will allow the PRA to assess the calculation and impact of each stress in greater detail.

Deadline for submission

Submission of Sections A and B of the Excel template is required by **17:00 on Monday 30 September 2019**.

Submission of Section C of the Excel template is required by **17:00 on Thursday 31 October 2019**.

The Excel workbook should contain the **Firm Name** and **FRN number** in the file name and the subject of the email. Firms should send submissions to **IST2019@bankofengland.co.uk.**

Governance requirements

On submission, Senior Management is required to confirm they are satisfied with the submission and that the information provides a reasonable estimate of own funds and their SCR after each stress scenario. The results do not need to be audited.

Please include a covering email on submission to confirm that "senior management are satisfied with the submission and that the information provides a reasonable estimate of own funds and the SCR after each stress scenario".

Presentation of the Stress Test results to the PRA

The PRA encourages firms to present their stress test results shortly after the formal submission date to help our understanding of the impact of the stresses and any issues that arose in completing this exercise. This need not contain any additional information, but reflects the value of a two-way dialogue to help understand the thought process and the underlying issues in greater depth. Following our previous stress test exercise, some firms shared their Board presentations – these were very constructive in supporting our understanding of their stress test results.

Resubmissions

Individual firm supervisors will be using the stress test submission as part of their ongoing supervisory reviews and the stress test results will inform the firm's supervisory risk score.

Firms should ensure that the quantitative and qualitative information provided is clear and sufficient. Where this is not the case, the PRA will ask for a resubmission to enable it to make an adequate assessment. Firms will need to provide a resubmission within 2 weeks of request.

Public Disclosure

The PRA will not publish any firm specific information as part of this exercise. Where there is a need to take firm specific supervisory action, the PRA will do so as part of our normal supervisory engagement with the firm.

The PRA intends to publish a Dear CEO letter containing our findings at an aggregate level during Q1 2020, drawing attention to sectoral findings or learnings of interest at a market level.

Queries

Firms should submit all queries to **IST2019@bankofengland.co.uk**, copying in the firm's PRA supervisor. Please ensure that the Firm Name and FRN number is included in the subject of the email.

ENCLOSURES

a) **LIST 2019 Template.xls** to record results

SCENARIO SPECIFICATION

This section outlines the details of the scenarios for Life insurance firms. The 'Event Definition' outlines the movements in key macroeconomic variables and market indices in each scenario. Further detail is included in sections on 'Assumptions' and 'Reporting' to outline to firms how to apply the stresses.

SECTION A

SCENARIO 1: INSURANCE ASSET SHOCK (IAS)

This asset shock has been designed to stress both life insurance and general insurance companies, with a fall in interest rates and risk free yield curves, a widening of corporate bond spreads coupled with a downgrade event, and falls in equity markets and real estate.

Event Definition

This section sets out the movements in key macroeconomic variables or market indices. Note that the stresses apply to all economies.

<table>
<tr><td><u>Interest rates</u></td><td>All interest rate spot curves experience a 100bps absolute fall at all tenors (including the Ultimate Forward Rate).

This stress is likely to lead to negative rates at shorter durations. Where this is the case, and firms have the capability to model negative rates they should do so. For firms without the capability to model negative rates, these should be floored at zero, but this should be made clear in the response and firms should attempt to quantify on a best efforts basis the impact were negative rates modelled explicitly.

The interest rate stresses should also apply to all assets whose valuation is interest rate sensitive in addition to the stresses outlined below (eg derivatives, corporate bonds, illiquid assets).</td></tr>
<tr><td><u>Gilt-swap spread</u></td><td>Firms should assume that there is no stress to gilt-swap spreads.</td></tr>
<tr><td><u>Sovereign and Central Bank Bonds, Government Guaranteed Bonds and Supranationals</u></td><td>Firms should assume that there is no credit downgrade/spread stress to sovereign assets. For the avoidance of doubt, firms should apply the interest rate stresses above to sovereign assets.</td></tr>
<tr><td><u>Credit Spreads</u></td><td>For fixed income assets, firms should apply the following stresses to credit spreads. For avoidance of doubt, the credit rating and Credit Quality Step (CQS) referred to in the table below is the pre-stress rating/CQS.

<table>
<tr><th>Credit Rating (non-MA fund)</th><th>Credit Quality Step (MA fund)</th><th>Credit Spread increase</th></tr>
<tr><td>AAA</td><td>0</td><td>150bps</td></tr>
<tr><td>AA</td><td>1</td><td>170bps</td></tr>
<tr><td>A</td><td>2</td><td>200bps</td></tr>
<tr><td>BBB</td><td>3</td><td>300bps</td></tr>
<tr><td>BB and lower and unrated</td><td>4+</td><td>400bps</td></tr>
</table>

The credit spread increase will apply to all types of bonds that do not qualify as 'sovereign' and does not vary by duration or sector.</td></tr>
</table>

Credit Downgrades	For Central Government and Central Bank bonds, firms should assume that the Credit Quality Step (CQS) remains unchanged post stress. For all other assets, firms should assume that 50% of each asset experiences a 1 CQS downgrade and the remaining 50% of each asset experiences no movement in credit rating. For avoidance of doubt, all assets should be notionally split into 50%/50% parts.
Equities	All equities experience a **30% decrease in value**. This applies to public and private equity, hedge funds and CIS investments.
Property	Firms should assume a **40% fall in commercial property** and **30% fall in residential property**.
Cash and Money Market Instruments	Firms should assume **no stress** to the value of cash or money market instruments with duration less than one year. For instruments with duration more than one year these should be treated as described under '*All other assets*' below. Firms should not assume any management actions post-stress including entering into new money market transactions.
Derivatives	Option values should move in line with an increase in implied volatility at all tenors and moneyness of **700bps**. This includes, but is not limited to, equity and swaption implied volatility. Swap values should move in line with a decrease in the floating yield curve of 100bps at all tenors (ie the interest rate stress). Where relevant, firms should assume that reference swap assets also fall in value in line with the relevant stress outlined in the asset shock scenario. Firms should assume that CDS derivatives change in value in a way that is consistent with changes to the reference underlying assets. The approach taken for significant CDS positions should be set out and validated by firms. In doing so firms should consider the anticipated credit quality of the swap counterparty following the stress if the derivative is not centrally cleared. *Longevity-linked instrument values should move as if floating longevity expectations matched the extent to which longevity is stressed (this is applicable only in scenarios 3 and 4).*
Inflation	Firms should assume that there is **no stress** to inflation rates.
Foreign exchange	Firms should assume that there is **no stress** to foreign exchange rates.

All other assets	Any investment asset not specifically referenced should be stressed as if it were a corporate bond (ie apply the **credit spread** and **interest rate** stresses above) where it is sensible to do so (ie the assets have a contractual cash flow profile and are either mapped to a CQS or have a credit rating). Where this is not possible, all other assets should experience a **30% value fall** as for equities. This is to ensure that all assets held by firms (other than cash) experience some form of stress. This should include investments in subsidiaries where the firm does not intend to 'look through'.
Fundamental Spread	Firms should use the relevant EIOPA Fundamental Spread (FS) based on the Financial/Non-Financial sector and revised Credit Quality Step of the asset post-stress. Firms should assume there is no change to the EIOPA FS tables at the stress date. Firms should assume the Long Term Average Spread (LTAS) floor component of FS is unchanged following the stress event.

SECTION B

SCENARIO 2: INSURANCE ASSET SHOCK (IAS) WITH FUNDAMENTAL SPREAD INCREASE

This scenario assumes that the economic downturn specified in Scenario 1 occurs with a simultaneous increase in assumed Fundamental Spreads. This is intended to represent that in stressed conditions as outlined in Scenario 1, the way Fundamental Spreads are derived are reassessed and a more pessimistic view is taken.

Event Definition

This section sets out the movements in key macroeconomic variables or market indices.

Firms should assume the changes to macroeconomic variables or market indices as set out in Scenario 1 above, plus:

<table>
<tr>
<td><u>Fundamental Spread</u></td>
<td>Apart from Central Government and Central Bank bonds (where firms should apply no stress to the EIOPA Fundamental Spread), firms should apply the following stresses to the EIOPA base FS tables:

For avoidance of doubt, the Credit Quality Step (CQS) referred to in the table below is the post-stress CQS.

<table>
<tr><th>Credit Quality Step (MA fund)</th><th>Fundamental Spread increase</th></tr>
<tr><td>0</td><td>10bps</td></tr>
<tr><td>1</td><td>20bps</td></tr>
<tr><td>2</td><td>30bps</td></tr>
<tr><td>3</td><td>30bps</td></tr>
<tr><td>4+</td><td>30bps</td></tr>
</table>

The same specified bps increase in FS should apply to all asset classes in the MA calculation post-stress. These increases in FS should be applied to all durations, with the same increase in FS applying to Financial and Non-Financial assets.

The assumed increase in FS should be split evenly between Probability of Default and Cost of Downgrade at all tenors.

Firms should assume that The Long Term Average Spread (LTAS) floor component of FS is unchanged following the stress event.</td>
</tr>
</table>

SCENARIO 3: INSURANCE ASSET SHOCK (IAS) AND LONGEVITY EVENT

This scenario assumes that the economic downturn specified in Scenario 1 occurs with a simultaneous increase in longevity expectations.

Event Definition

This section sets out the movements in key macroeconomic variables, market indices and demographic assumptions.

Firms should assume the changes to macroeconomic variables or market indices as set out in Scenario 1 above, plus:

Longevity	Firms should assume a **15% fall** in the base mortality table. There should be no change to mortality improvement assumptions.

For the avoidance of doubt, firms should not assume the increase in fundamental spreads set out in Scenario 2.

SCENARIO 4: INSURANCE ASSET SHOCK (IAS) AND LONGEVITY EVENT (REVERSE STRESS)

This scenario is a form of a reverse stress test and an extension of Scenario 3. Firms with SCR coverage at or below 100% after applying the previous scenario are not required to complete this scenario. Firms are requested to provide details of what level of percentage fall in the base mortality table would result in a SCR coverage ratio after the stress of 100%. This should be done on a best endeavours basis.

Event Definition

This section sets out the movements in key macroeconomic variables, market indices and demographic assumptions.

Firms should assume the changes to macroeconomic variables or market indices as set out in Scenario 1 above, plus:

Longevity	Firms should assume an **X% fall** in the base mortality table. There should be no change to mortality improvement assumptions. The fall in base mortality table should be estimated such that a fall of X% results in a SCR coverage ratio after the stress of 100%.

For the avoidance of doubt, firms should not assume the increase in fundamental spreads set out in Scenario 2.

ASSUMPTIONS

This section details assumptions that firms should make in relation to Matching Adjustment (MA), Volatility Adjustment (VA), Transitional Measures on Technical Provisions (TMTPs), Equity Release Mortgages (ERMs), other assets in the Matching Adjustment Portfolio (MAP) and Defined Benefit (DB) Pension Schemes. The details outlined in this section apply to all scenarios in Sections A and B above.

Matching Adjustment

Firms should calculate the Matching Adjustment (MA) assuming that asset values/spreads/CQS have experienced the stresses outlined above.

Firms should attempt to restore the asset and liability cash flow matching of their MA portfolio following the stress; so long as any assumed rebalancing actions are practical to be implemented in a post-stress environment within a 2-month time window. For the purpose of this exercise, firms should only incorporate within the stressed balance sheet those management actions which are anticipated within their SCR calculation.

Please note that for the purpose of this exercise firms should not assume any management actions (even if they are allowed for in the SCR calculation) which restore the credit quality of individual assets, within the results presented. Where firms do assume such management actions, these should be included in the 'Additional management actions not included within results' part of the template (Scenario Mgmt Act Detail tab).

Some firms may find that they have insufficient management actions within their SCR calculation to restore compliance with MA requirements post-stress. In this case, firms should seek to remove liabilities from the MA portfolio so that an MA compliant position can be achieved prior to determining the post-stress SCR. The balance sheet position should be shown post this action, but where this action is taken, firms should clearly set this out and provide details including quantitative information as to the impact of the action. The post-stress SCR should be based on the MA compliant position. Firms should be confident of meeting its own matching criteria post-stress, post-management actions (on a best efforts basis).

Firms should consider the potential lack of availability of post-stress investment grade fixed income assets in each scenario. Firms should not assume that they would be able to sell current holdings of illiquid assets, or purchase new illiquid assets, within the 2-month time window.

The BBB cap should continue to apply for the purposes of calculating technical provisions following the stress, consistent with Article 77c(1)(c) of the Directive (i.e. firms should limit the MA benefit obtained on lower credit quality assets to that obtained on similar BBB assets). Firms should estimate the impact of applying the BBB cap to their downgraded portfolio in determining technical provisions and set this out clearly in their response.

Where firms assume that liabilities are removed, but in practice would take alternative management actions instead of removing liabilities from the MAP to comply with MA requirements, firms may outline these management actions in their response. These management actions should be in line with the expectations set out in SS8/18[1]. If possible, firms should provide the balance sheet impact of assuming these management actions as additional information. For the avoidance of doubt, these alternative management actions should not be incorporated into the stressed balance sheet.

Separately, firms should provide as a sensitivity the estimated impact on their (stressed) balance sheet if the only assets they could purchase externally for the purpose of restoring their asset liability matching of the MA portfolio were gilts (scenario A1 only).

[1] https://www.bankofengland.co.uk/prudential-regulation/publication/2018/solvency-2-internal-models-modelling-of-the-matching-adjustment-ss

Volatility Adjustment

Firms should assume that the Volatility Adjustment increases by **20bps** after the stress.

TMTP

Firms should assume that they will successfully apply for a TMTP recalculation following the stress event as long as that is in line with the firm's recalculation policy and include the impact of that recalculation in the results (unless they can demonstrate that the impact is not significant). However, we expect that the post-stress calculation is conducted on a best endeavours basis.

ERMs

Restructured ERMs:

For simplicity, firms should treat any MA eligible note(s) as if it were a corporate bond (ie apply the **credit spread, credit downgrade** and **interest rate** stresses above).

Firms should stress the junior note(s)/equity tranche and other SPV assets as though they were an **equity** holding (ie apply a 30% fall in value).

Firms should not assume any management actions in respect of the restructured ERMs (including resizing of notes).

Separately, where firms have material holdings of restructured ERMs, we ask firms to investigate and disclose how the specified stress would compare to the alternative of applying a look-through approach, and the impact this would have on the senior and junior notes/equity tranche (and in particular whether the credit quality of the senior notes would be impacted). The look-through basis should be based on the specified stress to residential property and interest rates, including a stress to implied property volatility of 5%, and where firms use a property growth rate to value the underlying ERMs, a reduction in the future growth rate of 100bps at all tenors should be assumed. A 'best efforts basis' response will be satisfactory for this purpose. Where firms consider that the PRA should place more reliance on the look through results when considering the impact of the stress, they should however consider whether a more detailed calculation is required.

Firms should perform the stress testing without regard to the Effective Value Test (EVT) set out in SS3/17[1]. Please note the stipulations on management actions in the Management Actions and Matching Adjustment sections above, in particular that when performing the downgrades, firms should not allow for management actions aimed at restoring the credit quality of individual assets.

Unrestructured ERMs:

Unrestructured ERMs should be subject to a stress of a **30% fall** in value. We do not require firms to stress underlying properties and carry out a full revaluation of each ERM asset individually.

Other assets held in the Matching Adjustment Portfolio (MAP)

For the avoidance of doubt, all assets in the MAP (other than assets that qualify as 'sovereign' or cash) should be stressed as if they were a fixed income asset (ie apply the **credit spread, credit downgrade** and **interest rate** stresses above).

Regardless of the nature of the underlying asset, firms should assume that restructured assets experience the same treatment as outlined above for ERM restructurings. Firms should assume that the restructured MA eligible asset is treated as a fixed income asset (ie apply the **credit spread, credit downgrade** and **interest rate** stresses of that scenario). Firms should assume that all other assets of the SPV are equity holdings (ie 30% fall in value).

[1] This is because the EVT does not come into effect as a PRA expectation until 31 December 2019, with a phasing-in period on the deferment rate parameter until 31 December 2021, and is subject to proposals for amendments in CP7/19, which at the time of writing is an open consultation.

Similar to ERMs, where firms have material holdings of other restructured assets, we ask firms to separately investigate and disclose how the specified stress would compare to the alternative of applying a look-through approach to the underlying assets. A 'best efforts basis' response will be satisfactory for this purpose. Where firms consider that the PRA should place more reliance on the look through results when considering the impact of the stress, they should however consider whether a more detailed calculation is required.

Pension scheme discount rate

For the valuation of pension scheme liabilities, firms should assume that the discount rate would change by the level of any change in the risk-free rate plus 50% of the change in spread on AA rated corporate bonds. Under the proposed stress the risk-free rate decreases by 100bps and 50% of the spread on AA rated corporate bonds is an increase of 85bps. Therefore, both elements combined result in a **15bps fall** at all tenors to the discount rate.

Reinsurance assets

Where firms have material reinsurance arrangements, the value of the reinsurance asset in stress (and in particular the level of the Counterparty Default Adjustment) should be justified with sufficient backing evidence.

For material external reinsurance assets, firms should consider how the each scenario would impact the counterparty.

For intra-group reinsurance, one approach could be to include the group reinsurer within the scope of the stress testing exercise (and fill out the templates for the reinsurer). Where the group reinsurer is not a UK entity and/or it would be difficult to complete the templates at the specified level of granularity, firms should discuss with PRA what information can be provided in order to provide adequate justification for the value of the reinsurance asset. This should include but not be limited to an assessment of the stressed solvency position of the group reinsurer in each of the scenarios (whether or not the Group reinsurer is subject to the Solvency II regulations).

Where this is not possible, an alternative approach would be to assume that the reinsurance arrangement is unwound pre-stress (ie recaptured by the cedant), although this approach should be discussed and agreed with PRA in advance.

REPORTING

This section outlines how firms should report the results of the stress testing exercise.

Post-stress SCR

Firms are asked to re-calculate the SCR following the stress. As an initial baseline, firms may assume the SCR stresses/calibrations are unchanged following the stress. For example, if the biting equity stress is a X% fall in equities then firms should assume that, after the application of the scenario stress, their equity holdings experience a fall of X% (ie a total stress of (1-30%)*(1-X%)). However, firms may choose to provide supplementary information outlining whether/why the SCR calibration should change post-stress. For the avoidance of doubt, where firms do recalibrate, this would be additional information provided on top of the baseline assumption. However, we expect that the post-stress calculation is conducted on a best endeavours basis.

Some firms may have difficulty calculating a post-stress SCR because of, for example, the simplified application of stresses to restructured assets in the scenario. Where this is the case, we ask firms to be pragmatic in deriving a post-stress SCR for these assets. For the example given, one way to approach the SCR may be to back-solve what stress scenario is required to be applied to the underlying assets to give a similar impact on own funds (as to that obtained from applying the specified scenario) and then use this as a basis for deriving a post-stress SCR. Where firms have to

take such steps for the calculation of the post-stress SCR, we ask firms to set out clearly the approach taken.

Risk margin

As part of the stressed balance sheet, firms are required to recalculate their risk margin following the stress. Firms should assume no change to the methodology for calculating the risk margin in any of the stress scenarios. However, we expect that the post-stress calculation is conducted on a best endeavours basis. Note that firms should assume that TMTP will be recalculated post stress, as long as that is in line with the firm's recalculation policy.

With-profit funds

In previous stress testing exercises, where firms have been able to demonstrate a significant estate leading to no burn-through to shareholder assets post-stress, they have been exempt from stressing with-profit funds. The ring-fencing requirements of with-profit funds mean that self-supporting with-profit funds do not affect the remainder of the insurance entity. However, the economic stress outlined is severe and any firm who seeks to excuse a with-profit fund from the calculation should be able to demonstrate with a high degree of certainty that the estate is capable of absorbing the stress and that any impact on shareholder transfers out of the fund (where applicable) is immaterial. This includes demonstrating that the method used to derive the stress position of the with-profit fund is reliable (ie where a proxy model is used to support the exclusion, that there are no material errors in the proxy model for the fund at this point in the distribution).

If the funds are small or the burn-through is not expected to be material to the overall company result approximate approaches can be taken to model these funds. However, firms will be required to provide adequate evidence/validation that doing so does not have a material impact on excess own funds in the stressed scenario.

SECTION C: CLIMATE CHANGE SCENARIOS

The potential financial impacts of climate change are well-documented. Furthermore, the PRA's recent Supervisory Statement[1] set out the importance of firms using scenario analysis to assess the impact of the financial risks from climate change on their business strategy. However, last year's Task Force on Climate-related Financial Disclosures (TCFD) report (published in September 2018) showed that while firms were starting to consider impacts to their strategic resilience resulting from climate change, few were systematically using scenario analysis.

This exploratory exercise is designed to provide additional market impetus in this area. It will also provide additional data that informs the Bank's development of a consistent and effective approach to climate-focused scenario analysis, both domestically and through international groups like the Network for Greening the Financial System. Whilst this exercise will inform future Bank work, it should be viewed as investigatory in nature. **The assumptions and methodology have been designed on this basis and should therefore not be taken as a precedent for future domestic or international exercises.**

This section comprises of two parts:

Part 1 consists of three data-driven sets of hypothetical narratives that are designed to help companies think through how different plausible futures could impact their business models in the medium to longer term. And while we have provided a set of assumptions that are designed to quantify the impacts using simple metrics for illustrative purposes, this is designed to promote discussion on how business models and balance sheets may need to adapt, not about assessing current financial resilience.

Wherever possible we have obtained the underlying assumptions for each narrative based on publically available research. However, given the limited availability of research on how climate scenarios translate into financial impacts, high-level assumptions have been made to simplify the exercise and make results across firms comparable. These assumptions are set out below.

Part 2 asks those firms that have already made sufficient progress in developing climate change scenarios, we ask firms to outline the assumptions behind those scenarios. The aim of this qualitative information-gathering exercise is for the PRA to understand the range of assumptions and parameters currently considered by insurers, when assessing financial impacts from climate change risks. Firms are asked to complete this section on a best endeavours basis. Where firms are not able to answer a specific question they should provide a reason – for example, whether this is due to the firm's level of maturity in this area or whether their approach to managing climate-related risks means the question is not relevant.

PART 1: POTENTIAL QUANTITATIVE IMPACTS UNDER SPECIFIC SOCIO-ECONOMIC AND CLIMATIC CONDITIONS

Background

Firms are requested to consider the expected impact under three different climatic states on their assets, liabilities and business models, assuming that their current insurance exposures and their investment profile remain constant. In essence, we ask firms to undertake an instantaneous sensitivity analysis on today's balance sheet under three differing climate scenarios.

As a background to interpreting these three hypothetical scenarios, we refer to the Paris Agreement that has set out climate targets for the forthcoming decades. Meeting these targets will require significant structural changes in the economy over the coming years and decades. Our first two

[1] PRA expectations set out in SS3/19 'Enhancing banks' and insurers' approaches to managing the financial risks from climate change' available at: https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/supervisory-statement/2019/ss319.

scenarios assume that the Paris Agreement targets are broadly achieved, although through different means. In the third scenario, it is assumed that the targets are not met, resulting in a significant impact on the global climate.

To understand how each scenario could impact financial risks we consider two primary channels: physical and transition. Physical risks for this exercise are defined as the first-order risks that arise from weather-related events such as storms, floods, subsidence and freeze. Transition risks are those that arise from the adjustment towards a carbon-neutral economy – the severity of the impact will depend on whether the transition is orderly or disorderly[1]. The PRA recognises that the sequence and timing of physical and transition risks under an emissions scenario can be interdependent, a complexity that is purposely excluded from this exploratory exercise.

Exploratory climate scenarios

Scenario A: A sudden transition (a Minsky moment[2]), ensuing from rapid global action and policies, and materialising over the medium-term business planning horizon that results in achieving a temperature increase being kept below 2°C (relative to pre-industrial levels) but only following a **disorderly transition**. In this scenario, transition risk is maximised. The scenario is based on the type of disorderly transitions highlighted the IPCC Fifth Assessment Report (2014)[3]. [*Shock parameters illustrative of potential impact in 2022*]

Scenario B: A long-term **orderly** transition scenario that is broadly in line with the Paris Agreement. This involves a maximum temperature increase being kept well below 2°C (relative to pre-industrial levels) with the economy transitioning in the next three decades to achieve carbon neutrality by 2050 and greenhouse-gas neutrality in the decades thereafter. The underlying assumptions for this Scenario are based on the scenarios assessed in the IPCC Special Report on Global Warming of 1.5°C (2018)[4]. [*Shock parameters illustrative of potential impact in 2050*]

Scenario C: A scenario with failed future improvements in climate policy, reaching a temperature increase in excess of 4°C (relative to pre-industrial levels) by 2100 assuming no transition and a continuation of current policy trends. Physical climate change is high under this scenario, with climate impacts for these emissions reflecting the riskier (high) end of current estimates[5]. [*Shock parameters illustrative of potential impact in 2100*]

---

[1] Prudential Regulation Authority (2015), The impact of climate change on the UK insurance sector. Prudential Regulation Authority (2018), Transition in thinking: The impact of climate change on the UK banking sector. CRO Forum (2019); The heat is on: insurability and resilience in a changing climate. Emerging Risk initiative – Position Paper.

[2] UN PRI (2018); The inevitable policy response: act now. Forcing the climate transition. UNEP Finance Initiative. United Nations Global Compact. https://www.unpri.org/climate-change/the-inevitable-policy-response-to-climate-change/3578.article

[3] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp., Figure SPM.12. Furman, J, Shadbegian, R., Stock, J. (2015): 'The cost of delaying action to stem climate change: a meta-analysis', available at https://voxeu.org/article/cost-delaying-action-stem-climate-change-meta-analysis.

[4] Scenario B is based on the „1.5°C-low-OS" scenario category which keeps the maximum temperature increase below 2°C with greater than 80% probability and which results in median temperature increase projections of 1.5–1.6°C relative to pre-industrial levels). From: Rogelj et al (2018). Mitigation pathways compatible with 1.5°C in the context of sustainable development. Global Warming of 1.5 °C: an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. [G. Flato, et al (eds)] Geneva, Switzerland, IPCC/WMO**:** 93-174. This scenario's physical climate change is consistent with an SSP1 or SSP2 RCP1.9 scenario: Rogelj et al (2018). "Scenarios towards limiting global mean temperature increase below 1.5 °C." Nature Clim. Ch. 8(4): 325-332.

[5] Emissions in this scenario would be consistent with a continuation of current weak climate policies as included in the current Nationally Determined Contributions (NDCs) as assessed in the Intergovernmental Panel on Climate Change's (IPCC) Special Report on Global Warming of 1.5°C (2018), and assume a physical climate response that tracks the high-end of the temperature range assessed by the IPCC Fifth Assessment Report (2014). See *Cross-Chapter Box 11* in: de Coninck et al (2018). Strengthening and Implementing the Global Response. Global Warming of 1.5 °C: an IPCC special report on the impacts of global warming of 1.5 °C above

Translating climate scenarios into possible business model impacts

All three scenarios are referencing temperature targets that reflect different underlying greenhouse gas emission transition pathways, and which are assumed to impact firms at different points in time (2022, 2050 and 2100). However, to ensure cross-firm consistency in assessing the possible impact, firms are requested to assume that each scenario is considered as an instantaneous shock on the investments and liabilities as at 31 December2018. (Note this scenario is not being used to assess capital resilience). The PRA recognises that when considering second and third order effects of climate change impacts there may be a dependency between impacts on investments and liabilities, something that is not addressed in this exploratory exercise.

In addition, firms are requested to assess and report separately on the impacts from transition and physical risks on their investments and liabilities. Figure 1 summarises the extent to which transition and physical risk is captured within each of the scenarios.

Figure 1: Outline of Climate Change scenario coverage against the different segments of participating insurers' balance sheets

Scenario coverage	**Life insurers**		**General insurers**	
	Investments	*Liabilities*	*Investments*	*Liabilities*
Physical risk	Scenario A Scenario B Scenario C		Scenario A Scenario B Scenario C	Scenario A Scenario B Scenario C
Transition risk	Scenario A Scenario B		Scenario A Scenario B	

Deriving the assumptions and financial impacts for each scenario

The set of assumptions on climatic and financial impacts under the three scenarios are purposely non-exhaustive as the goal of this scenario analysis is investigatory in nature. The PRA recognises that for different portfolios, the materiality of natural catastrophe perils and asset classes affected will differ. We have provided reference values as part of the set of assumptions made based on our interpretation of readily available literature. Where firms have effected their own assessments of climate-related impacts under different scenarios, they are encouraged to provide those, together with their rationale as part of Part 2 (see page 25). We also encourage firms to consider the resources listed in Annex II as a guide to interpreting the scenario analysis values below.

The PRA recognises that metric(s) chosen to measure the financial impact from climate change are dependent on the focus of any given climate change study. This scenario analysis exercise does not intend to capture the full range of relevant metrics that could translate into a meaningful financial impact as a result of climate change. Following the PRA's request for technical input, the following metrics were selected for this exercise:

- Impact to investments: change in portfolio market valuation. Expressed as a monetary value amount and as a 1-in-100 Value at Risk (VAR), separately for equities and bonds.

pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. [Abdulla et al (eds)]. Geneva, Switzerland, World Meteorological Organisation; and IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Assumptions to assess the impact on an insurer's investments

The assumptions provided below have been developed for the purpose of this exploratory exercise only and should not be considered as the PRA's forecast or view of how climate change may impact other aspects of the economy.

Table 2 below provides factors to assess the potential impact on the market valuations and changes to the 1-in-100 Value-At-Risk measure for equities and bonds under the three climatic scenarios.

The following points should be considered when assessing the financial impact and interpreting these assumptions:

- The PRA recognises that feedback loops between climatic impact and the wider economy need to be fully incorporated when assessing the financial impacts from climate change on a firm. However, for this exercise, we have limited the complexity of the analysis to reflect the current level of maturity of available tools, data and systems.
- The table below provides assumptions affecting equities. We ask insurers to use the starting valuations as at the date on which the test is conducted (31 December 2018) – the shock parameters provided are already discounted to today's values.
- The PRA recognises that the impact of climate change to corporate bonds is more complex than the impact it may have on equities, and that there are different views on how those impacts interplay. For the purposes of this exploratory exercise, we invite firms to consider the impact on corporate bonds by applying a flat multiplier of 15% compared to the impact on equities (so that the impact on corporate bonds equals 0.15 times the impact on equities). For the avoidance of doubt, the shock parameters in the tables below are to be applied to the current asset price – in other words, shocks are applied at the respective time points in the future but assessed in terms of the NPV on balance sheets today assuming the discounting is already accounted for when deriving the shock parameters. We are not expecting firms to roll forward the value of the asset price in the future.
- Please note that the main differences between Scenarios A and B are: (i) the underlying assumption between disorderly and orderly transition; and (ii) the point in time at which the shocks occur. Hence the impact is instantaneous on the insurers' balance sheets but the shocks occur at different times in the future for each scenario.
- The table below provides factors to assess the potential impact on the market value of investments from transition and physical risks in each of the climate scenarios. The PRA recognises that the timing and sequence of financial impacts from climate change will in practice be complex, as changes in behaviour could mean that either physical risk could precede transition risk or vice versa. For simplicity, where the scenario contains both of these risks, they should be applied as consecutive shocks, so firms should assume that the physical risk factor is applied second, after allowing for the impacts of the transition risk. For the avoidance of doubt, for "fuel extraction" and "power generation", the impacts from transition risks are applied to specific segments whilst for the physical risks impacts are applied across the overall sector. The excel template requires firms to record both of these impacts separately.
- Against each sector, we have provided with an indicative list of references, which is a subset of the bibliography that the PRA used as a basis to interpret research and to derive the shock parameters. The list of references provided is purposely not exhaustive and only indicative to help firms commence their background research.

Table 1: Impacts on investments from both physical and transition risk for Life and General Insurers (refer to text above for a description of each Scenario)

			Transition Risks			Physical Risks		
Sector	% of investment portfolio in following sectors	Assumptions	Scenario A	Scenario B	Scenario C	Scenario A	Scenario B	Scenario C
Fuel extraction[1]	Gas/Coal/Oil (inc. crude)	Change in equity value for sections of the investment portfolio comprising material exposure to the energy sector as per below:						
		Coal Oil Gas	- 45% - 42% -25%	-40% -38% -15%			-5%	-20%
Power generation[1]	Power transmission and delivery of natural gas and, renewables (production and transmission)	Coal Oil Gas Renewables (inc. nuclear)	-65% -35% -20% +10%	-55% -30% -15% +20%			-5%	-20%

[1] Transition risk impacts based on interpretation of the SDS, NPS and CPS scenarios of the World Energy Outlook (IEA, 2019); and
De Nederlandsche Bank (2018); An energy transition risk stress test for the financial system of the Netherlands; and
UNEP FI (2019); Changing Course: a comprehensive investor guide to scenario-based methods for climate risk assessment, in response to the TCFD.
Physical risk impact on investments based on OECD (2015), The Economic Consequences of Climate Change; and
2Degrees Investing Initiative (2019); Storm Ahead: a proposal for a climate stress-test scenario; and http://www.427mt.com/scenario-analysis.

			Transition Risks			Physical Risks		
Sector	% of investment portfolio in following sectors	Assumptions	Scenario A	Scenario B	Scenario C	Scenario A	Scenario B	Scenario C
Transport[2]	Manufacturers, warehousing freight and passenger industries: Automotive (Electric Vehicles and non-Electric Vehicles), Aviation, Marine and other inland transport assets (ports, airports and related assets)	Change in equity value for sections of the investment portfolio comprising material exposure to the transport sector as per below: Automotive non EV Automotive EV Marine (inc. assets like ports) Aviation (inc. assets like airports)	 - 30% + 15% - 15% - 21%	 - 10% + 50% - 10% - 18%			-5%	-10%
Energy intensive industries (materials/metals)[2]	Manufacture and first-order processing of coke, chemicals, cement, iron and related alloys	Proportion of the manufacturing portfolio relying on transporting/extracting/processing fossil fuels or heavily reliant on fossil-fuel energy (eg cement, steel)	-35%	-25%		-5%	-10%	-20%
		Other manufacturing	-15%	-10%				
Agriculture and Food Security[1]	Agriculture, forestry, fishing, dairy cattle, food logistics and retail	Change in equity value for sections of the investment portfolio comprising material exposure to agriculture and food security sector	-65%	-50%		-5%	-10%	-20%
		Proportion of the portfolio with income heavily reliant on transporting/trading/supplying products based on food (eg super-market chains.)	-15%	-10%			-5%	-10%

[1] UNEP FI (2019); Changing Course: a comprehensive investor guide to scenario-based methods for climate risk assessment, in response to the TCFD. ; and Meijl, H. Van, Havlik, P., Bodirsky, B., Dijk, M. Van, Doelman, J., Fellmann, T., Valin, H. (2017). Challenges of Global Agriculture in a Climate Change Context by 2050. JRC Science for Policy Report. https://doi.org/10.2760/772445.

[2] Refer to footnote #1 in previous page

			Transition Risks			Physical Risks		
Sector	% of investment portfolio in following sectors	Assumptions	Scenario A	Scenario B	Scenario C	Scenario A	Scenario B	Scenario C
Real Estate Assets (inc. CRE, rental and leasing, construction, infrastructure) [1]	Change in property value for assets materially affected by physical climate change risk[2]. Apply the price drop impact on mortgage valuations where relevant[3].	Global Average (inc. other regions) North America Europe Asia and Pacific	-10% -10% -5% - 20%				-15% -15% - 8% - 30%	- 30% - 30% -15% - 60%
Sovereign and Municipal bonds[4]	Sovereign bond credit ratings downgraded as countries stress their balance sheets in their need to mitigate impacts from physical climate change. Rating downgrade as a function of a country vulnerability to climate change (refer to Annex II)					- 20 to 0 basis points[1]	- 30 to - 5 basis points	- 70 to - 20 basis points
	US municipal bond yield increase as cities stress their balance sheets in their need to mitigate impacts from physical climate change. Rating downgrade applied to relevant US municipalities most affected.[5]					+ 0.5%	+ 5%	+ 20%
Other shares	Water utilities					-5%	-10%	-20%
	Other Sectors (excluding the sectors above)						-2%	-5%

[1] Shock parameters based on FourTwentySeven publication: http://427mt.com/2018/10/11/climate-risk-real-estate-investment-trusts/.
[2] The change in value of the underlying asset (the property) which has directly been affected by physical climate change, will lead to changes in the valuation of any mortgages associated to that asset (property). Firms should separately assess the value of the investment/mortgage given the change in asset value. Firms should assume no matching adjustment offset for purpose of this exercise.
[3] As part of your return, please explain how you assessed which part of your real estate assets is affected by climate change risk and detail related assumptions.
[4] 2Degrees Investing Initiative (2019); Storm Ahead: a proposal for a climate stress-test scenario; and https://rhg.com/research/physical-risks-climate-blackrock/.
[5] Yield increases are based on our interpretation of historic yield increases following events like Hurricane Katrina (New Orleans) and Hurricane Maria (Puerto Rico). Example of US Municipal Bond climate change risk assessment can be found here: https://www.blackrock.com/us/individual/insights/blackrock-investment-institute/physical-climate-risks.

Notes on applying the shock parameters outlined above:

1. The financial shocks are calculated either at business activity or sector level, as a function of the data availability and the granularity of the scenarios. Where shocks should be applied at sector level, insurance companies can resort to sector classification codes. To help firms classify the asset portfolio across the categories outlined in the table above, we have provided in Annex II a crosswalk across different sector classification codes (ie indicative NACE and GICS codes). Firms can use tools such as Thomson Reuters and Bloomberg Terminal to help them map their investment portfolio against sector classification codes. As part of this exercise, insurers are invited to identify the portion of their overall portfolio that they have been unable to map (typically this may include investment funds, partial subsidiaries, unit link funds or non-listed assets).
2. Where the shocks are applied at business activity level, insurance companies will be required to classify the assets in their portfolio according to sub-sectoral business activities (eg split between oil vs. gas). This can be done using alternatively in-house classification approaches or open-source and freely available tools, including but not limited to tools like S&P Trucost, Bloomberg, MSCI or PACTA tool (www.transitionmonitor.org). As part of this exercise, insurers are invited to comment on the extent to which they have been able to undertake the higher granularity split of their investment portfolio.
3. Where assets operate across multiple business activities, the asset value should be split as a function of the estimated revenue or physical asset split underlying the asset. The associated breakdown can be accessed using tools like the ones listed above. Example: A GBP 100 exposure to a utility with an asset base split evenly between coal and renewables should be considered as a GBP 50 exposure to coal and a GBP 50 exposure to renewables. The associated financial shocks should then be applied to the individual exposures respectively.
4. In the final step, the shocks should be applied on the disaggregated portfolio. When applying the shocks involving a delayed (Scenario B) or no (Scenario C) transition, insurance companies should assume a constant portfolio composition over the time horizon of the stress-test, independent of the maturity profile of the portfolio' assets.

Other resources: A non-exhaustive list of tools and data providers that may assist firms in undertaking this scenario analysis is provided below. This set of resources should not be considered as an endorsement of the following products or services, or the data underlying them, but rather as a list of resources that may be useful to consult as a starting point of this investigatory exercise.

- TCFD Knowledge Hub: for resources on how to get started on climate-related scenario analysis.
- PACTA tool[1]: for help in assigning listed debt and equity to specific sector categories such as energy, transport and materials.
- Transition Pathway Initiative: assessing companies' strategic resilience to transition-related risks for a subset of large global firms.
- Climate Impact Lab: probabilistic climate projections and evidence-based economic impact estimates at a granular level around the world.
- Notre Dame Global Adaptation Initiative's country vulnerability ranking or Moody's Investors Service's Climate Change & Sovereign Credit Risk**.** They provide relative country ranking on sovereign susceptibility to climate risks.

[1] The PACTA tool on the transitionmonitor.org website will be customised to allow users to directly apply the IST 2019 climate stress-test. The modified tool is expected to be available to users by mid July 2019, allowing users to apply the granular shocks designed in this stress-test. For this website 2° Investing Initiative uses a stand-alone server, ie no other website or information is stored on the server. The server is set up in compliance with the security standards of the German Federal Data Protection Act (BDSG, "Bundesdatenschutzgesetz"), Tele Media Act (TMG, "Telemediengesetz"), and is built on infrastructure that is DIN ISO/IEC 27001 certified. All uploaded data will be deleted after performing the analysis. All analytical results will only be shared (downloadable) exclusively with the respective user of the tool.

PART 2: SCENARIO ASSUMPTIONS

The purpose of the information gathering exercise in Part 2 is to support the PRA's development of climate scenarios for future stress tests. As such, we are inviting firms to provide their assumptions and parameters relating to existing work in assessing the financial impacts from climate change.

Of particular interest to the PRA is the work insurers may have done to develop Climate Scenarios either on their own or with the help of third parties. The information that we are trying to collate should ideally include how climate change scenarios represent physical and transition risks in the context of firms' key business decisions. We are aiming to obtain information that details aspects of material assumptions such as:

Climatic scenario assumptions

1. Greenhouse gas projection levels and extent of the global temperature rises assumed to occur;
2. Time frame and pathway over which any rise is assumed to occur;
3. Material additional aspects such as the impacts of international initiatives / policy actions, assumptions around technology (for example carbon-capture), or consumer sentiment. It would be particularly helpful if firms could explain what assumptions they have made about a future carbon price, and how that was calculated.

Assumptions required translating climatic scenarios to business impacts

1. Impacts on asset valuations (by material class – equities, corporate bonds, sovereigns, property, infrastructure, utilities, oil and gas, automotive, and so on, where it is found to bematerial), and split between:
    a. Physical risk: physical risks from climate change are those which arise from climate and weather-related events, such as droughts, floods and storms, and sea-level rise. In particular, changes in the frequency and severity of hydro-meteorological natural catastrophes (to the extent that the firm has exposure to specific perils). Physical risk can impact both general and life insurers (eg impact on mortality rates of more extreme summers or winters).
    b. Transition risk: transition risks from climate change are those financial risks that result from the process of adjustment towards a carbon-neutral economy and associated impact/cost of reducing emissions. For example, the transition to a carbon-neutral economy and wider adoption of electric vehicles could affect levels of air pollutants.
2. Impact on the valuation of liabilities, also split between physical and transition risks:

Where firms have assumed management actions to mitigate potential climate risk impacts in their analysis, we ask firms to list those management actions and to explain how much credit they have taken in their analysis for those actions.

Where firms have other material assumptions, these will also need to be set out in the feedback. Furthermore, firms should set out where they make assumptions about potential opportunities (such as green revenues), as well as risks, in their analysis.

REPORTING

For Part 1 please use the feedback template provided in the Excel workbook under the tab 'C1 Climate Change'. This contains information that will enable us to understand the business model and possible financial impacts in a relatively standardised way. Nevertheless, given the complexity and the relative infancy of analysis in this area, we recognise that the standard template may oversimplify some of the issues and implications. Where you believe this to be material, we encourage you to provide additional commentary and/or materials. For clarity, firms are invited to report against each of

the metrics requested for each shock separately and in aggregate (for instance for liability shocks, report AAL and 200 year AEP for each of the eight sub-perils against each of the three scenarios).

For Part 2 there is no prescribed format, so firms can provide the documentation in whichever way they choose. Firms can chose whether to fill in this Part as Solo or Group. However, we encourage firms to provide sufficient sign-posting to enable easy navigation of the main assumptions to help understand how both transitional and physical transition have been considered across liabilities and investments.

ANNEX I: CLIMATE CHANGE SCENARIOS – ADDITIONAL INFORMATION

The background information provided in this Annex is aimed to aid participating firms understand the basis upon which expert judgement assumptions were developed in creating the climate change scenario analysis shock parameters. The information provided below is neither an example of a thorough nor exhaustive research effort to develop climate change scenarios. Instead this information is shared to demonstrate in full transparency some of the underlying assumptions. Since the aim of the scenario analysis as part of the Insurance Stress Test 2019 exercise is principally exploratory, the information upon which the scenarios were based are not representing the latest research and understanding that would normally permit an insurance firm to build their own climate change scenarios. Future Bank of England initiatives such as the NGFS will provide with further information to support firms build their own climate change scenarios.

Impact to investments

- For clarity, Scenario A that describes a disorderly transition scenario is assumed to have its impacts coupled with a decreased sectorial demand. Positive shocks are more muted to respond to demand adjustment.
- The values related to the set of assumptions behind the Fuel Extraction and Power Generation sectors have been developed based on International Energy Agency's World Energy Outlook (2018) assuming projections given an interpretation of the New Policies, Current Policies and Sustainable Development scenario projections.
- The development of hypothetical values affecting investments are based on the interpretation of available literature by the PRA and discussions with specialists in the field including 2^{o} Investing Initiative, Aviva, Carbon-Delta, DWS, FourTwentySeven, Oliver Wyman, PwC, Rhodium Group. The hypothetical values put forward in this exploratory exercise do not represent the opinions of the above-mentioned sources.
- To support the investment portfolio segmentation, indicative NACE and GICS codes are provided as examples of the sectors discussed. The Table below is provide indicatively and firms can chose to differentiate the way they classify their portfolio against the different Sectors. In such cases, firms are requested to (i) provide evidence of their cross-walk assumptions where different to the one provided in the Appendix; and (ii) why they made this decision.

Table 1: Indicative cross-walk table linking Sectors to investment portfolio codes. Firms are encouraged to develop their own portfolio cross-walk considering the below as a starting point.

Sectors	Example NACE sector codes to consider when mapping your investment portfolio
Fuel extraction	5 Mining of coal and lignite 6.1 Extraction of crude petroleum 6.2 Extraction of natural gas 8.92 Extraction of peat 9.1 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
Transport	C29 Manufacture of motor vehicles, trailers and semi-trailers C29.1 Manufacture of motor vehicles (supplemented by percentage of EV) H49.1 Passenger rail transport, interurban H49.2 Freight rail transport

	H49.3 Other passenger land transport H49.4 Freight transport by road and removal services H50.1 Sea and coastal passenger transport H50.2 Sea and coastal freight water transport H51.1 Passenger air transport H51.2 Freight air transport C29 Manufacture of motor vehicles, trailers and semi-trailers C29.1 Manufacture of motor vehicles (supplemented by percentage of EV) H49.1 Passenger rail transport, interurban
Power generation	D35 Production of electricity D35.11 Production of electricity, to be supplemented with additional classification by source: oil, gas, coal, renewable energy (solar, wind, hydro, geothermal, nuclear)
Agriculture & food Security	A Agriculture, forestry, and fishing
Energy-intensive industries (materials/metals)	B7 Mining of metal ores C20 Manufacture of chemicals and chemical products C23.51 Manufacture of cement C24.1 Manufacture of basic iron and steel and of ferro-alloys

- To aid the assessment of sovereign credit risk, firms are invited to estimate by linearly interpolating the country rank based on a published source. For instance, using the Notre Dame country vulnerability ranking: Switzerland under Scenario B will suffer 5 basis points downgrade whilst Albania would suffer 30.
- Transition Risk assumptions were developed based on discussions with experts in the field and material[1] reviewed for purposes of this exploratory exercise.

[1] Sources: 2º investing initiative (2016); Transition Risk Toolbox; and
CISL (2015); Unhedgeable risk; and
CRO Forum (2019); The heat is on – insurability and resilience in a changing climate; and
De Nederlandsche Bank (2018); An energy transition risk stress test for the financial system of the Netherlands;
ESRB (2018); Adverse macro-financial scenario for the 2018 EU-wide banking sector stress test; and
FED Reserve (2018); Dodd-Frank Act Stress Test 2018: Supervisory Stress Test Methodology and Results; and
GIZ; UNEP FI; NCFA (2017) Drought Stress Testing – Making Financial Institutions More Resilient to Environmental Risks; and
IRENA (2019); Renewable Energy Prospects for the European Union; and
OECD (2015) The Economic Consequences of Climate Change; and
Ralite, S., and Thoma, J for the 2O investing initiative (2019); Storm Ahead: A proposal for a climate stress-test scenario. Discussion Paper; and
Standard & Poors (2017); How Environmental and Climate Risks And Opportunities Factor into Global Corporate Ratings – an update; and
UNEP FI - Acclimatise (2018); Navigating a New Climate.

- Municipal bonds yield assumptions where based on historic yields of US municipal bonds following natural catastrophes. For instance, following hurricane Maria in 2017 the Puerto Rico 5year bond yield experienced an increase of more than 20%. PRA recognises that there is a range of views on the degree of susceptibility of US municipal bond market to natural disasters and climate change, however, for purposes of this exercise, it has presented with a view based on a historic perspective.

ANNEX II: ABBREVIATIONS USED

AAL	Annual Average Loss
ACS	Annual Cyclical Scenario
AEP	Aggregate Exceedance Probability
AOF	Ancillary Own Funds
BOF	Basic Own Funds
CC	Climate Change
CQS	Credit Quality Step
PD	Probability of Default
E(.)	Expected Value
EEA	European Economic Area
EIOPA	European Insurance and Occupational Pensions Authority
ERM	Equity Release Mortgages
FS	Fundamental Spread
FRN	Firm Reference Number
GBP	Great Britain Pound
IAS	Insurance Asset Shock
IM	Internal Model
IMAP	Internal Model Approval Process
IST	Insurance Stress Test
LEI	Legal Entity Identifier
LGD	Loss Given Default
LTAS	Long Term Adjustment Spread
MA	Matching Adjustment
MAP	Matching Adjustment Portfolio
Nat Cat	Natural Catastrophe
OEP	Occurrence Exceedance Probability
OF	Own Funds
PRA	Prudential Regulatory Authority
SCR	Solvency Capital Requirement
SD	Standard Deviation
SII	Solvency II
TMTP	Transitional Measures on Technical Provisions
TP	Technical Provisions
VA	Volatility Adjustment
VAR	Value At Risk
UFR	Ultimate Forward Rate
USD	United States Dollar

ANNEX III: CONTENTS OF TEMPLATE

TAB	CONTENTS
Firm Info	Firm Information, Sign Off details, Exchange Rates used
	Details on numbers of SPVs, MAPs and modelled RFFs - once entered click macro button to populate the spreadsheet
Summary	Eligible Own Funds, SCR and Coverage Ratio from each Scenario
Pre-Stress Information	
Base BS	Solvency II base balance sheet S.02.01.01
Base SCR A	Solvency II SCR split be risk type (pre-div)
Base SCR B	Solvency II SCR split be risk type (post-div)
Base Own Funds	Own Funds (S.23.01.01.01)
	Reconciliation Reserve (S.23.01.01.02)
	Impact of long term guarantees measures and transitionals (S.22.01.01)
Post-Stress Information	
Scenario Summary A1	Views of strength of stress, Impact on business model, Details of material reinsurance arrangements post stress, details of any post stress SCR recalibration
Scenario Mgmt Act Detail A1	Management Action Details; split by those already within the existing SCR calculation and additional management actions that could be taken
Scenario SPV Details A1	Value of restructured assets (by credit rating/seniority) pre and post stress
	Value of restructured assets (by credit rating/seniority) pre and post stress on a look through basis
	Repeated for each SPV
Scenario MAP Details A1	MAP asset allocation pre-stress (table 1)
	MAP asset allocation post-stress (table 2)
	MAP asset allocation post-rebalancing (table 3)
	Description of other Assets
	Balance sheet impact of BBB cliff
	Summary of rebalancing actions split by internal transfer to/from MAP and external sales/purchases
	Balance sheet impact if MAP rebalanced with gilts only (A1 only)
	Repeated for each MAP
Scenario BS A1	Solvency II base balance sheet S.02.01.01
Scenario SCR A1 A	Solvency II SCR split be risk type (pre-div)
Scenario SCR A1 B	Solvency II SCR split be risk type (post-div)
Scenario Own Funds A1	Own Funds (S.23.01.01.01)
	Reconciliation Reserve (S.23.01.01.02)
	Impact of long term guarantees measures and transitionals (S.22.01.01)
Scenarios B2, B3 and B4 have exact copies of the above	
Section C Climate Change	Climate change exercise Parts 1 and 2
Free Form Comments	Please record any comments you have on the way you have completed the spreadsheet
Asset Definitions	Please use the definitions of different asset classes here to categorise your MAP assets

ANNEX IV: ACKNOWLEDGEMENTS

The PRA is grateful for the following organisations for valuable discussions held in the design and parameterisation stage of this exercise:

2°Investing Initiative

AIR Worldwide

Ambiental

Aviva

Beazley

Carbon Delta

Cybercube

DWS

FourTwentySeven

Impact Forecasting

Imperial College

JBA Risk Management

KatRisk

LSE

Oliver Wyman

PwC

Rhodium Group

RMS

RSA

Scor

Tremblor

University College London