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Integrating Climate Change Risk Management into Icelandic Insurance Companies

Master's Thesis

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Abstract

Climate change poses significant challenges to the insurance industry. This thesis focuses on the integration of climate change risk management within the risk management frameworks of Icelandic insurance companies. The research leverages the Application Guidance provided by the European Insurance and Occupational Pensions Authority (EIOPA) to conduct climate change materiality assessments, incorporates climate change stress tests and scenarios, and utilizes the "R" software to assess risks within the Solvency II framework. The objective is to support Icelandic insurers in effectively managing climate-related risks, promoting sustainability, and ensuring industry resilience. Through the use of dummy life and non-life insurance companies, this thesis presents practical approaches for identifying, assessing, and monitoring climate-related risks specific to the Icelandic insurance industry.

Keywords: Climate change, risk management, insurance, Iceland, solvency

CONTENTS

1.INTRODUCTION

Climate change has the potential to significantly impact the insurance industry by creating new challenges in accurately assessing and pricing risks. Climate change poses a threat to the industry, requiring the development of forward-looking risk management strategies. Human activity, according to the Intergovernmental Panel on Climate Change (IPCC), has contributed to global warming, which could lead to more frequent and severe natural disasters such as storms, floods, and wildfires European Commission, 2013. These events can cause significant damage to infrastructure and property, leading to increased insurance claims and payouts.

The Arctic region, which includes Iceland, is warming at a rate that is two to three times faster than the global average Rantanen et al., 2022. This has caused the country's glaciers to melt rapidly, contributing to sea level rise. Iceland is also experiencing more frequent and intense storms, leading to flooding and landslides.

The European Insurance and Occupational Pensions Authority (EIOPA) is a regulatory institution of the European Union. It is an independent advisory body to the European Commission, the European Parliament, and the Council of the European Union, carrying out specific legal, technical, or scientific tasks and giving evidence-based advice to help shape informed policies and laws at the EU and national level. In January 2016, EIOPA established the Solvency II framework for the supervision of Europe's insurance sector, which emphasized the importance of a risk-based approach to assessing and mitigating risks. Solvency II sets out requirements for insurance and reinsurance companies in the EU, aiming to ensure adequate protection of policyholders and beneficiaries through a risk-based approach that assesses overall solvency through quantitative and qualitative measures EIOPA, 2016.

Recognizing the criticality of addressing climate change risks, EIOPA has set Delegated Regulations for insurers' solvency, including risks such as non-life catastrophe risk, natural catastrophe risk, windstorm risk, and earthquake risk. The framework also requires the adequate protection of policyholders and beneficiaries by assessing and mitigating risks through a risk-based approach EIOPA, n.d.

EIOPA's recognition of the importance of addressing climate change risks, both in the

short and long term, highlights the significant and lasting impact of climate change on the insurance and pensions sectors. It requires a comprehensive approach to ensure the sustainability of the industry and the protection of policyholders and beneficiaries. The impact of climate change on the insurance and pensions sectors can be significant and long-lasting, translating into physical and transition risks.

This master thesis explores the integration of climate change risk management into the risk management frameworks of Icelandic insurance companies. Ultimately, this master thesis seeks to contribute to the growing body of knowledge surrounding climate change risk management within the Icelandic insurance context. By expanding on the Application Guidance; provided by the European Insurance and Occupational Pensions Authority (EIOPA) on running climate change materiality assessment; using climate change scenarios in the Own Risk and Solvency Assessment (ORSA) and utilizing the "R" software to assess risks using the Solvency II framework, this research strives to assist Icelandic insurers in effectively managing climate-related risks, promoting sustainable practices, and ensuring the resilience of the insurance industry. By employing a dummy life insurance company and a dummy non-life insurance company as illustrative examples, this thesis will outline practical approaches for identifying, assessing, and monitoring climate-related risks that are relevant to the Icelandic insurance industry.

2.SOLVENCY BALANCE SHEET

Solvency refers to the insurer's ability to meet its financial obligations and maintain stability in the face of potential risks. The Solvency II balance sheet structure plays a central role in evaluating an insurer's solvency. On the asset side, the balance sheet showcases the investments and holdings of the insurer. It provides insights into the asset classes held and allows analysis of investment quality, including credit ratings, maturities, and diversification, which influences solvency Dieckhoff, 2015.

The liability side of the Solvency II balance sheet highlights the insurer's obligations; policyholder reserves, claims provisions, and other outstanding liabilities. Policyholder reserves represent funds set aside to cover future policyholder benefits, while claims provisions are estimates for potential claims. Other outstanding liabilities include various financial commitments, such as expenses and unpaid premiums. Understanding these liabilities is crucial for assessing an insurer's ability to honor its obligations.

The Solvency II balance sheet structure also incorporates the concept of available capital and required capital. Available capital includes shareholders' equity and eligible subordinated debt instruments, representing the funds that an insurer can utilize to absorb losses and maintain solvency. Required capital is the minimum capital required to cover potential risks and is determined based on the insurer's risk profile. The solvency ratio, calculated by comparing available capital to required capital, provides a measure of an insurer's capital adequacy and financial stability.

3.ICELANDIC CLIMATE

3.1 Temperature

There is considerable spatial variability in temperature conditions in Iceland, during winter the warmest conditions are observed along the south coast, where the coldest months range from 0.7–1.6°C, but the coldest conditions prevail on the north coast and in the northern part of the highlands. The amplitude of the annual temperature ranges from 9°C on the east coast to 16°C in the interior in the north-eastern part of Iceland Icelandic met office, n.d.

3.2 Precipitation

Precipitation is highest in the glaciated highlands of south Iceland with annual values in excess of 5000 mm of annual accumulated precipitation on the highest glaciers and in general with high values ranging from 1000 mm up to 3000 mm in mountainous areas. Lower values with less than 1000 mm prevail north of the glaciers. Precipitation is greater during winter than summer with median values of monthly average precipitation in December and January being twice the median value in May and June, the months with the least precipitation Icelandic met office, n.d.

Precipitation increased during the 20th century, it was slightly less than 1000 mm per year early in the century but increased to about 1100–1200 towards the end of the 20th and beginning of the 21st century. While precipitation measurements in the highlands are limited, a comparison between current measurements and reanalysis data can be used as a base for a precipitation estimate for Iceland as a whole during the 20th century. The estimated annual precipitation before the middle of the century was about 1500 mm but increased to 1700 mm in the 21st century Icelandic met office, n.d.

3.3 Climate change in Iceland

NGFS's (Network for Greening the Financial System) current policies assumes that only currently implemented policies are preserved, leading to high physical risks: "Emissions grow until 2080 leading to about 3°C of warming and severe physical risks". This includes irreversible changes like higher sea level rise. Furthermore, data suggests that windstorm

claims are becoming more frequent. See the appendix for graphs that show historical claims in ISK, taken from TM insurance, and graphs of relative change in precipitation in Iceland for the next 80 years according to NGFS's current policies.

Drought is a significant climate change risk with far-reaching consequences. As the earth's climate continues to warm, shifts in precipitation patterns and increased evaporation rates contribute to more frequent and severe drought events. Water scarcity becomes a pressing concern, agriculture suffers from reduced water availability, leading to crop failures, livestock losses, and food price fluctuations. Ecosystems face disruption as rivers, lakes, and wetlands dry up, impacting biodiversity and habitats. Drought conditions create ideal environments for wildfires, resulting in extensive damage to forests and property. Economic losses ripple through various sectors, impacting livelihoods, productivity, and revenue.

The country's exposure to the North Atlantic weather systems contributes to the presence of powerful cyclones and intense windstorms. These weather systems bring strong winds, particularly during the winter months. Additionally, wind speeds can vary significantly depending on the topography and local atmospheric conditions; winds tend to be stronger and more turbulent in mountainous regions and areas exposed to open coastlines. Wind monitoring stations have been established across the country to collect data on wind speed and direction, providing insights into wind trends and their potential implications for various sectors. While specific long-term wind trends in Iceland are still being studied, analyses of wind data indicate that there might be an increase in wind speeds in certain regions, particularly in coastal areas, often attributed to climate change. See the appendix for graphs of relative change in wind speed in Iceland for the next 80 years according to NGFS's current policies.

3.4 Natural Catastrophe Insurance of Iceland

In Iceland, all buildings and movables with fire insurance are insured with the Natural Catastrophe Insurance of Iceland (Náttúruhamfaratryggingar Íslands). NCI is a public institution whose role is to compensate for damage caused by earthquakes, volcanic eruptions, landslides, avalanches, and floods. Insurance companies receive a fee for collecting catastrophe cover premiums alongside fire premiums.

4.RISK MODULES

The concepts below are derived from COMMISSION DELEGATED REGULATION (EU) 2015/35 of 10 October 2014 European Union, 2015. While the definitions provide a clear overview of the risk modules, they may include details or specifications that are not essential for understanding the bigger picture and will thus not be mentioned.

4.1 Market risk module

1. The market risk module shall consist of all of the following sub-modules:

(a) the interest rate risk sub-module referred to in point (a) of subparagraph 2 of Article 105(5) of Directive 2009/138/EC; L 12/104 EN Official Journal of the European Union 17.1.2015

(b) the equity risk sub-module referred to in point (b) of subparagraph 2 of Article 105(5) of Directive 2009/138/EC;

(c) the property risk sub-module referred to in point (c) of subparagraph 2 of Article 105(5) of Directive 2009/138/EC;

(d) the spread risk sub-module referred to in point (d) of subparagraph 2 of Article 105(5) of Directive 2009/138/EC;

(e) the currency risk sub-module referred to in point (e) of subparagraph 2 of Article 105(5) of Directive 2009/138/EC;

(f) the market risk concentrations sub-module referred to in point (f) of subparagraph 2 of Article 105(5) of Directive 2009/138/EC.

2. The capital requirement for market risk referred to in Article 105(5) of Directive 2009/138/EC shall be equal to the following:

$$SCR_{\text{market}} = \sqrt{\sum_{i,j} Corr_{(i,j)} \cdot SCR_i \cdot SCR_j} \tag{4.1}$$

where

a) the sum covers all possible combinations i,j of sub-modules of the market risk module;

(b) $Corr(i, j)$ denotes the correlation parameter for market risk for sub-modules i and j;

(c) SCR_i and SCR_j denote the capital requirements for sub-modules i and j, respectively.

3. The correlation parameter $Corr(i, j)$ referred to in paragraph 2 shall be equal to the

item set out in row i and in column j of the following correlation matrix:

i \ j	Mortality	Longevity	Disability	Life expense	Revision	Lapse	Life catastrophe
Mortality	1	-0,25	0,25	0,25	0	0	0,25
Longevity	-0,25	1	0	0,25	0,25	0,25	0
Disability	0,25	0	1	0,5	0	0	0,25
Life expense	0,25	0,25	0,5	1	0,5	0,5	0,25
Revision	0	0,25	0	0,5	1	0	0
Lapse	0	0,25	0	0,25	0	0,25	1
Life catastrophe	0,25	0	0,25	0,25	0	0,25	0

Table 4.1: Correlation matrix

4.2 Interest rate risk sub-module

1. The capital requirement for interest rate risk referred to in point (a) of the second subparagraph Article 105(5) of Directive 2009/138/EC shall be equal to the larger of the following:

(a) the sum, over all currencies, of the capital requirements for the risk of an increase in the term structure of interest rates as set out in Article 166 of the Regulation;

(b) the sum, over all currencies, of the capital requirements for the risk of a decrease in the term structure of interest rates as set out in Article 167 of the Regulation.

2. Where the larger of the capital requirements referred to in points (a) and (b) of paragraph 1 and the larger of the corresponding capital requirements calculated in accordance with Article 206(2) are not based on the same scenario, the capital requirement for interest rate risk shall be the capital requirement referred to in points (a) or (b) of paragraph 1 for which the underlying scenario results in the largest corresponding capital requirement calculated in accordance with Article 206(2).

4.2.1 Equity risk sub-module

1. The equity risk sub-module referred to in point (b) of the second subparagraph of Article 105(5) of Directive 2009/138/EC shall include a risk sub-module for type 1 equities and a risk sub-module for type 2 equities.

2. Type 1 equities shall comprise equities listed in regulated markets in the countries which are members of the European Economic Area (EEA) or the Organisation for Economic Cooperation and Development (OECD).

3. Type 2 equities shall comprise equities listed in stock exchanges in countries which are not members of the EEA or the OECD, equities which are not listed, commodities and other alternative investments. They shall also comprise all assets other than those covered in the interest rate risk sub-module, the property risk sub-module or the spread risk sub-module, including the assets and indirect exposures referred to in Article 84(1) and (2) where a look-through approach is not possible and the insurance or reinsurance undertaking does not make use of the provisions in Article 84(3).
4. The capital requirement for equity risk shall be equal to the following:

$$SCR_{\text{equity}} = \sqrt{SCR^2_{\text{type1equities}} + 2 \cdot 0,75 \cdot SCR_{\text{type2equities}} + SCR^2_{\text{type2equities}}} \tag{4.2}$$

where:
(a) $SCR_{\text{type1equities}}$ denotes the capital requirement for type 1 equities;
(b) $SCR_{\text{type2equities}}$ equities denotes the capital requirement for type 2 equities.
5. The impact of the instantaneous decreases set out in Articles 169 and 170 on the value of participations as referred to in Article 92(2) of Directive 2009/138/EC in financial and credit institutions shall be considered only on the value of the participations that are not deducted from own funds pursuant to Article 68 of this Regulation.

4.2.2 Property risk sub-module

The capital requirement for property risk referred to in point (c) of the second subparagraph of Article 105(5) of Directive 2009/138/EC shall be equal to the loss in the basic own funds that would result from an instantaneous decrease of 25% in the value of immovable property.

4.2.3 Spread risk sub-module

The capital requirement for spread risk referred to in point (d) of the second subparagraph of Article 105(5) of Directive 2009/138/EC shall be equal to the following:

$$SCR_{\text{spread}} = SCR_{\text{bonds}} + SCR_{\text{securitisation}} + SCR_{\text{cd}} \tag{4.3}$$

where

(a) SCR_{bonds} denotes the capital requirement for spread risk on bonds and loans;

(b) $SCR_{\text{securitisation}}$ denotes the capital requirement for spread risk on securitisation positions;

(c) SCR_{cd} denotes the capital requirement for spread risk on credit derivatives.

4.2.4 Market risk concentrations sub-module

1. The capital requirement for market risk concentration shall be calculated on the basis of single name exposures. For this purpose exposures to undertakings which belong to the same corporate group shall be treated as a single name exposure. Similarly, immovable properties which are located in the same building shall be considered as a single immovable property.

2. The exposure at default to a counterparty shall be the sum of the exposures to this counterparty.

3. The exposure at default to a single name exposure shall be the sum of the exposures at default to all counterparties that belong to the single name exposure.

4. The weighted average credit quality step on a single name exposure shall be equal to the rounded-up average of the credit quality steps of all exposures to all counterparties that belong to the single name exposure, weighted by the value of each exposure.

5. For the purposes of paragraph 4, exposures for which a credit assessment by a nominated ECAI is available, shall be assigned a credit quality step in accordance with Chapter 1 Section 2 of this Title. Exposures for which a credit assessment by a nominated ECAI is not available shall be assigned to credit quality step 5. 1. The capital requirement for market risk concentration shall be equal to the following:

$$SCR_{\text{conc}} = \sqrt{\sum_i Conc_i^2} \tag{4.4}$$

where:

(a) the sum covers all single name exposures i;

(b) $Conc_i$ denotes the capital requirement for market risk concentration on a single name exposure i.

2. For each single name exposure i, the capital requirement for market risk concentration

$Conc_i$ shall be equal to the loss in the basic own funds that would result from an instantaneous decrease in the value of the assets corresponding to the single name exposure i equal to the following: $XS_i * g_i$ where:
(a) XS_i is the excess exposure referred to in Article 184;
(b) g_i is the risk factor for market risk concentration referred to in Articles 186 and 187;

4.2.5 Currency risk sub-module

1. The capital requirement for currency risk referred to in point (e) of the second subparagraph of Article 105(5) of Directive 2009/138/EC shall be equal to the sum of the capital requirements for currency risk for each foreign currency. Investments in type 1 equities referred to in Article 168(2) and type 2 equities referred to in Article 168(3) which are listed in stock exchanges operating with different currencies shall be assumed to be sensitive to the currency of its main listing. Type 2 equities referred to in Article 168(3) which are not listed shall be assumed to be sensitive to the currency of the country in which the issuer has its main operations. Immovable property shall be assumed to be sensitive to the currency of the country in which it is located. For the purposes of this Article, foreign currencies shall be currencies other than the currency used for the preparation of the insurance or reinsurance undertaking's financial statements ('the local currency').
2. For each foreign currency, the capital requirement for currency risk shall be equal to the larger of the following capital requirements:
(a) the capital requirement for the risk of an increase in value of the foreign currency against the local currency;
(b) the capital requirement for the risk of a decrease in value of the foreign currency against the local currency.
3. The capital requirement for the risk of an increase in value of a foreign currency against the local currency shall be equal to the loss in the basic own funds that would result from an instantaneous increase of 25% in the value of the foreign currency against the local currency.
4. The capital requirement for the risk of a decrease in value of a foreign currency against the local currency shall be equal to the loss in the basic own funds that would result from an instantaneous decrease of 25% in the value of the foreign currency against the local currency.

5. For currencies which are pegged to the euro, the 25% factor referred to in paragraphs 3 and 4 of this Article may be adjusted in accordance with the implementing act adopted pursuant to point (d) of Article 109a(2) of Directive 2009/138/EC, provided that all of the following conditions are met:

(a) the pegging arrangement shall ensure that the relative changes in the exchange rate over a one-year period do not exceed the relative adjustments to the 25% factor, in the event of extreme market events, that correspond to the confidence level set out in Article 101(3) of Directive 2009/138/EC;

(b) one of the following criteria is complied with:

(i) participation of the currency in the European Exchange Rate Mechanism (ERM II);

(ii) existence of a decision from the Council which recognises pegging arrangements between this currency and the euro;

(iii) establishment of the pegging arrangement by the law of country establishing the country's currency. For the purposes of point (a), the financial resources of the parties that guarantee the pegging shall be taken into account.

6. The impact of an increase or a decrease in the value of a foreign currency against the local currency on the value of participations as defined in Article 92(2) of Directive 2009/138/EC in financial and credit institutions, shall be considered only on the value of the participations that are not deducted from own funds pursuant to Article 68 of this Regulation. The part deducted from own funds shall be considered only to the extent such impact increases the basic own funds.

7. Where the larger of the capital requirements referred to in points (a) and (b) of paragraph 2 and the largest of the corresponding capital requirements calculated in accordance with Article 206(2) are not based on the same scenario, the capital requirement for currency risk on a given currency shall be the capital requirement referred to in points (a) or (b) of paragraph 2 for which the underlying scenario results in the largest corresponding capital requirement calculated in accordance with Article 206(2).

4.3 Counterparty default risk module

1. The capital requirement for counterparty default risk shall be equal to the following:

$$SCR_{\text{def}} = \sqrt{SCR_{(def,1)}^2 + 1,5 \cdot SCR_{(def,1)} \cdot SCR_{(def,2)} + SCR_{(def,2)}^2} \tag{4.5}$$

where:

(a) $SCR_{(def,1)}$ denotes the capital requirement for counterparty default risk on type 1 exposures as set out in paragraph 2;

(b) $SCR_{(def,2)}$ denotes the capital requirement for counterparty default risk on type 2 exposures as set out in paragraph 3.

2. Type 1 exposures shall consist of exposures in relation to the following: (a) Risk-mitigation contracts including reinsurance arrangements, special purpose vehicles, insurance securitisations and derivatives;

(b) Cash at bank as defined in Article 6 item F of Council Directive 91/674/EEC (1);

(c) Deposits with ceding undertakings, where the number of single name exposures does not exceed 15;

(d) Commitments received by an insurance or reinsurance undertaking which have been called up but are unpaid, where the number of single name exposures does not exceed 15, including called up but unpaid ordinary share capital and preference shares, called up but unpaid legally binding commitments to subscribe and pay for subordinated liabilities, called up but unpaid initial funds, members' contributions or the equivalent basic own-fund item for mutual and mutual-type undertakings, called up but unpaid guarantees, called up but unpaid letters of credit, called up but unpaid claims which mutual or mutual-type associations may have against their members by way of a call for supplementary contributions;

(e) Legally binding commitments which the undertaking has provided or arranged and which may create payment obligations depending on the credit standing or default on a counterparty including guarantees, letters of credit, letters of comfort which the undertaking has provided.

4.4 Operational risk module

1. The capital requirement for the operational risk module shall be equal to the following:

$$SCR_{\text{Operational}} = \min(0,3 \cdot BSCR; Op) + 0,25 \cdot Exp_{ul} \tag{4.6}$$

where:

(a) $BSCR$ denotes the Basic Solvency Capital Requirement;

(b) Op denotes the basic capital requirement for operational risk charge;

(c) Exp_{ul} denotes the amount of expenses incurred during the previous 12 months in respect of life insurance contracts where the investment risk is borne by policy holders.

2. The basic capital requirement for operational risk shall be calculated as follows:

$$Op = \max(Op_{\text{premiums}}; Op_{\text{provisions}}) \tag{4.7}$$

where:

(a) Op_{premiums} denotes the capital requirement for operational risks based on earned premiums;

(b) $Op_{\text{provisions}}$ denotes the capital requirement for operational risks based on technical provisions.

3. The capital requirement for operational risks based on earned premiums shall be calculated as follows:

$$\begin{aligned} Op_{\text{premiums}} = 0,04 \cdot (&Earn_{\text{life}} – Earn_{\text{life–ul}}) + 0,03 \cdot Earn_{\text{non–life}} \\ &+ \max(0; 0,04 \cdot (Earn_{\text{life}} – 1,2 \cdot pEarn_{\text{life}} \\ &\quad – (Earn_{\text{life-ul}} – 1,2 \cdot pEarn_{\text{life-ul}}))) \\ &\quad + max(0; 0,03 \cdot (Earn_{\text{non-life}} – 1,2 \cdot pEarn_{\text{non-life}})) \end{aligned}$$

where:

(a) $Earn_{\text{life}}$ denotes the premiums earned during the last 12 months for life insurance and reinsurance obligations, without deducting premiums for reinsurance contracts;

(b) $Earn_{\text{life-ul}}$ denotes the premiums earned during the last 12 months for life insurance and reinsurance obligations where the investment risk is borne by the policy holders without deducting premiums for reinsurance contracts;

(c) $Earn_{\text{non-life}}$ denotes the premiums earned during the last 12 months for non-life insurance and reinsurance obligations, without deducting premiums for reinsurance contracts;

(d) $pEarn_{\text{life}}$ denotes the premiums earned during the 12 months prior to the last 12 months for life insurance and reinsurance obligations, without deducting premiums for reinsurance contracts;

(e) $pEarn_{\text{life-ul}}$ denotes the premiums earned during the 12 months prior to the last 12 months for life insurance and reinsurance obligations where the investment risk is borne

by the policy holders without deducting premiums for reinsurance contracts;
(f) $pEarn_{\text{non-life}}$ denotes the premium earned during the 12 months prior to the last 12 months for non-life insurance and reinsurance obligations, without deducting premiums for reinsurance contracts. 4. The capital requirement for operational risk based on technical provisions shall be calculated as follows:

$$Op_{\text{provisions}} = 0,0045 \cdot \max(0; TP_{\text{life}} - TP_{\text{life-ul}}) + 0,03 \cdot max(0; TP_{\text{non-life}}) \tag{4.8}$$

where:
(a) TP_{life} denotes the technical provisions for life insurance and reinsurance obligations;
(b) $TP_{\text{life-ul}}$ denotes the technical provisions for life insurance obligations where the investment risk is borne by the policy holders;
(c) $TP_{\text{non-life}}$ denotes the technical provisions for non-life insurance and reinsurance obligations.

4.5 Life underwriting risk module

1. The life underwriting risk module shall consist of all of the following sub-modules:
(a) the mortality risk sub-module referred to in point (a) of subparagraph 2 of Article 105(3) of Directive 2009/138/EC;
(b) the longevity risk sub-module referred to in point (b) of subparagraph 2 of Article 105(3) of Directive 2009/138/EC;
(c) the disability-morbidity risk sub-module referred to in point (c) of subparagraph 2 of Article 105(3) of Directive 2009/138/EC;
(d) the life-expense risk sub-module referred to in point (d) of subparagraph 2 of Article 105(3) of Directive 2009/138/EC;
(e) the revision risk sub-module referred to in point (e) of subparagraph 2 of Article 105(3) of Directive 2009/138/EC;
(f) the lapse risk sub-module referred to in point (f) of subparagraph 2 of Article 105(3) of Directive 2009/138/EC;
(g) the life-catastrophe risk sub-module referred to in point (g) of subparagraph 2 of Article 105(3) of Directive 2009/138/EC. 2. The capital requirement for life underwriting

risk shall be equal to the following:

$$SCR_{\text{life}} = \sqrt{\sum_{i,j} CorrNL_{(i,j)} \cdot SCR_i \cdot SCR_j} \tag{4.9}$$

where:

(a) the sum covers all possible combinations (i,j) of the sub-modules set out in paragraph 1;

(b) $CorrNL_{(i,j)}$ denotes the correlation parameter for life underwriting risk for sub-modules i and j;

(c) SCR_i and SCR_j denote the capital requirements for risk sub-module i and j respectively.

3. The correlation coefficient $Corri, j$ referred to in point 3 of Annex IV of Directive 2009/138/EC shall be equal to the item set out in row i and in column j of the following correlation matrix:

j / i	Mortality	Longevity	Disability	Life expense	Revision	Lapse	Life catastrophe
Mortality	1	-0,25	0,25	0,25	0	0	0,25
Longevity	-0,25	1	0	0,25	0,25	0,25	0
Disability	0,25	0	1	0,5	0	0	0,25
Life expense	0,25	0,25	0,5	1	0,5	0,5	0,25
Revision	0	0,25	0	0,5	1	0	0
Lapse	0	0,25	0	0,5	0	1	0,25
Life catastrophe	0,25	0	0,25	0,25	0	0,25	1

Table 4.2: Correlation matrix

4.5.1 (Simplified) Mortality risk sub-module

Where Article 88 is complied with, insurance and reinsurance undertakings may calculate the capital requirement for life mortality risk as follows:

$$SCR_{\text{mortality}} = 0,15 \cdot CAR \cdot q \sum_{k=1-0,5}^{n-0,5} \left(\frac{(1-q)}{(1-i_k)}\right)^k \tag{4.10}$$

where, with respect to insurance and reinsurance policies with a positive capital at risk:

(a) CAR denotes the total capital at risk, meaning the sum over all contracts of the higher of zero and the difference between the following amounts:

(i) the sum of:

- the amount that the insurance or reinsurance undertaking would currently pay in the event of the death of the persons insured under the contract after deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles;
- the expected present value of amounts not covered in the previous indent that the undertaking would pay in the future in the event of the immediate death of the persons insured under the contract after deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles;

(ii) the best estimate of the corresponding obligations after deduction of the amounts recoverable form reinsurance contracts and special purpose vehicles;
(b) q denotes the expected average mortality rate of the insured persons during the following 12 months weighted by the sum insured;
(c) n denotes the modified duration in years of payments payable on death included in the best estimate;
(d) i_k denotes the annualized spot rate for maturity k of the relevant risk-free term structure as referred to in Article 43.

4.5.2 (Simplified) Life catastrophe risk

Where Article 88 is complied with, insurance and reinsurance undertakings may calculate the capital requirement for life-catastrophe risk calculated as follows:

$$SCR_{\text{life catastrophe}} = \sum_i 0,0015 \cdot CAR_i \tag{4.11}$$

where: (a) the sum includes all policies with a positive capital at risk;
(b) CAR_i denotes the capital at risk of the policy i, meaning the higher of zero and the difference between the following amounts:
(i) the sum of:

- the amount that the insurance or reinsurance undertaking would currently pay in the event of the death of the persons insured under the contract after deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles;

- the expected present value of amounts not covered in the previous indent that the insurance or reinsurance undertaking would pay in the future in the event of the immediate death of the persons insured under the contract after deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles;

(ii) the best estimate of the corresponding obligations after deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles.

4.6 Non-life underwriting risk module

1. The non-life underwriting risk module shall consist of all of the following sub-modules:
(a) the non-life premium and reserve risk sub-module referred to in point (a) of the third subparagraph of Article 105(2) of Directive 2009/138/EC;
(b) the non-life catastrophe risk sub-module referred to in point (b) of the third subparagraph of Article 105(2) of Directive 2009/138/EC;
(c) the non-life lapse risk sub-module.
2. The capital requirement for non-life underwriting risk shall be equal to the following:

$$SCR_{\text{non-life}} = \sqrt{\sum_{i,j} \sqrt{CorrNL_{i,j} \cdot SCR_i \cdot SCR_j}} \tag{4.12}$$

where: (a) the sum covers all possible combinations (i, j) of the sub-modules set out in paragraph 1;
(b) $CorrNL_{(i,j)}$ denotes the correlation parameter for non-life underwriting risk for sub-modules i and j;
(c) SCR_i and SCR_j denote the capital requirements for risk sub-module i and j respectively.
3. The correlation parameter $CorrNL_{(i,j)}$ referred to in paragraph 2 denotes the item set out in row i and in column j of the following correlation matrix:

i \ j	Non-life premium and reserve	Non-life catastrophe	Non-life lapse
Non-life premium and reserve	1	0,25	0
Non-life catastrophe	0,25	1	0
Non-life lapse	0	0	1

Table 4.3: Correlation matrix

4.6.1 Natural catastrophe risk sub-module

1. The non-life catastrophe risk sub-module shall consist of all of the following sub-modules:

(a) the natural catastrophe risk sub-module;

(b) the sub-module for catastrophe risk of non-proportional property reinsurance;

(c) the man-made catastrophe risk sub-module;

(d) the sub-module for other non-life catastrophe risk.

2. The capital requirement for the non-life catastrophe underwriting risk module shall be equal to the following:

$$SCR_{\text{nlCAT}} = \sqrt{(SCR_{\text{natCAT}} + SCR_{\text{npproperty}})^2 + SCR_{\text{mmcat}}^2 + SCR_{\text{CATother}}^2} \tag{4.13}$$

where: (a) SCR_{natCAT} denotes the capital requirement for natural catastrophe risk;

(b) $SCR_{\text{npproperty}}$ denotes the capital requirement for the catastrophe risk of non-proportional property reinsurance;

(c) SCR_{mmcat} denotes the capital requirement for man-made catastrophe risk;

(d) SCR_{CATother} denotes the capital requirement for other non-life catastrophe risk.

4.6.2 Natural catastrophe risk sub-module

1. The natural catastrophe risk sub-module shall consist of all of the following sub-modules:

(a) the windstorm risk sub-module;

(b) the earthquake risk sub-module;

(c) the flood risk sub-module;

(d) the hail risk sub-module;

(e) the subsidence risk sub-module.

2. The capital requirement for natural catastrophe risk shall be equal to the following:

$$SCR_{\text{natCAT}} = \sqrt{\sum_i SCR_i^2} \tag{4.14}$$

where:

(a) the sum includes all possible combinations of the sub-modules i set out in paragraph

1;

(b) SCR_i denotes the capital requirement for sub-module i.

4.6.3 Windstorm risk sub-module

1. The capital requirement for windstorm risk shall be equal to the following:

$$SCR_{\text{windstorm}} = \sqrt{\sum_{(r,s)} CorrWS_{(r,s)} \cdot SCR_{(\text{windstorm},r)} \cdot SCR_{(\text{windstorm},s)} \cdot SCR^2_{(\text{windstorm, other})}} \tag{4.15}$$

here:

(a) the sum includes all possible combinations (r,s) of the regions set out in Annex V;

(b) $CorrWS_{(r,s)}$ denotes the correlation coefficient for windstorm risk for region r and region s as set out in Annex V;

(c) $SCR_{(\text{windstorm},r)}$ and $SCR_{(\text{windstorm},s)}$ denote the capital requirements for windstorm risk in region r and s respectively;

(d) $SCR_{(\text{windstorm, other})}$ denotes the capital requirement for windstorm risk in regions other than those set out in Annex XIII.

2. For all regions set out in Annex V the capital requirement for windstorm risk in a particular region r shall be the larger of the following two capital requirements:

(a) the capital requirement for windstorm risk in region r according to scenario A as set out in paragraph 3;

(b) the capital requirement for windstorm risk in region r according to scenario B as set out in paragraph 4.

3. For all regions set out in Annex V the capital requirement for windstorm risk in a particular region r according to scenario A shall be equal to the loss in basic own funds of insurance and reinsurance undertakings that would result from the following sequence of events:

(a) an instantaneous loss of an amount that, without deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles, is equal to 80% of the specified windstorm loss in region r;

(b) a loss of an amount that, without deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles, is equal to 40% of the specified windstorm

loss in region r.

4. For all regions set out in Annex V the capital requirement for windstorm risk in a particular region r according to scenario B shall be equal to the loss in basic own funds of insurance and reinsurance undertakings that would result from the following sequence of events:

(a) an instantaneous loss of an amount that, without deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles, is equal to 100% of the specified windstorm loss in region r;

(b) a loss of an amount that, without deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles, is equal to 20% of the specified windstorm loss in region r.

5. For all regions set out in Annex V, the specified windstorm loss in a particular region r shall be equal to the following amount:

$$L_{(\text{windstorm},r)} = Q_{(\text{windstorm},r)} \cdot \sqrt{\sum_{(i,j)} Corr_{(\text{windstorm},r,i,j)} \cdot WSI_{(\text{windstorm},r,i)} \cdot WSI_{(\text{windstorm},r,j)}} \tag{4.16}$$

where:

(a) $Q_{(\text{windstorm},r)}$ denotes the windstorm risk factor for region r as set out in Annex V;

(b) the sum includes all possible combinations of risk zones (i, j) of region r set out in Annex IX;

(c) $Corr_{(\text{windstorm},r,i,j)}$ denotes the correlation coefficient for windstorm risk in risk zones i and j of region r set out in Annex XXII;

(d) $WSI_{(\text{windstorm},r,i)}$ and $WSI_{(\text{windstorm},r,j)}$ denote the weighted sums insured for windstorm risk in risk zones i and j of region r set out in Annex IX.

4.7 Health underwriting risk module

1. The health underwriting risk module shall consist of all of the following sub-modules:

(a) the NSLT health insurance underwriting risk sub-module;

(b) the SLT health insurance underwriting risk sub-module;

(c) the health catastrophe risk sub-module.

2. The capital requirement for health underwriting risk shall be equal to the following:

$$SCR_{\text{health}} = \sqrt{\sum_{i,j} \sqrt{CorrH_{i,j} \cdot SCR_i \cdot SCR_j}} \tag{4.17}$$

where:

(a) the sum covers all possible combinations (i, j) of the sub-modules set out in paragraph 1;

(b) $CorrH_{(i,j)}$ denotes the correlation parameter for health underwriting risk for sub-modules i and j;

(c) SCR_i and SCR_j denote the capital requirements for risk sub-module i and j respectively.

3. The correlation coefficient $CorrH_{(i,j)}$ referred to in paragraph 2 denotes the item set out in row i and in column j of the following correlation matrix:

j / i	NSLT health underwriting	SLT health underwriting	Health catastrophe
NSLT health underwriting	1	0,5	0,25
SLT health underwriting	0,5	1	0,25
Health catastrophe	0,25	0,25	1

Table 4.4: Correlation matrix

5.DEFINITIONS

Definition 1. Solvency is the ability of a company to meet its long-term debts and financial obligations.

Definition 2. Solvency ratio is defined as

$$\text{Solvency ratio} = \frac{\text{eligible capital}}{\text{regulatory capital requirement}} \cdot 100 \tag{5.1}$$

Definition 3. Market risk is a key risk module under the Solvency II framework. It is the risk of financial loss arising from fluctuations in the values of assets and liabilities due to changes in market conditions, such as interest rates, equity prices, and foreign exchange rates. To manage market risk, insurers are required to hold capital to cover potential losses.

Definition 4. Under Solvency II, market risk is broken down into three sub-modules: interest rate risk, equity risk, and spread risk. Interest rate risk refers to the risk of loss due to changes in interest rates, which affect the value of investments such as bonds. Equity risk refers to the risk of loss due to changes in the value of equity investments. Spread risk refers to the risk of loss due to changes in the difference between the yield on assets and the risk-free rate, which can affect the value of assets such as mortgage-backed securities.

Definition 5. Counterparty risk refers to the risk of loss that an insurance company faces if a counterparty fails to meet its financial obligations. Counterparties can include other financial institutions, such as banks or other insurance companies, as well as non-financial entities. Under Solvency II, insurance companies are required to assess the creditworthiness of their counterparties and assign them a credit rating. The higher the credit rating, the lower the risk of default. Insurance companies are also required to monitor their exposure to each counterparty and set limits to manage their overall counterparty risk.

Definition 6. The health underwriting risk module within Solvency II focuses on the risks associated with underwriting health insurance policies. This includes risks related

to the pricing of policies, the claims experience of policyholders, and the development of diseases and medical conditions that could impact the costs of providing coverage. The health underwriting risk module requires insurers to develop risk management strategies to mitigate these risks and to establish robust underwriting policies and procedures. Insurers must also regularly monitor and assess the performance of their health insurance portfolio and ensure that they have adequate reserves in place to cover potential losses.

Definition 7. Life underwriting risk refers to the risk of underestimating the amount of future claims due to factors such as incorrect pricing, underwriting, or reserving. This risk can arise due to a range of factors such as mortality, morbidity, and policyholder behavior, which may vary over time and across different demographic groups. Insurers need to take appropriate measures to mitigate the life underwriting risk by implementing effective underwriting and pricing policies, setting aside adequate reserves, and monitoring their portfolios regularly.

Definition 8. Non-life underwriting risk encompasses risks associated with the underwriting of insurance policies that cover property, liability, and casualty risks. This risk module includes various types of risks, such as pricing risk, reserving risk, and catastrophe risk. The objective of the non-life underwriting risk module is to ensure that insurers have adequate technical provisions and capital to cover the risks associated with their non-life insurance business. This risk module also aims to encourage insurers to adopt best practices in underwriting and risk management to ensure the long-term sustainability of their non-life insurance business.

Definition 9. When recalculating bond price based on a new yield,

$$\text{New Bond Price} = (1 + (\Delta Y/100)) \cdot \text{Old Bond Price} \tag{5.2}$$

Where:

- New Bond Price is the adjusted bond price after the change in yield,
- ΔY is the change in yield expressed as a decimal,
- Old Bond Price is the original price of the bond.

Definition 10. Operational risk refers to the risk of loss resulting from inadequate or failed internal processes, systems, people, or external events. In the context of the Solvency II framework, operational risk is defined as the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events, including legal risk but excluding strategic and reputational risk. The operational risk module within Solvency II requires insurers to implement effective governance, risk management, and internal control systems to manage and mitigate operational risks. The module also requires insurers to conduct regular self-assessments of their operational risks, including identifying potential sources of operational risk, assessing the likelihood and impact of these risks, and implementing risk-mitigation measures.

5.1 Solvency Capital Requirement (SCR)

The Solvency Capital Requirement (SCR) is generally considered a good measure of risk for an insurance company. The SCR is a regulatory capital requirement under the Solvency II framework, which sets out the capital standards and risk management requirements for insurance companies in the European Unionn, calculated based on a comprehensive assessment of the risks faced by the insurance company. By evaluating the SCR, insurance companies can assess their ability to absorb unexpected losses and meet their obligations to policyholders and beneficiaries. It provides a measure of the company's financial strength and resilience to adverse events. Insurers with a higher SCR relative to their liabilities and risk exposure are considered to have a stronger capital position and are better equipped to withstand adverse market conditions or unexpected losses. However, it is important to note that the SCR is just one component of a comprehensive risk management framework. Insurance companies should also consider other risk measures, such as stress testing, scenario analysis, and internal risk models, to gain a more holistic view of their risk profile. Additionally, while the SCR provides a useful quantitative measure of risk, it should be complemented with qualitative assessments and risk management practices to effectively manage risks in the insurance business.

1. The Solvency Capital Requirement shall be calculated in accordance with paragraphs 2 to 5 EIOPA, n.d.
2. The Solvency Capital Requirement shall be calculated on the presumption that the

undertaking will pursue its business as a going concern EIOPA, n.d.

3. The Solvency Capital Requirement shall be calibrated so as to ensure that all quantifiable risks to which an insurance or reinsurance undertaking is exposed are taken into account. It shall cover existing business, as well as the new business expected to be written over the following 12 months. With respect to existing business, it shall cover only unexpected losses EIOPA, n.d.

It shall correspond to the Value-at-Risk of the basic own funds of an insurance or reinsurance undertaking subject to a confidence level of 99.5% over a one-year period EIOPA, n.d.

4. The Solvency Capital Requirement shall cover at least the following risks:

(a) non-life underwriting risk;

(b) life underwriting risk;

(c) health underwriting risk;

(d) market risk;

(e) credit risk;

(f) operational risk.

Operational risk as referred to in point (f) of the first subparagraph shall include legal risks, and exclude risks arising from strategic decisions, as well as reputation risks EIOPA, n.d.

5. When calculating the Solvency Capital Requirement, insurance and reinsurance undertakings shall take account of the effect of risk-mitigation techniques, provided that credit risk and other risks arising from the use of such techniques are properly reflected in the Solvency Capital Requirement EIOPA, n.d.

5.1.1 Structure of the Standard Formula for the Solvency Capital Requirement calculation

The Solvency Capital Requirement calculated on the basis of the standard formula shall be the sum of the following items:

(a) the Basic Solvency Capital Requirement, as laid down in Article 104 EIOPA, n.d.;

(b) the capital requirement for operational risk, as laid down in Article 107 EIOPA, n.d.;

(c) the adjustment for the loss-absorbing capacity of technical provisions and deferred

taxes, as laid down in Article 108 EIOPA, n.d.

5.1.2 Risk model

An existing model that has been considerably modified and simplified to fit the dummy companies, implemented in the "R" software is utilized to demonstrate the application of stress testing and scenario analysis within the framework of Solvency II.

5.1.3 Material risks

Definition 11. Risks are considered to be material in the context of Solvency II where ignoring the risk could influence the decision-making or the judgement of the users of the information, which in case of the ORSA would be the undertaking's administrative, management or supervisory body and its relevant staff European Union, 2015.

5.1.4 Look-through approach

1. The Solvency Capital Requirement SCR shall be calculated on the basis of each of the underlying assets of collective investment undertakings and other investments packaged as funds (look-through approach) European Union, 2015.
2. The look-through approach referred to in paragraph 1 shall also apply to the following:
(a) indirect exposures to market risk other than collective investment undertakings and investments packaged as funds European Union, 2015;
(b) indirect exposures to underwriting risk European Union, 2015;
(c) indirect exposures to counterparty risk European Union, 2015.
3. Where the look-through approach cannot be applied to collective investment undertakings or investments packaged as funds, the Solvency Capital Requirement may be calculated on the basis of the target underlying asset allocation of the collective investment undertaking or fund, provided such a target allocation is available to the undertaking at the level of granularity necessary for calculating all relevant sub-modules and scenarios of the standard formula, and the underlying assets are managed strictly according to this target allocation. For the purposes of that calculation, data groupings may be used, provided they are applied in a prudent manner, and that they do not apply to more than 20% of the total value of the assets of the insurance or reinsurance undertaking European

Union, 2015.

5.1.5 Transition and physical risks

Transition risks are risks that arise from a rapid transition to a low-carbon and climate-resilient economy EIOPA, 2022a. They, for example, include:

- Policy risks, for example as a result of energy efficiency requirements, carbon-pricing mechanisms which increase the price of products which are using fossil fuels EIOPA, 2022a.
- Legal risks, for example the risk of litigation for failing to avoid or minimise adverse impacts on the climate, or failing to adapt to climate change EIOPA, 2022a.
- Technology risks, for example if a technology with a less damaging impact on the climate replaces a technology that is more damaging to the climate EIOPA, 2022a.
- Market sentiment risks, for example if the social norms and choices of consumers and business customers shift towards products and services that are less damaging to the climate EIOPA, 2022a.
- Reputational risks, for example the difficulty of attracting and retaining customers, employees, business partners and investors if a company has reputation for damaging the climate EIOPA, 2022a.

Physical risks are risks that arise from the physical effects of climate change EIOPA, 2022a. They include:

- Acute physical risks, which arise from particular events, especially weather-related events such as storms, floods, fires or heatwaves that may damage production facilities and disrupt value chains EIOPA, 2022a.
- Chronic physical risks, which arise from longer-term changes in the climate, such as temperature changes, rising sea levels, reduced water availability, biodiversity loss and changes in land and soil productivity EIOPA, 2022a.

5.1.6 Time frames

The company will utilize the following time frames:

- Short-term projection: 1-5 years, which is the period during which boards typically operate to develop risk appetite, strategy and business plans EIOPA, 2022a.
- Medium-term projection: 5-10 years, which is the period that the viability of new products would need to be tested against EIOPA, 2022a.
- Long-term projection: 10 years and more EIOPA, 2022a.

6.SCENARIOS

The Solvency II natural catastrophe Standard Formula covers the following natural perils depending on the country:

- earthquake;
- flood;
- hail;
- subsidence;
- windstorm.

However, for Iceland, only winstorm is covered. It is very important that transition and physical risks are looked at in conjunction and that scenarios include different combinations of transition and physical risks EIOPA, 2022b. These 3 scenarios are widely considered appropriate when measuring climate change risk Bank of England, 2019:

- Scenario A: A sudden transition (a Minsky moment2), 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) Bank of England, 2019. [Shock parameters illustrative of potential impact in 2026]
- 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) Bank of England, 2019. [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 Bank of England, 2019. [Shock parameters illustrative of potential impact in 2100]

See the appendix for a table that outlines climate change scenario coverage against the different segments of participating in insurers' balance sheets Bank of England, 2019. As for granularity, this method strikes a balance between complexity and comparability EIOPA, 2022b:

- Sectoral level for corporate bonds, equities and real estate exposures. For specific sectors a higher granularity may be explored if needed (for instance based on technology used in energy production, e.g. coal, gas, oil or renewables) EIOPA, 2022b;
- Country level for government bonds exposures EIOPA, 2022b;
- Regional level for climate related factors, such as temperature and emission pathways and intra-country regional level for climate-related perils EIOPA, 2022b.

6.1 Assumptions

The following shocks are implemented Bank of England, 2019:

			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%

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%

			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%

The following assumptions are applied:

- Transition risks affect the portfolio's market prices as mentioned above.
- 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 Bank of England, 2019.
- The physical risk of the sovereign bonds presents as a decrease of 0 bps in scenario A, 15 bps decrease in scenario B and 30 bps decrease in scenario C.

7.DUMMY NON-LIFE INSURANCE UNDERTAKING

7.1 SCR

A dummy non-life insurance company based in Iceland has been fabricated to provide a hypothetical example of how climate change risk management can be implemented. It has no long-term commitments and does not plan to make significant changes to its investments in the next few years, including its investment mix and duration, which is approximately **1 year**. The company has defined its risk appetite such that its solvency ratio is between $1,4$-$1,6$. A look-through approach will be applied to collective investment undertakings (investment funds).

Balance sheet	**Solvency value**
Property, plant & equipment held for own use	35.568.699
Investments (other than assets held for index-linked and unit-linked contracts)	200.494.299.846
Cash and cash equivalents	1.390.888.844
Corporate Bonds	83.861.542.227
Equities - listed	47.234.305.436
Equities - unlisted	1.235.139.398
Government Bonds	6.522.776.486
Investment funds	56.594.706.217
Participation	3.654.941.237
Insurance receivables	1.791.820.095
Non-life excluding health	1.791.820.095
Other assets	0
Property, plant & equipment held for own use	0
Intangible assets	0
Deferred tax assets	0
Other non-financial assets	0
Total assets	**202.321.688.640**
Technical provisions – non-life (excluding health)	88.016.807.190
Technical provisions - health (similar to non-life)	19.068.493.780
Other Liabilities	0
Total liabilities	**107.085.300.970**
Excess of assets over liabilities	95.236.387.670
Equity	91.663.450.921
Shareholder's equity	91.663.450.921
Total equity	**91.663.450.921**

Table 7.1: Balance sheet for the dummy non-life insurance underwriting

Solvency	91.663.450.921
Solvency Capital Requirement	59.507.730.684
Solvency ratio	1,54

Table 7.2: Solvency ratio of the dummy non-life insurance underwriting

The table presented below showcases the Solvency Capital Requirement (SCR) calculations for the dummy non-life insurance undertaking. According to the Solvency II risk profile, the life insurance company is exposed to market risk, counterparty risk, health- and non-life underwriting risk, and operational risk, with the largest risks being market risk and non-life underwriting risk. The main sub-risks of the market risk are equity

Risk category	SCR
Market risk	49.944.368.175
Counterparty default risk	304.881.316
Life underwriting risk	0
Health underwriting risk	7.435.203.955
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.478.051.430
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.544.917.679
Total SCR	**59.507.730.684**

Table 7.3: Calculation of SCR for the dummy non-life insurance underwriting

risk and concentration risk and the main sub-risk of non-life underwriting risk is non-life catastrophe risk; which are all physical risks.

The table presented below shows a breakdown of market risk SCR for the undertaking.

Market sub-risk category	SCR
Interest rate risk	6.153.016.649
Equity risk risk	31.639.353.397
Property risk	0
Spread risk	6.178.960.635
Concentration risk	30.963.004.363
Currency risk	5.925.775.807
Diversification effect	-30.915.742.676
Market risk	**49.944.368.175**

Table 7.4: Calculation of SCR for the dummy non-life insurance underwriting

The table presented below shows a breakdown of non-life underwriting risk SCR for the undertaking.

Non-life underwriting risk category	SCR
Premium & Reserve risk	27.363.900.0622
Non-life lapse risk	57.657.035
Non-life catastrophe risk	1.160.069.569
Diversification effect	-904.847.118
Non-life underwriting risk	**27.676.780.109**

Table 7.5: Calculation of SCR for the dummy non-life insurance underwriting

1-fossil-fuel	0%
2-utility/electricity	0,16%
3-energy-intensive	5,2%
4-buildings	22,57%
5-transportation	19,88%
6-agriculture	3,41%
None of the above	48,79%
Grand total	**100%**

Table 7.6: Non-life insurance undertaking's portfolio split into CPRS sectors

7.2 Researching the impacts and assessing the relevance on the business

7.2.1 Classification by NACE codes

It's important to note that the specific effects of climate change on morbidity and mortality rates can vary regionally and depend on various factors such as geographic location, socioeconomic conditions, healthcare infrastructure, and adaptive measures taken to mitigate climate change impacts. In order to calculate transition risk we will take advantage of the classification proposed by Battiston via the NACE codes, a parameter already included in the Quantitative Reporting Template S06.02 ("List of Assets"). The aim is to identify the sectors which might be relevant to climate mitigation policies (Climate Policy Relevant Sector - CPRS). It defines six climate-related sectors (agriculture, fossil fuel, utilities, energy-intensive, transport, housing) based on their greenhouse gas emissions, their role in the energy supply chain, and the so-called carbon leakage risk classification. The table below (Battiston 2017) summarizes the mapping between the NACE codes and the sector considered climate sensitive.

The life insurance underwriting notes that categories 4-buildings and 5-transportation have a significant portion of the assets.

7.2.2 Natural catastrophe and concentration risk

The physical risk would incorporate any impairment of property that the insurance company owns or insures, due to physical damages related to extreme weather events. According to the company's research, climate change could contribute to the frequency and severity of natural disasters, including hurricanes, floods, wildfires, windstorms, and heavy

precipitation. According to the company's data available for wind speed and precipitation, all areas of Iceland are susceptible to damage. The company recognizes that precipitation is supposed to increase in the northern, northeastern, and north-western parts of Iceland, in the short-term, medium, and long-term, when looking at the NGFS's current policy.

Transportation companies may face liability claims for accidents or disruptions caused by climate-related events. Further, climate-related events can cause direct physical damage to transportation assets, such as vehicles, terminals, and infrastructure. The insurance undertaking's exposure is driven by the overall value of the buildings insured (as determined by their location and replacement value, among other factors). Information related to the area of the insured properties is considered one of the critical determinants of exposure to risk. Though NGFS's weather scenario for 2030–2100 points towards less wind in almost all parts of Iceland, there is some evidence that windstorm claims are becoming more frequent. See the appendix for graphs of relative change in wind speed in Iceland for the next 80 years according to NGFS's current policies as well as frequency data. NGF's weather scenario for 2030–2050; which would fall into the company's medium and long-term time projection; shows an increase in precipitation in almost all parts of Iceland, particularly north and western Iceland. For 2050–2100; the company's long-term time projection; precipitation is supposed to increase mainly in north Iceland. See the appendix for graphs of relative change in precipitation in Iceland for the next 80 years according to NGFS's current policies. Given its portfolio mix; particularly category 4-buildings and 5-transportation; the physical risks of windstorms and heavy precipitation are considered material in the medium and long term. Further, concentration risk is considered material in the medium and long term.

Considering that the NCI covers any equities that the insurance undertaking owns in its portfolio or its client's buildings and movables with fire insurance, the company decides that fire risk due to wildfires is non-material in the short, medium, and long term. The company recognizes that precipitation is supposed to increase in the short, medium, and long term and thus the company deems any water scarcity due to droughts highly unlikely. However, droughts might have agricultural impacts and thus increasing insurance claims and losses in the agricultural asset category. As only $3,4\%$ of the company's assets are in the agricultural category and no changes will be made to the portfolio mix, the company deems the risk non-material in the short, medium, and long term.

7.2.3 Market risk

As the transition to a low-carbon economy progresses, the company may need to adjust its investment strategies to align with those principles. The transition in investment portfolios can carry risks associated with market volatility, liquidity, and potential capital losses. For the non-life insurance underwriting an increase in premiums and liability costs for transportation companies might decrease their equity values in that sector. Climate change can alter travel patterns and demand for transportation services. For instance, rising temperatures and changing weather patterns may impact tourism and leisure travel, leading to fluctuations in passenger volumes for airlines, cruise lines, and other transportation providers. Changes in precipitation patterns or sea-level rise can affect cargo transportation and logistics, particularly in regions with vulnerable supply chains. Due to the short duration of the company's portfolio, interest rate risk is not considered material. The company decides that equity risk for the transportation sector is non-material in the short term, but material in the medium, and long term. Transition risks arise from evolving regulations and policies aimed at addressing climate change. Non-life insurance companies may face challenges in adapting their underwriting practices and policies to comply with new requirements. The company considers legal and policy risk non-material.

	Risks	Short	Medium	Long
Physical risks	Windstorm	NM	M	M
	Heavy precipitation	NM	M	M
	Rising sea level	NM	NM	MN
	Wildfires	NM	NM	NM
	Rising temperature	NM	NM	NM
	Ocean acidification	NM	NM	NM
	Food insecurity	NM	NM	NM
	Air pollution	NM	NM	NM
	Biodiversity loss	NM	NM	NM
Transition risks	Liability risk	NM	NM	NM
	Equity risk	NM	M	M
	Concentration risk	NM	NM	NM
	Policy	NM	NM	NM
	Legal	NM	NM	NM
	Technology	NM	NM	NM

7.3 Shocks to individual modules or sub-modules

First, the market value of assets in the building category will be shocked by -10%, -20%, -30%, and -40%. The impact is calculated net of reinsurance. See the appendix for SCR calculations.

Stress	Solvency ratio
0%	1,54
−10%	1,92
−20%	1,94
−30%	2,01
−40%	2,03

Table 7.7: SCR when market value of assets in the building category are shocked

Secondly, the market value of assets in the transportation category will be shocked in a similar fashion. See the appendix for SCR calculations.

Next, the windstorm risk factor for region r, $Q_{(windstorm,r)}$, in the windstorm risk sub-module, is shocked. Currently, Iceland is only considered to be one region with $Q_{(windstorm,r)} = 0,03\%$. The company's current risk exposure for windstorms is 4.444.000.000.000

Stress	Solvency ratio
0%	1,54
−10%	1,92
−20%	1,94
−30%	2,01
−40%	2,03

Table 7.8: SCR when market value of assets in the transportation category are shocked

ISK, with own risk of 444.000.000 ISK. Using the windstorm sub-module, the gross windstorm loss is

$$L_{(windstorm,r)} = 0,0003 \cdot 4.444.000.000.000 = 1.331.945.897 \tag{7.1}$$

which yields scenarios A1, A2, B1, and B2 (gross of own risk), with their risk mitigation effect below:

```
risk_mitigation <- pmax(gross_loss_ab-as.numeric(own_risk),0)
> gross_event
$gross_loss_ab
  European Countries      Event A1      Event A2      Event B1      Event B2
1            Iceland 1065556718.02 532778359.008 1331945897.52 266389179.504

$risk_mitigation
  European Countries      Event A1      Event A2      Event B1 Event B2
1            Iceland 621556718.017 88778359.0083 887945897.521        0
```

Since the non-life catastrophe risk capital requirement for any $Q_{(windstorm,r)}$ is

$$\begin{aligned} &0.8 \cdot Q_{(windstorm,r)} \cdot 4.444 \times 10^{12} + 0.4 \cdot Q_{(windstorm,r)} \cdot 4.444 \times 10^{12} \\ &\quad - max(0.8 \cdot Q_{(windstorm,r)} \cdot 4.444 \times 10^{12} - 444.000.000, 0) \\ &\quad - max(0.4 \cdot Q_{(windstorm,r)} \cdot 4.444 \times 10^{12} - 444.000.000, 0) \end{aligned} \tag{7.2}$$

which when solved gives

$$\left\{ \begin{array}{ll} 8.88 \times 10^8, & \text{for } Q_{(windstorm,r)} \geq 0,000249775 \\ 5.3328 \times 10^{12} Q_{(windstorm,r)}, & \text{for } Q_{(windstorm,r)} \leq 0,000124887 \\ 1.7776 \times 10^{12} Q_{(windstorm,r)} + 4.44 \times 10^8, & otherwise \end{array} \right\}$$

The (net) non-life catastrophe risk capital requirement is the value of the greater capital requirement, 888.000.000 in scenario A.

The company shocks $Q_{(windstorm,r)}$:

$Q_{(windstorm,r)}$	**Non-life catastrophe risk SCR**
$0,0003$	888.000.000
$0,0002$	1.066.560.000
$0,0001$	533.280.000

Table 7.9: SCR when $Q_{(windstorm,r)}$ is shocked

7.4 Climate change scenario analysis

The company shocks their own property and investments according to the scenario Bank of England, 2019. Shareholders equity is decreased by $0,5\%$ to reflect climate-related changes in investment portfolio. Technical provisions are increased by the absolute value of the shock given for the scenario. Sovereign bond yields and technical provisions have not been shocked.

7.4.1 Scenario A

In this short-term scenario, market risk decreases by 11% and health risk by $0,52$, Solvency ratio is still within risk appetite. The company does not need to make significant changes.

Solvency	91.215.967.471
Solvency Capital Requirement	58.302.518.590
Solvency ratio	1,56

Table 7.10: Solvency ratio, scenario A

7.4.2 Scenario B

The company shocks their own property and investments according to the scenario Bank of England, 2019. Shareholders equity is decreased by 5% to reflect climate-related changes in investment portfolio. Technical provisions are increased by the absolute value of the shock given for the scenario. Sovereign bond yields and technical provisions have been shocked by 15 bps.

Balance sheet	**Solvency value**
Property, plant & equipment held for own use	33.790.264
Investments (other than assets held for index-linked and unit-linked contracts)	183.107.506.371
Cash and cash equivalents	1.390.888.844
Corporate Bonds	75.543.310.837
Equities - listed	38.245.360.876
Equities - unlisted	1.126.901.306
Government Bonds	6.555.294.938
Investment funds	56.590.808.333
Participation	3.654.941.237
Insurance receivables	1.791.820.095
Non-life excluding health	1.791.820.095
Other assets	0
Property, plant & equipment held for own use	0
Intangible assets	0
Deferred tax assets	0
Other non-financial assets	0
Total assets	**1.977.718.116**
Technical provisions – non-life (excluding health)	88.016.807.190
Technical provisions - health (similar to non-life)	19.068.493.780
Other Liabilities	0
Total liabilities	**107.085.300.970**
Excess of assets over liabilities	76.055.995.665
Equity	91.215.967.471
Shareholder's equity	91.215.967.471
Total equity	**91.215.967.471**

Table 7.11: Scenario A

Risk category	**SCR**
Market risk	48.752.932.628
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.203.955
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.373.265.492
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.679.486.252
Total SCR	**58.302.518.590**

Table 7.12: Scenario A

Market sub-risk category	SCR
Interest rate risk	6.300.748.949
Equity risk risk	30.791.100.055
Property risk	0
Spread risk	6.190.081.323
Concentration risk	29.843.592.936
Currency risk	6.246.553.981
Diversification effect	-30.619.144.616
Market risk	**48.752.932.628**

Table 7.13: Scenario A

Solvency	87.080.278.375
Solvency Capital Requirement	57.776.392.500
Solvency ratio	1,51

Table 7.14: Solvency ratio, scenario A

7.4.3 Scenario C

The company shocks their own property and investments according to the scenario Bank of England, 2019. Shareholders equity is decreased by 12% to reflect climate-related changes in investment portfolio. Technical provisions are increased by the absolute value of the shock given for the scenario. Sovereign bond yields and technical provisions have been shocked by 30 bps.

Balance sheet	**Solvency value**
Property, plant & equipment held for own use	30.233.394
Investments (other than assets held for index-linked and unit-linked contracts)	181.896.329.352
Cash and cash equivalents	1.363.071.067
Corporate Bonds	75.140.361.617
Equities - listed	37.948.556.384
Equities - unlisted	1.224.598.933
Government Bonds	6.981.532.661
Investment funds	55.461.795.621
Participation	3.776.413.069
Insurance receivables	1.791.820.095
Non-life excluding health	1.791.820.095
Other assets	0
Property, plant & equipment held for own use	0
Intangible assets	0
Deferred tax assets	0
Other non-financial assets	0
Total assets	**181.926.562.746**
Technical provisions – non-life (excluding health)	86.696.555.082
Technical provisions - health (similar to non-life)	18.782.466.373
Other Liabilities	0
Total liabilities	**105.479.021.455**
Equity	87.080.278.375
Shareholder's equity	87.080.278.375
Total equity	**87.080.278.375**
Excess of assets over liabilities	76.447.541.291

Table 7.15: Scenario B

Solvency	87.080.278.375
Solvency Capital Requirement	57.776.392.500
Solvency ratio	1,51

Table 7.16: Solvency ratio of the dummy non-life insurance underwriting, scenario B

Risk category	**SCR**
Market risk	48.112.965.047
Counterparty default risk	314.485.028
Life underwriting risk	0
Health underwriting risk	7.435.203.955
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.306.910.710
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.625.597.167
Total SCR	**57.776.392.500**

Table 7.17: Scenario B

Market sub-risk category	**SCR**
Interest rate risk	62.83.812.335
Equity risk risk	30.498.936.364
Property risk	0
Spread risk	6.190.475.042
Concentration risk	29.237.654.846
Currency risk	6.116.047.923
Diversification effect	-30.213.961.464
Market risk	**48.112.965.047**

Table 7.18: Scenario B

Solvency	80.562.524.809
Solvency Capital Requirement	59.507.730.684
Solvency ratio	1,35

Table 7.19: Solvency ratio of the dummy non-life insurance underwriting

Balance sheet	**Solvency value**
Property, plant & equipment held for own use	34.501.638
Investments (other than assets held for index-linked and unit-linked contracts)	183.878.872.652
Cash and cash equivalents	1.321.344.401
Corporate Bonds	74.917.596.711
Equities - listed	42.623.810.468
Equities - unlisted	1.118.492.127
Government Bonds	6.659.142.857
Investment funds	53.766.291.911
Participation	3.472.194.176
Insurance receivables	1.791.820.095
Non-life excluding health	1.791.820.095
Other assets	0
Property, plant & equipment held for own use	0
Intangible assets	0
Deferred tax assets	0
Other non-financial assets	0
Total assets	**183.913.374.290**
Technical provisions - non-life (excluding health)	85.376.302.974
Technical provisions - health (similar to non-life)	18.496.438.967
Other Liabilities	0
Total liabilities	**103.872.741.941**
Excess of assets over liabilities	80.040.632.349
Equity	80.562.524.809
Shareholder's equity	80.562.524.809
Total equity	**80.562.524.809**

Table 7.20: Scenario C

Risk category	**SCR**
Market risk	49.944.368.175
Counterparty default risk	304.881.316
Life underwriting risk	0
Health underwriting risk	7.435.144.640
Non-life underwriting risk	7.435.203.955
Diversification effect	-20.478.051.430
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.544.917.679
Total SCR	**59.507.730.684**

Table 7.21: Scenario C

Market sub-risk category	**SCR**
Interest rate risk	6.153.016.649
Equity risk risk	31.639.353.397
Property risk	0
Spread risk	6.178.960.635
Concentration risk	30.963.004.363
Currency risk	5.925.775.807
Diversification effect	-30.915.742.676
Market risk	**49.944.368.175**

Table 7.22: Scenario C

8.DUMMY LIFE INSURANCE UNDERTAKING

8.1 SCR

We are assuming a hypothetical life insurance company based in Iceland that has no long-term commitments and does not plan to make significant changes to its investments over the next few years, including its investment mix and duration of approximately 1,5 years. Its portfolio's total market value is **6.229.063.948 ISK**, and its solvency is **6.547.389.000 ISK**. The company has defined its risk appetite such that its solvency ratio is between $1,9$-$2,0$. A look-through approach will be applied to collective investment undertakings (investment funds). A simplified balance sheet of the company is presented below: To calculate the company's solvency, intangible assets are subtracted from its equity.

The table presented below showcases the Solvency Capital Requirement (SCR) calculations for the dummy life insurance undertaking. According to the Solvency II risk profile, the life insurance company is exposed to market risk, life and health underwriting risk, and operational risk, with the largest risks being market and life underwriting risk. The main sub-risks of the market risk are interest rate risk and concentration risk.

The tables presented below shows a breakdown of market risk and life underwriting risk SCR for the undertaking.

8.2 Researching the impacts and assessing the relevance on the business

The company thoroughly assesses any exposure to risks to decide if they are material. Its portfolio is organized by NACE codes and their corresponding CPRS sector. The life insurance underwriting notes that category 4-buildings is the only one with significant assets.

8.2.1 Interest rate risk

Interest rate risk is a significant concern for the insurance industry, as insurance companies are heavily invested in long-term financial instruments, such as bonds and mortgages.

Balance sheet	**Solvency value**
Investments (other than assets held for index-linked and unit-linked contracts)	6.229.063.948
Cash and cash equivalents	3.257.942
Collateralised securities	46.803.913
Corporate Bonds	1.050.812.239
Equities - listed	1.378.534.836
Equities - unlisted	2.812.555.646
Government Bonds	17.509.033
Investment funds	660.990.342
Other investments	258.599.998
Insurance receivables	405.116.445
Health similar to life	358.315.170
Life excluding health and index-linked and unit-linked	46.911.275
Other assets	0
Property, plant & equipment held for own use	0
Intangible assets	0
Deferred tax assets	0
Other non-financial assets	0
Total assets	**6.634.180.393**
Technical provisions - health (similar to life)	1.388.597.095
Technical provisions - life (excluding health, index-linked and unit-linked)	416.837.360
Technical provisions - index-linked and unit-linked	15.735.365
Policyholder liabilities	0
Policyholder account balances	0
Debts and borrowings	0
Other liabilities	0
Total liabilities	**1.821.169.820**
Excess of assets over liabilities	4.407.894.128
Equity	6.547.389.000
Shareholder's equity	6.547.389.000
Total equity	**6.547.389.000**

Table 8.1: Balance sheet for the dummy life insurance underwriting

These instruments are sensitive to changes in interest rates, which can significantly impact an insurer's financial health. For example, if governments need to borrow more money to fund climate change initiatives, it could put upward pressure on interest rates, which could affect the value of the life insurance company's bond portfolio. Similarly, changes in investor behavior towards more sustainable and socially responsible companies could re-

Equity	6.547.389.000
Intangible assets	0
Solvency	6.547.389.000
Solvency Capital Requirement	3.443.382.219
Solvency ratio	1,93

Table 8.2: Solvency ratio of the dummy life insurance underwriting

Risk category	**SCR**
Market risk	2.488.490.928
Counterparty default risk	927.259
Life underwriting risk	2.186.952.022
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-984.391.584
Operational risk	199.318.016
Adjustment for deferred taxes	-461.373.957
Total SCR	**3.443.382.219**

Table 8.3: Calculation of SCR for the dummy life insurance underwriting

Market sub-risk category	**SCR**
Interest rate risk	170.904.596
Equity risk risk	1.877.794.060
Property risk	0
Spread risk	227.088.714
Concentration risk	1.334.599.514
Currency risk	130.055.868
Diversification effect	-1.251.951.825
Market risk	**2.488.490.928**

Table 8.4: Calculation of SCR for the dummy life insurance underwriting

Life underwriting risk category	**SCR**
Mortality risk	1.622.517.536
Longevity risk	0
Disability risk	0
Life expense risk	0
Revision risk	0
Lapse risk	11.443.513
Life catastrophe risk	222.731.206
Diversification effect	-560.665.056
Life underwriting risk	**2.186.952.022**

Table 8.5: Calculation of SCR for the dummy life insurance underwriting

1-fossil-fuel	0,05%
2-utility/electricity	%
3-energy-intensive	0,42%
4-buildings	26,23%
5-transportation	0%
6-agriculture	2,06%
None of the above	71,29%
Grand total	**100%**

Table 8.6: Life insurance undertaking's portfolio split into CPRS sectors

sult in lower demand for bonds issued by companies that are not perceived as sustainable, leading to higher interest rates for these companies. Due to 26% of the assets being in the buildings category, the company decides the exposure is material in the short, medium, and long term. Additionally, if the impacts of climate change become more severe, it could lead to higher inflation and higher interest rates in the long term. Central banks may also adjust their monetary policy in response to climate change, potentially leading to higher interest rates to combat inflation or lower interest rates to stimulate economic growth. The company decides that the exposure is non-material in the short, medium, and long term.

8.2.2 Concentration risk

Climate change could exacerbate concentration risk in several ways. For example, if climate change causes a sudden drop in the value of certain investments, such as fossil fuel companies or properties in areas at high risk of flooding, the company could experience significant losses if a large portion of its portfolio is invested in those assets. Additionally, climate change could lead to increased market volatility, making it difficult to effectively manage concentration risk. Sudden changes in weather patterns could lead to agricultural losses, which could impact the value of investments in agricultural commodities. The company decides that the exposure is material in the medium and long term. The company should make sure that funds are not heavily invested in a single asset or sector.

8.2.3 Operational risk

Furthermore, changes in regulations and policies related to climate change could increase operational risk. For instance, regulations requiring greater disclosure of climate-related

risks could increase the administrative burden on the company. Since EIOPA is mainly focusing on long-term climate change risk management and there is plenty of time to act accordingly, the company decides the exposure is non-material in the short, medium, and long term.

8.2.4 Life underwriting risk

Rising temperatures could increase the frequency and intensity of heatwaves which could lead to heat exhaustion, heatstroke, and other heat-related illnesses; especially among vulnerable populations such as the elderly, children, and individuals with pre-existing health conditions; resulting in an increase in morbidity and mortality rates during heatwave events. The company, due to its location's average temperature, considers the exposure non-material in the short, medium, and long term.

Climate change could influence the distribution and prevalence of certain infectious diseases. For instance, vector-borne diseases; warmer temperatures, and changes in precipitation patterns might expand the geographic range of disease-carrying vectors like mosquitoes and ticks, leading to higher morbidity and, in severe cases, mortality rates; as well as waterborne diseases; changes in precipitation patterns and extreme weather events could impact water quality and increase the risk of waterborne diseases. Floods can contaminate water sources, leading to outbreaks and higher morbidity rates. The company, due to its geographical location, considers the exposure non-material in the short, medium, and long term.

Climate change could worsen air quality, due to increased concentrations of pollutants, pollen, and allergens, exacerbating respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD), leading to higher morbidity rates among affected individuals. Iceland generally has good air quality due to its geographical location. However, climate change can contribute to the long-range transport of pollutants, such as fine particulate matter (PM2.5) or air pollutants originating from distant sources. While the direct impact on local air quality in Iceland may be limited, the long-range transport of pollutants can still have some influence, although it is typically less pronounced compared to more urbanized and industrialized areas. The company considers the exposure non-material in the short, medium, and long term.

Iceland has a relatively low diversity of vegetation compared to many other regions, and the prevalence of allergenic plants and pollen is generally lower. However, climate change can potentially impact pollen production and dispersal patterns. As temperatures and growing seasons change, it is possible that certain plant species may adapt, leading to variations in pollen production and allergenic potential. However, the overall impact on pollen and allergens in Iceland is likely to be comparatively modest compared to regions with a higher diversity of vegetation and more pronounced allergy seasons. The company considers the exposure non-material in the short, medium, and long term.

The frequency and severity of natural disasters, including hurricanes, floods, wildfires, windstorms, and heavy precipitation could cause direct injuries and fatalities, leading to increased mortality rates. They can also disrupt healthcare infrastructure and access to medical services, impacting the management and treatment of various health conditions. The company, due to its geographical location, considers the risk of windstorms and heavy precipitation material in the long term.

Climate change and its associated impacts, such as extreme weather events and displacement, can have adverse effects on mental health. Increased stress, anxiety, depression, and post-traumatic stress disorder can contribute to higher morbidity rates related to mental health conditions. The company, due to its geographical location, considers this risk non-material in the short, medium, and long term.

Climate change could lead to an increase in the incidence and severity of certain health conditions, such as respiratory illnesses, which could impact the claims experience for health insurance policies. Additionally, climate change could lead to changes in patterns of disease transmission, which could impact the risk profile of health insurance policies. For example, changes in the distribution and behavior of disease vectors, such as mosquitoes or ticks, could impact the risk of certain diseases in different regions.

To mitigate the potential impacts of climate change on health underwriting risk, the company should incorporate climate-related risks into its underwriting and pricing models. Climate change could lead to changes in mortality rates, with some populations being more vulnerable to climate-related health issues. This could impact the profitability of life insurance policies. Additionally, climate change could impact the incidence and severity of certain diseases or health conditions, such as heat stroke, which could impact the claims experience for life insurance policies.

	Risks	Short	Medium	Long
Physical risks	Windstorm	NM	M	M
	Mortality risk	NM	NM	M
	Life catastrophe risk	NM	NM	M
Transition risks	Liability risk	NM	NM	NM
	Interest rate risk	M	M	M
	Concentration risk	NM	M	M
	Policy	NM	NM	NM
	Legal	NM	NM	NM
	Technology	NM	NM	NM

8.3 Shocks to individual modules or sub-modules

8.3.1 Market value shock

First, the model will undergo a process where individual modules or sub-modules will be shocked. As the company has identified its material risks, it will focus on modules related to those risks. First, the market value of assets in the building category will be shocked by -10%, -20%, -30%, and -40%. The impact is calculated net of reinsurance. See the appendix for the SCR calculations.

Stress	Solvency ratio
0%	1,90
-10%	1,92
-20%	1,94
-30%	2,01
-40%	2,03

Table 8.7: SCR when market value of assets in the building category are shocked

8.3.2 Life underwriting shock

Mortality risk: q denotes the expected average mortality rate of the insured persons during the following 12 months weighted by the sum insured. The current value of q is 0,02. The model calculates SCR for $q = 0,2,\ 0,025,\ 0,03,\ 0,035$.

q	**Solvency ratio**
$0,02$	1,75
$0,025$	1,62
$0,03$	1,49
$0,035$	1,38

Table 8.8: SCR when parameter q is shocked

8.4 Climate change scenario analysis

For material risks, the Opinion expects undertaking to run climate change scenarios. Impact is calculated net of reinsurance. The company shocks their own property according to the scenario as well as investments. Technical provisions and other liabilities are not shocked for the life insurance underwriting Bank of England, 2019.

8.4.1 Scenario A

The company shocks their investments according to the scenario. Shareholders equity is decreased by $0,5\%$ to reflect climate-related changes in investment portfolio. Technical provisions and other liabilities are not shocked Bank of England, 2019. In this short-term scenario, market risk SCR is affected and solvency ratio is still within risk appetite. When taking a closer look at the market risk sub-categories, the most difference is within currency risk SCR because of an asset in the agriculture category (large shock) in NOK. The company does not need to make significant changes but might want to adjust this one asset.

8.4.2 Scenario B

The company shocks their investments according to the scenario. Shareholders equity is decreased by 5% to reflect climate-related changes in investment portfolio. Technical provisions and other liabilities are not shocked Bank of England, 2019. In this medium-term scenario, market risk is affected as well as counterparty risk. Solvency ratio is not within risk appetite. When taking a closer look at the market risk sub-categories, again the most difference is within currency risk SR because of the already mentioned asset in the agriculture category (large shock) in NOK as well as the decrease in value on assets in the other high-risk categories. Assets in all other sectors were decreased in value by 2%.

Balance sheet	**Solvency value**
Investments (other than assets held for index-linked and unit-linked contracts)	6.051.600.480
Cash and cash equivalents	3.257.942
Collateralised securities	46.803.913
Corporate Bonds	1.002.255.534
Equities - listed	1.366.741.406
Equities - unlisted	2.695.442.313
Government Bonds	17.509.033
Investment funds	660.990.342
Other investments	258.599.998
Insurance receivables	405.116.445
Health similar to life	358.315.170
Life excluding health and index-linked and unit-linked	46.911.275
Other assets	0
Property, plant & equipment held for own use	0
Intangible assets	0
Deferred tax assets	0
Other non-financial assets	0
Total assets	**6.456.716.925**
Technical provisions - health (similar to life)	1.388.597.095
Technical provisions - life (excluding health, index-linked and unit-linked)	416.837.360
Technical provisions - index-linked and unit-linked	15.735.365
Total liabilities	**1.821.169.820**
Excess of assets over liabilities	4.635.547.105
Equity	6.514.652.055
Shareholder's equity	6.514.652.055
Total equity	**6.514.652.055**

Table 8.9: Scenario A

Solvency	6.514.652.055
Solvency Capital Requirement	3.388.075.558
Solvency ratio	1,92

Table 8.10: Scenario A

Further, interest rate risk SCR has decreased by 8% and spread risk as well. Counterparty risk SCR has decreased by 2%. The company does need to make changes to avoid further exposure to climate change risk.

Risk category	SCR
Market risk	2.418.316.278
Counterparty default risk	927.259
Life underwriting risk	2.186.952.022
Health underwriting risk	13.459.534
Non-life underwriting risk	0
Diversification effect	-971.546.079
Operational risk	199.318.016
Adjustment for deferred taxes	-459.351.474
Total SCR	**3.388.075.558**

Table 8.11: Scenario A

Market sub-risk category	SCR
Interest rate risk	163.058.467
Equity risk	1.815.985.274
Property risk	0
Spread risk	216.599.041
Concentration risk	1.325.089.239
Currency risk	108.644.137
Diversification effect	-1.211.059.879
Total SCR	**2.418.316.278**

Table 8.12: Scenario A

8.4.3 Scenario C

The company shocks their investments according to the scenario. Shareholders equity is decreased by 12% to reflect climate-related changes in investment portfolio. Technical provisions and other liabilities are not shocked Bank of England, 2019. In this long-term scenario, market risk SCR is affected as well as counterparty risk SCR. Solvency ratio is not within risk appetite. When taking a closer look at the market risk sub-categories, the most difference is within currency risk SCR, 22% decrease. Further, spread risk SCR has decreased by 18% and counterparty risk SCR decreased by 5%. The company does need to make changes to avoid further exposure to climate change risk.

Balance sheet	**Solvency value**
Investments (other than assets held for index-linked and unit-linked contracts)	5.919.370.527
Cash and cash equivalents	3.257.942
Collateralised securities	43.059.600
Corporate Bonds	973.036.676
Equities - listed	1.269.905.722
Equities - unlisted	2.697.624.435
Government Bonds	17.509.033
Investment funds	656.377.121
Other investments	258.599.998
Insurance receivables	405.116.445
Health similar to life	358.315.170
Life excluding health and index-linked and unit-linked	46.911.275
Other assets	0
Property, plant & equipment held for own use	0
Intangible assets	0
Deferred tax assets	0
Other non-financial assets	0
Total assets	**6.324.486.972**
Technical provisions - health (similar to life)	1.388.597.095
Technical provisions - life (excluding health, index-linked and unit-linked)	416.837.360
Technical provisions - index-linked and unit-linked	15.735.365
Total liabilities	**1.821.169.820**
Excess of assets over liabilities	4.503.317.152
Equity	6.220.019.550
Shareholder's equity	6.220.019.550
Total equity	**6.220.019.550**

Table 8.13: Scenario B

Solvency	6.220.019.550
Solvency Capital Requirement	3.351.317.016
Solvency ratio	1,85

Table 8.14: Scenario B

Risk category	**SCR**
Market risk	2.372.380.490
Counterparty default risk	908.714
Life underwriting risk	2.186.952.022
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-962.879.191
Operational risk	199.318.016
Adjustment for deferred taxes	-458.822.569
Total SCR	**3.351.317.016**

Table 8.15: Scenario B

Market sub-risk category	**SCR**
Interest rate risk	158.020.051
Equity risk	1.785.157.391
Property risk	0
Spread risk	209.999.494
Concentration risk	1.295.722.102
Currency risk	110.453.676
Diversification effect	-1.186.972.223
Total SCR	**2.372.380.490**

Table 8.16: Scenario B

Balance sheet	**Solvency value**
Investments (other than assets held for index-linked and unit-linked contracts)	5.621.893.132
Cash and cash equivalents	3.257.942
Collateralised securities	39.783.326
Corporate Bonds	863.837.114
Equities - listed	1.164.830.831
Equities - unlisted	2.621.900.092
Government Bonds	17.509.033
Investment funds	652.174.796
Other investments	258.599.998
Insurance receivables	405.116.445
Health similar to life	358.315.170
Life excluding health and index-linked and unit-linked	46.911.275
Other assets	0
Property, plant & equipment held for own use	0
Intangible assets	0
Deferred tax assets	0
Other non-financial assets	0
Total assets	**5.621.893.132**
Technical provisions - health (similar to life)	1.388.597.095
Technical provisions - life (excluding health, index-linked and unit-linked)	416.837.360
Technical provisions - index-linked and unit-linked	15.735.365
Total liabilities	**1.821.169.820**
Excess of assets over liabilities	3.800.723.312
Equity	5.761.702.320
Shareholder's equity	5.761.702.320
Total equity	**5.761.702.320**

Table 8.17: Scenario C

Solvency	5.761.702.320
Solvency Capital Requirement	3.252.478.316
Solvency ratio	1,77

Table 8.18: Scenario C

Risk category	**SCR**
Market risk	2.246.149.309
Counterparty default risk	880.896
Life underwriting risk	2.186.952.022
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-938.021.524
Operational risk	199.318.016
Adjustment for deferred taxes	-456.259.939
Total SCR	**3.252.478.316**

Table 8.19: Scenario C

Market sub-risk category	**SCR**
Interest rate risk	158.020.051
Equity risk	1.694.065.243
Property risk	0
Spread risk	185.838.709
Concentration risk	1.239.156.541
Currency risk	102.061.149
Diversification effect	-1.114.842.483
Total SCR	**2.246.149.309**

Table 8.20: Scenario C

9.CONCLUSIONS

Overall, this thesis underscores the importance of integrating climate change risk management into the risk management frameworks of Icelandic insurance companies, providing insights for effectively navigating climate-related risks. Furthermore, it highlights the significance of defining risk appetite based on factors such as size and location, with the solvency ratio being a valuable metric. The thesis emphasizes the specific climate-related risks faced by Iceland, such as windstorms and heavy rainfall and how they might materialize.

The European Insurance and Occupational Pensions Authority (EIOPA) and the Solvency II framework have been instrumental in promoting a risk-based approach to assessing and mitigating risks in the insurance sector. However, the standard formula's treatment of windstorm risks has limitations and may not adequately capture the exposure to risk. It has demonstrated how altering the windstorm module can impact windstorm Solvency Capital Requirements (SCR) and emphasizes the importance of considering both transitional and physical risks in conjunction.

Climate change poses significant challenges to the insurance industry, including increased frequency and severity of weather-related events, rising sea levels, and changing risk profiles. These challenges necessitate proactive measures to accurately assess and mitigate climate-related risks.The absence of specific regulations pertaining to climate change in Iceland presents an opportunity for insurance companies to take a proactive approach in researching and addressing climate-related risks. While the regulatory framework may not yet exert sufficient pressure, the importance of conducting research and incorporating climate risk assessment into risk management practices is evident.

It is crucial for insurance companies to assess the materiality of different risks associated with climate change. In particular, heavy rainfall, which has become more prevalent in Iceland, should be included in the risk management frameworks to adequately address the associated risks such as flooding and landslides.

The integration of transitional and physical risks into the standard model by adjusting the portfolio value has proven to be effective in assessing the impact of climate change on insurers' risk profiles. This approach allows for a comprehensive evaluation of both

transitional risks associated with the transition to a low-carbon economy and physical risks arising from climate-related events.

Defining a risk appetite tailored to the size, location, and specific characteristics of insurance companies is of utmost importance. While the solvency ratio serves as a valuable measure of risk, it is not without its limitations. Insurance companies should consider additional risk indicators and qualitative factors to ensure a comprehensive assessment of risk exposure.

In light of these conclusions, insurance companies in Iceland might want to look into increasing premiums on products related to high-risk sectors; to adequately account for the potential impact of climate change on claims frequency and severity; and diversify their investment portfolios to mitigate exposure to sectors highly susceptible to climate-related risks. There is a need to incorporate climate risk assessment tools, scenario analysis, and stress testing to better quantify and manage climate-related risks. They should collaborate with regulatory authorities, industry associations, and research institutions to share knowledge, best practices, and develop common guidelines for addressing climate-related risks. By implementing these recommendations, insurance companies can effectively navigate the challenges posed by climate change, protect policyholders' interests, and ensure the long-term sustainability and resilience of the insurance industry in Iceland.

It is important to acknowledge that climate change is an evolving field, and continuous monitoring, research, and adaptation will be necessary to stay ahead of emerging risks. This thesis has provided a foundation for further research and dialogue on climate change risk management within the Icelandic insurance context, contributing to the collective efforts in building a resilient and sustainable insurance industry in the face of a changing climate

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10.APPENDIX

10.1 Weather related graphs

The graphs show data for precipitation and wind speed in Iceland Climate Analytics, n.d.

10.2 Outline of Climate Change scenario coverage against the different segments of participating insurers' balance sheets

10.3 Shocking life insurance underwriting's asset

Risk category	**SCR**
Market risk	2.436.700.617
Counterparty default risk	927.259
Life underwriting risk	2.186.952.022
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-974.954.566
Operational risk	199.318.016
Adjustment for deferred taxes	-459.466.107
Total SCR	**3.402.936.776**
SR	**1,92**

Table 10.1: SCR when market value of life insurance underwriting's assets in the building category are shocked by -10%

Risk category	**SCR**
Market risk	2.386.489.945
Counterparty default risk	927.259
Life underwriting risk	2.186.952.022
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-965.571.212
Operational risk	199.318.016
Adjustment for deferred taxes	-457.623.721
Total SCR	**3.363.951.845**
SR	**1,94**

Table 10.2: SCR when market value of life insurance underwriting's assets in the building category are shocked by -20%

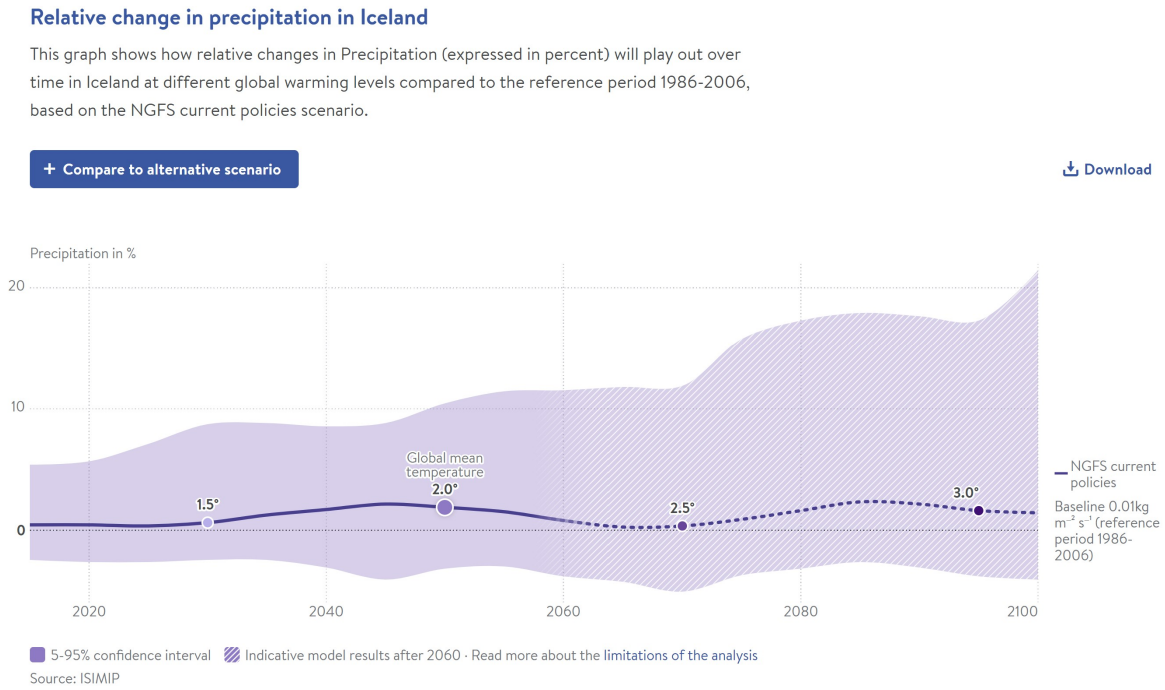

Figure 10.1: Relative change in precipitation in Iceland

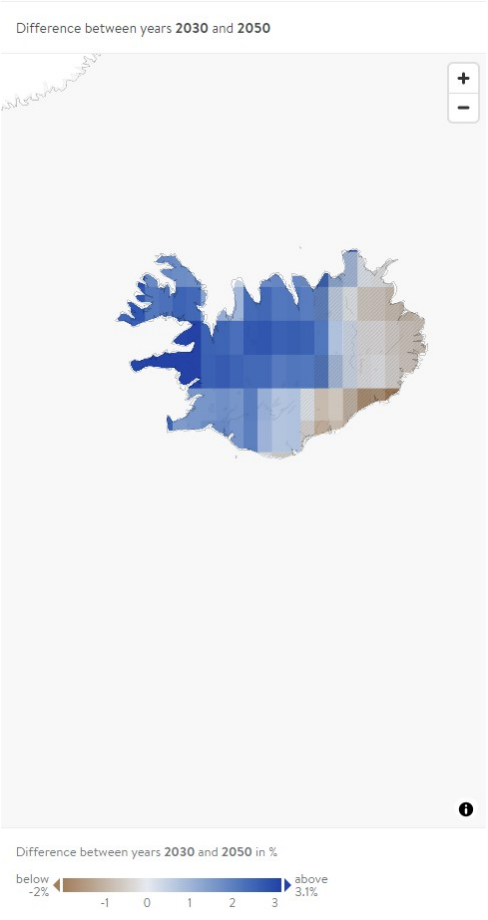

Figure 10.2: Difference between 2030 and 2050 in %

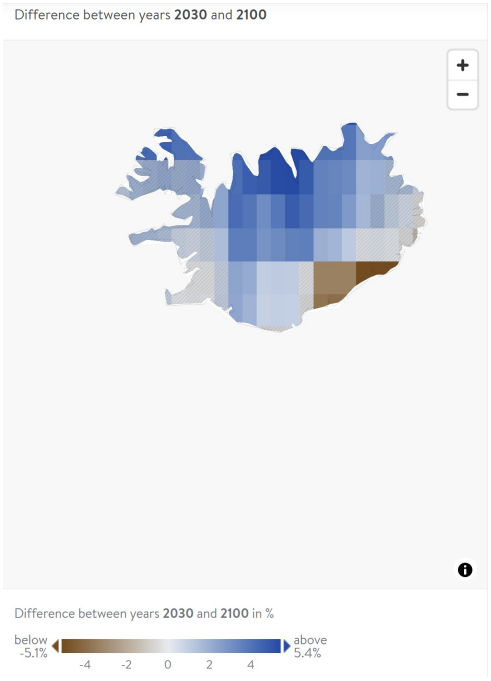

Figure 10.3: Difference between 2050 and 2100 in %

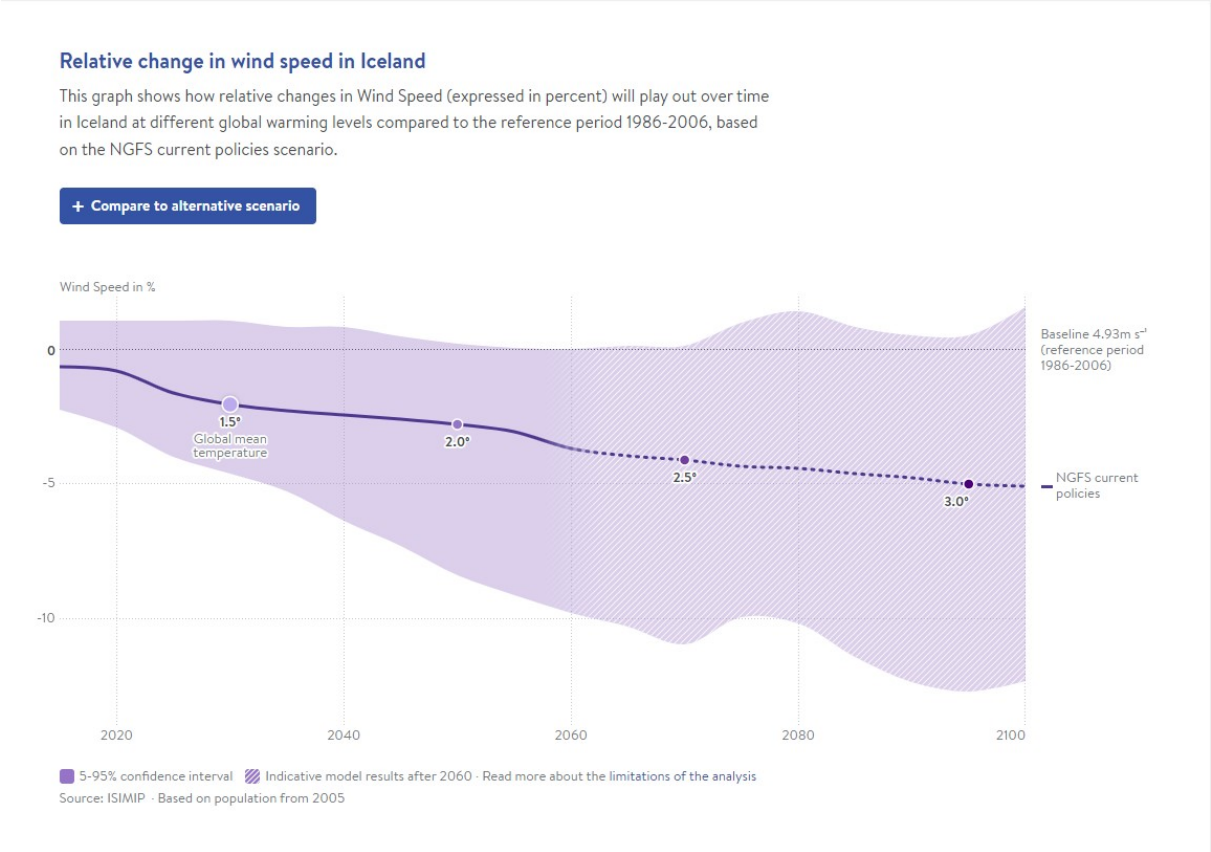

Figure 10.4: Relative change in wind speed in Iceland

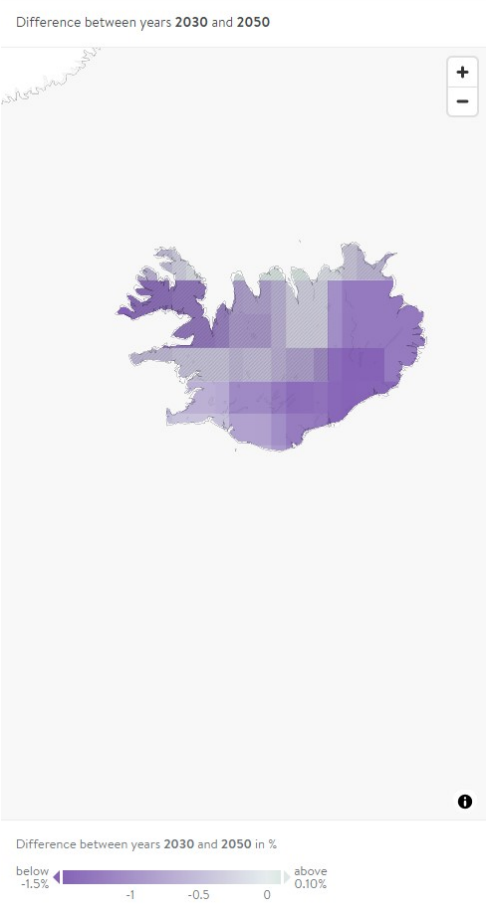

Figure 10.5: Difference between 2030 and 2050 in %

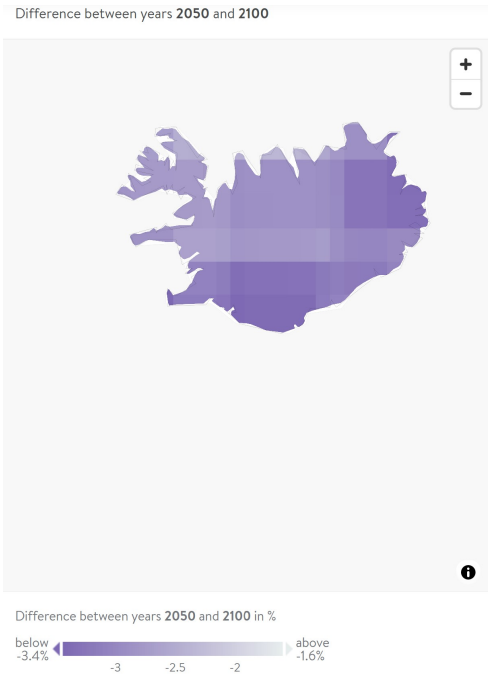

Figure 10.6: Difference between 2050 and 2100 in %

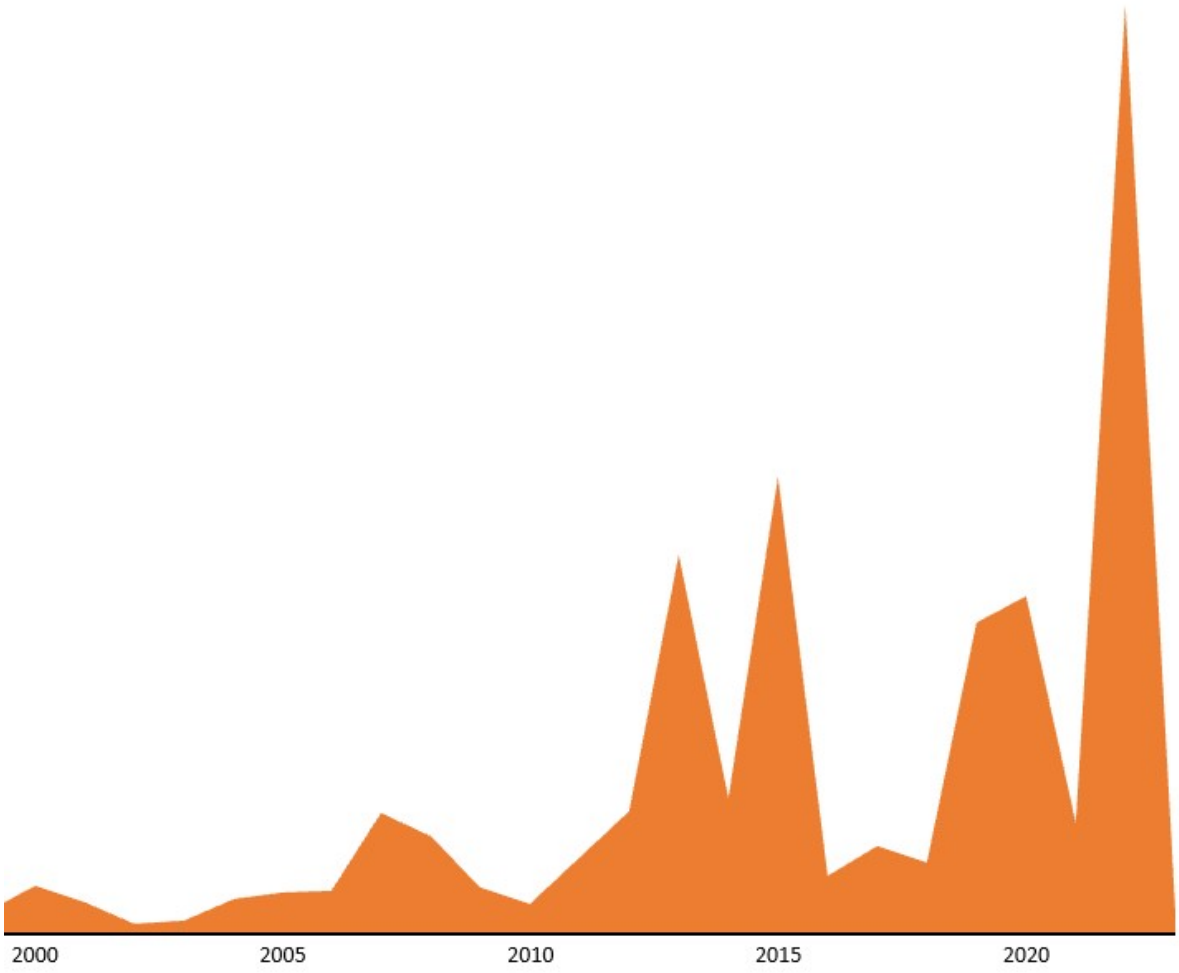

Figure 10.7: TM insurance's wind related claims

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	

Figure 10.8: Outline of Climate Change scenario coverage against the different segments of participating insurers' balance sheets

Risk category	SCR
Market risk	2.242.003.425
Counterparty default risk	927.259
Life underwriting risk	2.186.952.022
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-937.210.047
Operational risk	199.318.016
Adjustment for deferred taxes	-452.381.542
Total SCR	**3.253.068.669**
SR	**2,01**

Table 10.3: SCR when market value of life insurance underwriting's assets in the building category are shocked by -30%

Risk category	SCR
Market risk	2.187.016.186
Counterparty default risk	927.259
Life underwriting risk	2.186.952.022
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-925.855.814
Operational risk	199.318.016
Adjustment for deferred taxes	-450.434.382
Total SCR	**3.211.382.824**
SR	**2,03**

Table 10.4: SCR when market value of life insurance underwriting's assets in the building category are shocked by -40%

10.4 Shocking life insurance underwriting's expected mortality rate

10.5 Shocking non-life insurance underwriting's asset

Risk category	**SCR**
Market risk	2.488.490.928
Counterparty default risk	927.259
Life underwriting risk	2.670.479.858
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-1.088.742.420
Operational risk	199.318.016
Adjustment for deferred taxes	-557.152.880
Total SCR	**3.726.780.297**
SR	**1,75**

Table 10.5: SCR for life insurance underwriting when $q = 0,02$

Risk category	**SCR**
Market risk	2.187.016.186
Counterparty default risk	927.259
Life underwriting risk	3.172.566.821
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-1.175.874.596
Operational risk	199.318.016
Adjustment for deferred taxes	-656.895.483
Total SCR	**4.041.992.480**
SR	**1,62**

Table 10.6: SCR for life insurance underwriting when $q = 0,025$

Risk category	**SCR**
Market risk	2.187.016.186
Counterparty default risk	927.259
Life underwriting risk	3.685.635.879
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-1.248.175.974
Operational risk	199.318.016
Adjustment for deferred taxes	-759.003.600
Total SCR	**4.380.652.042**
SR	**1,49**

Table 10.7: SCR for life insurance underwriting when $q = 0,03$

Risk category	SCR
Market risk	2.187.016.186
Counterparty default risk	927.259
Life underwriting risk	4205.669.680
Health underwriting risk	13.459.533
Non-life underwriting risk	0
Diversification effect	-1.308.411.108
Operational risk	199.318.016
Adjustment for deferred taxes	-862.620.279
Total SCR	**4.736.834.031**
SR	**1,38**

Table 10.8: SCR for life insurance underwriting $q = 0,035$

Risk category	SCR
Market risk	54.709.647.596
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.333.006
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.904.837.555
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.856.508.587
Total SCR	**63.550.768.212**
SR	**1,44**

Table 10.9: SCR when market value of life insurance underwriting's assets in the building category are shocked by -10%

Risk category	SCR
Market risk	54.689.170.574
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.333.006
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.903.160.207
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.854.879.467
Total SCR	**63.533.597.656**
SR	**1,44**

Table 10.10: SCR when market value of life insurance underwriting's assets in the building category are shocked by -20%

Risk category	SCR
Market risk	54.668.701.460
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.333.006
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.901.482.556
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.853.250.675
Total SCR	**63.516.434.986**
SR	**1,44**

Table 10.11: SCR when market value of life insurance underwriting's assets in the building category are shocked by -30%

Risk category	SCR
Market risk	54.648.240.263
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.333.006
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.899.804.602
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.851.622.210
Total SCR	**63.499.280.208**
SR	**1,44**

Table 10.12: SCR when market value of life insurance underwriting's assets in the building category are shocked by -40%

Risk category	SCR
Market risk	52.343.547.190
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.333.006
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.704.520.864
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.844.938.393
Total SCR	**61.396.554.689**
SR	**1,49**

Table 10.13: SCR when market value of life insurance underwriting's assets in the transportation category are shocked by -10%

Risk category	**SCR**
Market risk	50.052.564.410
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.333.006
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.497.251.675
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.832.766.829
Total SCR	**59.325.012.663**
SR	**1,55**

Table 10.14: SCR when market value of life insurance underwriting's assets in the transportation category are shocked by -20%

Risk category	**SCR**
Market risk	47.871.110.101
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.333.006
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.286.517.028
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.822.097.300
Total SCR	**57.364.962.530**
SR	**1,60**

Table 10.15: SCR when market value of life insurance underwriting's assets in the transportation category are shocked by -30%

Risk category	**SCR**
Market risk	45.815.078.434
Counterparty default risk	320.887.405
Life underwriting risk	0
Health underwriting risk	7.435.333.006
Non-life underwriting risk	27.676.780.109
Diversification effect	-20.074.793.612
Operational risk	3.169.466.237
Adjustment for deferred taxes	-8.813.398.160
Total SCR	**55.529.339.282**
SR	**1,65**

Table 10.16: SCR when market value of life insurance underwriting's assets in the transportation category are shocked by -40%