

Climate Change: Actuarial Roles and Strategies

November 2023



Agenda for Today's Discussion

1. Climate change insurance regulatory considerations and stakeholder overview
2. Climate change risk assessments and integration into risk management frameworks
3. Climate change scenario testing
4. Net Zero in insurance - greenhouse gas quantification and business integration
5. The actuary's role in climate risk management and strategies for future climate uncertainties

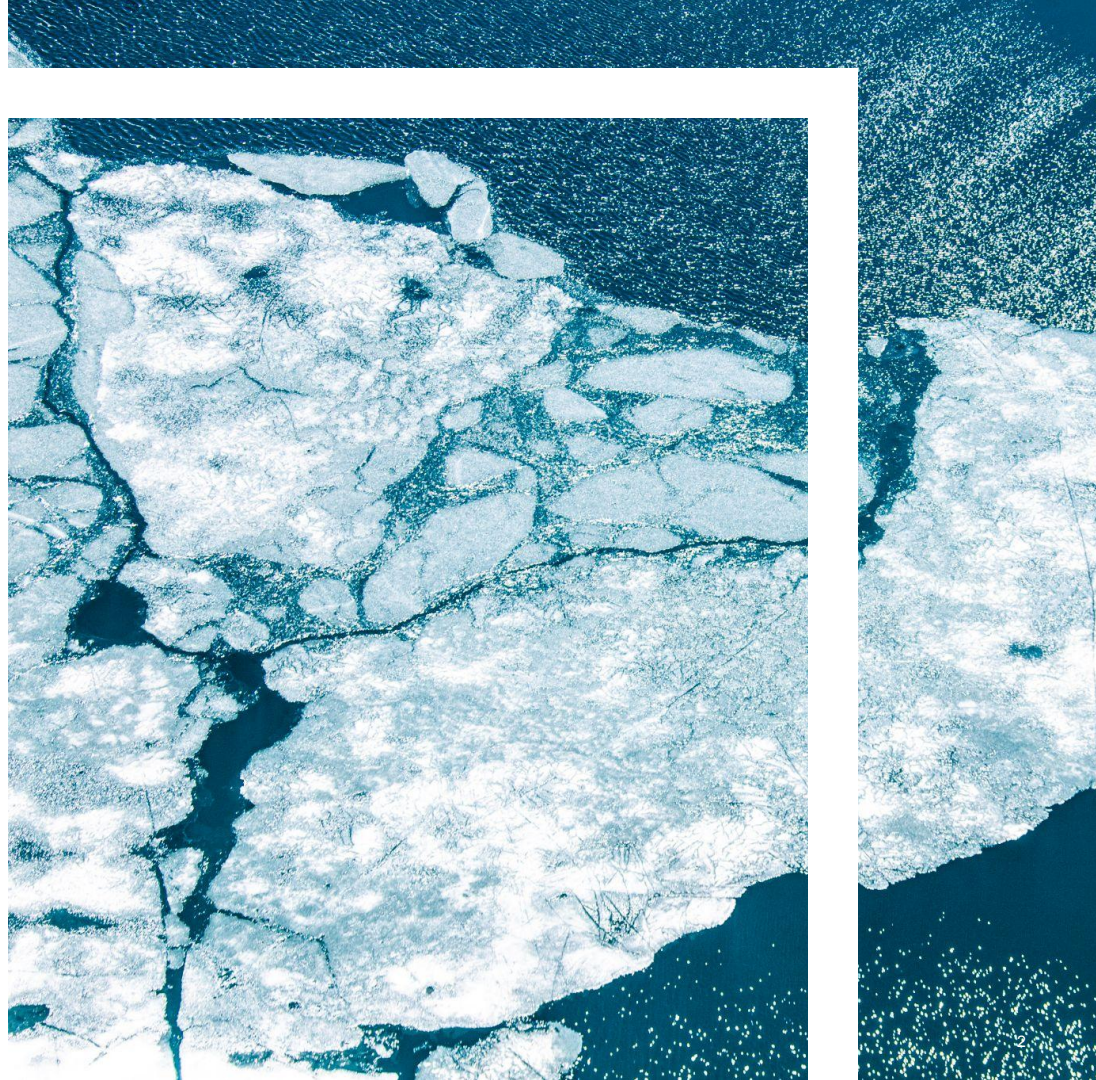


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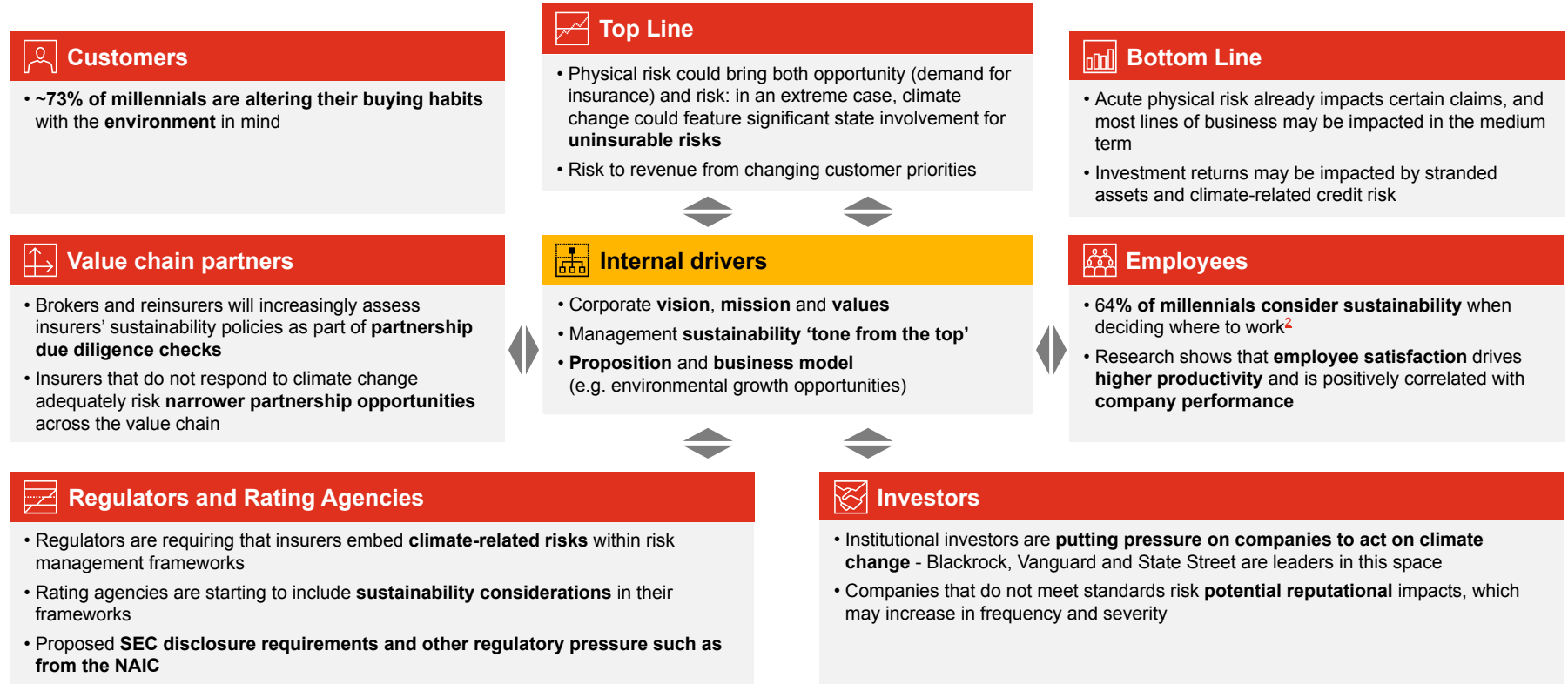




Climate change insurance regulatory considerations and stakeholder overview



What are current issues and considerations for insurers as it relates to climate risk?



Regulatory bodies are increasing demands on climate disclosures

Movement from regulators and rating agencies on ESG topics is as key driver for many insurers to consider integration of ESG into their businesses.



NAIC

Hosted an annual climate change disclosure survey since 2010, and in 2022, updated the questions to be aligned with the TCFD framework.



NYDFS

Issued final guidance for the integration of climate change for insurers it regulates in November 2021 including qualitative and quantitative metrics and target setting and performing scenario analysis.



CA & WA DOIs

In 2021 the commissioners of the California and Washington DOIs issued a letter to all carriers they regulate encouraging them to publish a TCFD report, rather than submitting the NAIC climate change disclosure survey.



SEC

In 2022 proposed SEC rule for climate change disclosure, including Scope 1, 2, and 3 emissions, and qualitative and quantitative risks and opportunities.



International

CSRD has already entered into force, requiring public disclosure of ESG matters on a “double materiality” basis. The ISSB’s IFRS S2 was published in June 2023 and is also applicable. Both require disclosure of climate risks & scopes 1-3 emissions.

What is the TCFD?

The Task Force on Climate-related Financial Disclosures (TCFD) issued guidance for climate risk disclosure for all sectors, and specific recommendations for certain sectors (such as insurance)

01
Insufficient disclosure

The TCFD is an advisory body set up by the G20 to address concerns around insufficient disclosure of climate-related risks and opportunities for businesses.

02
Led by industry leaders

The TCFD is chaired by Michael Bloomberg and consists of 32 industry leaders, including representatives from Blackrock and Unilever

03
Informed investment decisions

The TCFD recommendations aim to enable better understanding of exposures to climate risks and opportunities.

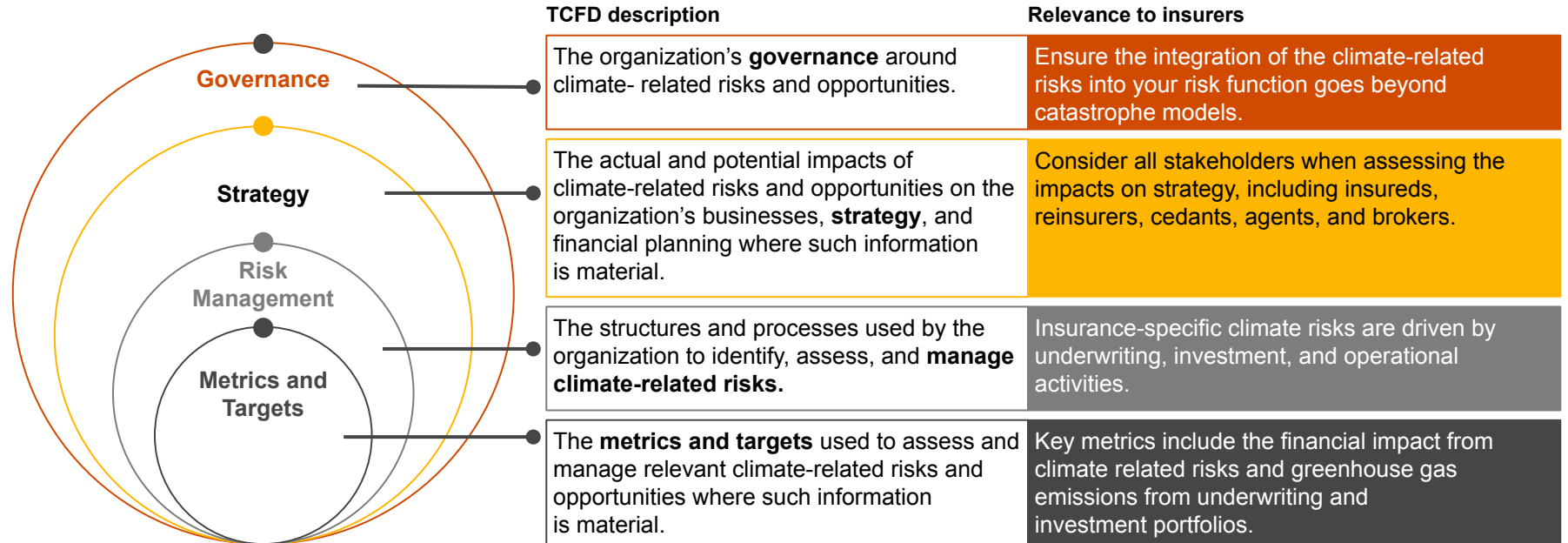
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Progress

The Task Force released a status report in 2021, highlighting the progress made in companies' climate risk disclosure over the past year. In 2021 the TCFD issued proposed guidance on climate-related metrics, targets, and transition plans. An additional report specific to the insurance industry, "Insuring the Climate Transition", was issued in January 2021.

TCFD has quickly become the industry standard for how companies should orient around climate risk, and how they should disclose on it publicly

More than 4000+ organizations from 100+ countries with a combined market capitalization of \$27 trillion have announced support for the guidelines, including 1,500+ financial firms responsible for assets of \$217 trillion.

TCFD has four disclosure components



Overview of sought disclosures



Disclosures are generally qualitative information (narrative) with supporting quantitative information, i.e., scenario analysis results and in the Metrics & Targets section)



Governance

Disclose the organization's governance around climate-related risks and opportunities.

Recommended disclosures

- Describe the **board's oversight** of climate-related risks and opportunities.
- Describe **management's role** in assessing and managing climate-related risks and opportunities.



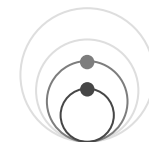
Strategy

Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material.

Recommended disclosures

- Describe the **climate-related risks and opportunities** the organization has identified over the **short, medium, and long term**.
- Describe the **impact** of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.
- Describe the **resilience** of the organization's strategy, taking into consideration different **climate-related scenarios, including a 2°C or lower scenario**.

Overview of sought disclosures (continued)



Disclosures are generally qualitative information (narrative) with supporting quantitative information, i.e., scenario analysis results and in the Metrics & Targets section



Risk management

Disclose how the organization identifies, assesses, and manages climate-related risks.

Recommended disclosures

- Describe the organization's processes for **identifying and assessing** climate-related risks.
- Describe the organization's processes for **managing** climate-related risks.
- Describe how processes for identifying, assessing, and managing climate-related risks are **integrated into the organization's overall risk management**.



Metrics and targets

Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.

Recommended disclosures

- Disclose the **metrics** used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process.
- Disclose **Scope 1, Scope 2**, and, if appropriate, **Scope 3** greenhouse gas (GHG) emissions, and the related risks.
- Describe the **targets used by the organization to manage** climate-related risks and opportunities and performance against targets.

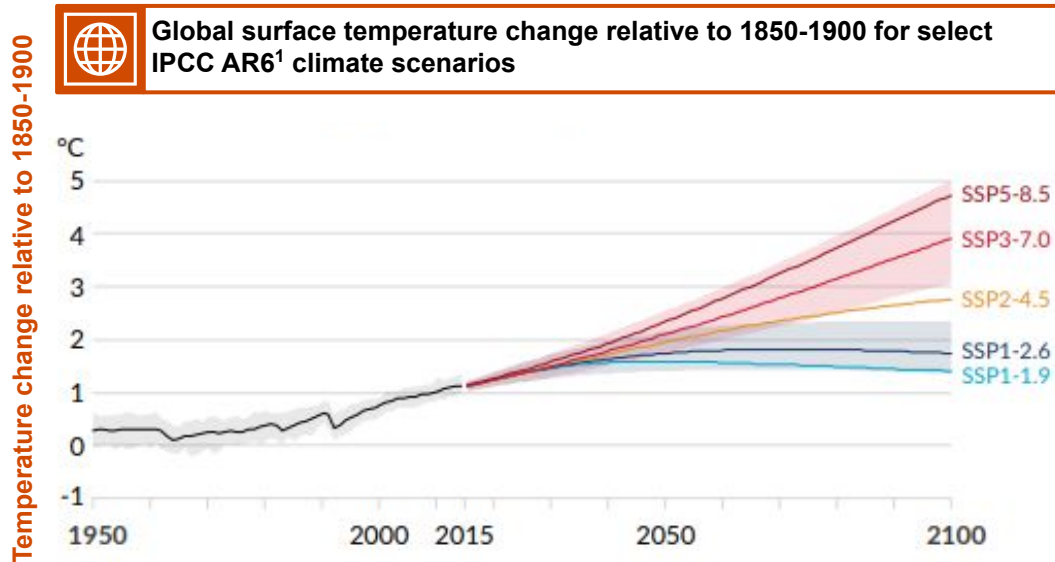


Climate change risk assessments and integration into risk management frameworks



Climate change poses new business risks to insurance companies

Depending on future efforts to curb climate change, or lack thereof, insurers will be faced with a new set of risks to consider as part of ongoing operations.



¹ Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6 ([AR6](#)) [Climate Change 2021: The Physical Science Basis](#)



Physical risk: Risks which arise from short & long term weather events (e.g., auto underwriting losses increase over time driven by increasingly severe hailstorm events)
Physical risk is higher in climate scenarios with a temperature rise (relative to 1850-1900) greater than 2°C

Transition risk: Risks which arise from the process of adjusting towards a low-carbon economy (e.g., impact of a carbon tax, volatile underwriting due to lack of data on green technologies, reputational risk if slow to go to net zero)

Liability risk: Risks of potential climate-related legal claims or regulatory proceedings to companies and directors (e.g., increased D&O and third-party environmental claims)

Transition and liability risks are higher in forward looking climate scenarios with a temperature rise (relative to 1850-1900) limited to 2°C

Example climate risks and opportunities

Climate changes risks and opportunities are typically considered across the following categories:

Transition & liability risks as a result of transition to a low carbon economy

Policy and legal

- Increased carbon policy/pricing of GHG emissions
- Enhanced emissions-reporting obligations
- Mandates on and regulation of existing products and services
- Exposure to litigation

Technology

- Substitution of existing products and services with lower emissions options
- Unsuccessful investment in new technologies
- Costs to transition to lower emissions technology

Market

- Changing customer behavior
- Uncertainty in market signals Increased cost of raw materials

Reputation

- Shifts in consumer preferences
- Stigmatization of sector
- Increased stakeholder concern or negative stakeholder feedback

Physical risks resulting from changes in the climate

Acute

- Increased severity of extreme weather events, e.g.
 - Floods
 - Wind storm
 - Storms and cyclones
 - Wildfire
 - Storm surge
 - Hail

Chronic

- Changes in precipitation patterns
- Changes in extreme variability in weather patterns
- Rising mean temperatures
- Rising sea levels

Opportunities

Resource efficiency

- More efficient resource use
- Move to more efficient buildings and modes of transport

Energy source

- Use of lower emission energy sources
- Use of supportive policy structures
- Use of new technologies
- Participation in carbon markets

Products and services

- Development/expansion of low emission goods and services
- Climate adaptation and insurance risk services

Markets

- Access to new markets
- Use of public sector incentives

Resilience

- Resource substitution/diversification
- Renewable energy programs, efficiency initiatives

Climate risk to insurers can be classified into three buckets



Underwriting Risks



Investment Risks



Operational Risks

	Underwriting Risks	Investment Risks	Operational Risks
Transition & Liability	Policy & legal Increased climate-related litigation significantly increasing claim and defense costs for D&O coverages	Investment in sectors where bottom lines are impacted most by carbon taxes (e.g., parts of the energy sector) negatively affecting asset value.	Onerous enhanced reporting requirements leads to issues with adequately disclosing information required by regulators and investors
	Market Shifting demand or carbon taxes lead to market movement away from fossil fuels, leading to reduced premiums from carbon intensive sectors.	Shift in customer preferences for climate friendly goods and services (e.g. electrical cars and transport vehicles) puts investments in producers of conventional, carbon-based goods and services under pressure.	Shift in customer preferences for sustainable companies diminishes demand for certain insurance products and services, as business strategies not sufficiently taking into account the long term impact of sustainability factors.
	Technology High claims ratios on new insurance products covering green technologies because of underpricing due to lack of data.	Investee companies or sectors invest in new low-carbon technologies but some of those prove unsuccessful, depressing their asset values & creating credit risk.	Failure to take into account disruption of conventional industrial organization induced by technology- driven transition to low-carbon economy; new firms in the space demand insurance products/services where traditional players lack expertise, leading to a drop premium.
	Reputation P&C underwriting in economic sectors contributing to climate change damages the reputation of insurance carriers, making it difficult to attract and retain customers and staff.	Investments in certain companies perform poorly because of their reputation of contributing to climate change.	Insureds may prefer insurers who demonstrate climate risk awareness and have incorporated climate risk into their strategy publicly and in a way that aligns with their own values.
Physical	Acute Property underwriting losses increase over time due to increased severe weather events, if pricing not proactively adjusted.	Values of real estate portfolios decline due to properties being located in areas highly sensitive to the increase in extreme weather events.	Inappropriate strategy relating to acute physical climate risk mitigation reduces the insurer's competitiveness.
	Chronic Increase in temperatures may make some areas of the country uninhabitable, which can lead to reduced premiums.	Higher credit spreads on government bonds issued by countries that are highly susceptible to chronic physical risks.	Climate change-induced sea level rise renders office buildings and operations in vulnerable areas uninsurable.

Illustrative climate change impacts on life insurance assumptions

Specific products will behave differently in unique climate scenarios. In a scenario with high greenhouse gas emissions, mortality, incidence, lapses, and expense are expected to increase, which will impact profitability differently depending on the product mix.



Expected impacts to key assumptions in a high GHG scenario

Mortality rates will increase overall, which will impact profit differently depending on the product

- Lengthening of the transmission season of vector-borne diseases, therefore increasing the chances of pandemics
- Increased accidents due to extreme weather events and increased intensity of natural disasters
- Increased heat waves (frequency and intensity) and heat-related deaths

Lapse rates may increase or decrease, which may create uncertainty on overall profit

- Economic contraction (e.g., causing lower wages) or financial strains arising from extreme weather events could cause insurance premiums payments to become unaffordable
- Increasing concern of climate change and/or deteriorating health conditions may cause policyholders to keep their policies and the protection they provide

Incidence rates will increase, decreasing profitability for disability and health products

- Decreased air quality from more wildfires and increased levels of pollutants, causing increased hospitalizations and disability claims due to a number of diseases
- Increased accidents due to extreme weather events and natural disasters
- Increased heat waves (frequency and intensity) tied to increased hospitalization

Expenses will increase, decreasing overall profitability

- Climate disclosures and regulatory compliance will increase both upfront and ongoing costs
- Business/operational disruption will occur due to the increased frequency and intensity of extreme weather events

Illustrative example: Term life in a high GHG scenario

In a high greenhouse gas scenario, where physical risks are anticipated to cause higher mortality, increased lapses and increased expenses, term life products can be expected to be negatively impacted. Particularly, increased mortality is expected to drive the largest negative impact given the sensitivity of the product to mortality assumptions. Additionally, increased lapses would only exacerbate anti-selection mortality, as policyholders who wish to continue on the policy are higher risk individuals.



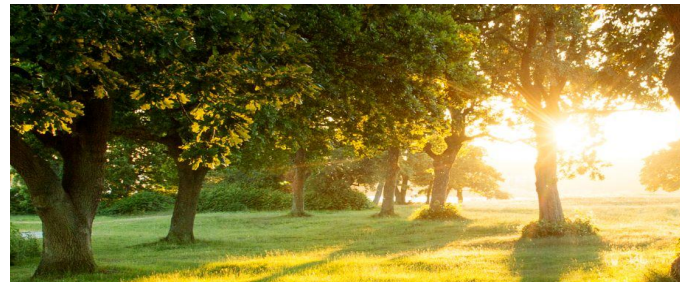
Expected impacts on product profitability in a high GHG scenario

Assumptions	Products			Example: Term life
	Life	Annuities	Health	
Increased Mortality	Medium Negative	High Positive	High Positive	High Negative
Increased Lapse	Low Negative	Low Positive	Low Positive	Low Negative
Increased Expenses	Low Negative	Medium Negative	Low Negative	Low Negative
Increased Incidence	NA	NA	High Negative	NA

High Negative



High Positive



Illustrative climate change impacts on P&C insurance coverages

1 Coverage Type	Workers' Compensation	Commercial Property / Homeowners	D&O	General / Products Liability	Auto Liability	Others
2 Transition Risk	<p>Medium</p> <p>Workers transition from jobs with credible loss history to newer technology where claims development trends are not yet known</p>	<p>Low</p> <p>Technologies required to meet new environmental building regulations may fail, leading to increased business interruptions</p>	<p>High</p> <p>Climate-related litigation being brought against insureds requiring unexpected levels of claim and defense costs</p>	<p>Medium</p> <p>Increasing litigation against heavy polluters for their contributions to climate change creates latent claim risks</p>	<p>Low</p> <p>Greater adoption of electric vehicles could lead to underpricing/higher claims ratios due to limited historical data on repair costs</p>	<p>Unknown</p> <p>Transition risks may continue to emerge from unexpected sources as changes are made to move towards a low carbon economy</p>
3 Physical Risk	<p>Medium</p> <p>Heatwaves leading to heat stress of more workers, particularly in the agricultural, construction, and manufacturing fields</p>	<p>High</p> <p>Increased frequency and severity of claims related to damage to buildings, storefronts, etc from severe weather events</p>	<p>Low</p> <p>N/A</p>	<p>Medium</p> <p>Coverages such as contractors' liability could see rise in weather-related damages claims</p>	<p>Medium</p> <p>Increased personal auto comprehensive coverage claim costs due to severe weather</p>	<p>Unknown</p> <p>Physical risks may result in downstream effects not currently felt or identified</p>

General industry approach to climate change risk management and scenario analysis

Risk assessment

In the marketplace, we observe insurers conducting a **comprehensive risk assessment** of the risks to its business from climate change. This typically covers both transition risks and physical risks. Such a risk assessment may include:

- a. High/Medium/Low assessment of the business across risks types, investments, products and key assumptions
- b. Most often measured based on likely frequency and severity of the risk if it were to emerge
- c. Isolating the top 5 risks to the business and measuring their impact accordingly

This risk assessment is used to inform the scenario testing exercise.

Scenario analysis

Insurers may perform scenario testing exercises after completion of the risk assessment; these typically focus on three specific areas of an insurer's business:

1. Asset portfolio

- Calculate the impact of climate change on the investments held under different climate change scenarios and time horizons

2. Underwriting portfolio

- Stress the key assumptions and processes used to understand and manage accumulations and exposure

3. Operational impact

- Assess the operational impact of extreme/intensifying weather events on corporate locations and employee homes

Where possible, companies may seek to **leverage existing scenario analysis framework** to streamline this process.

Business integration

Insurers may assess how the results of the risk assessment and scenario testing exercise integrate into the business, specifically considering:

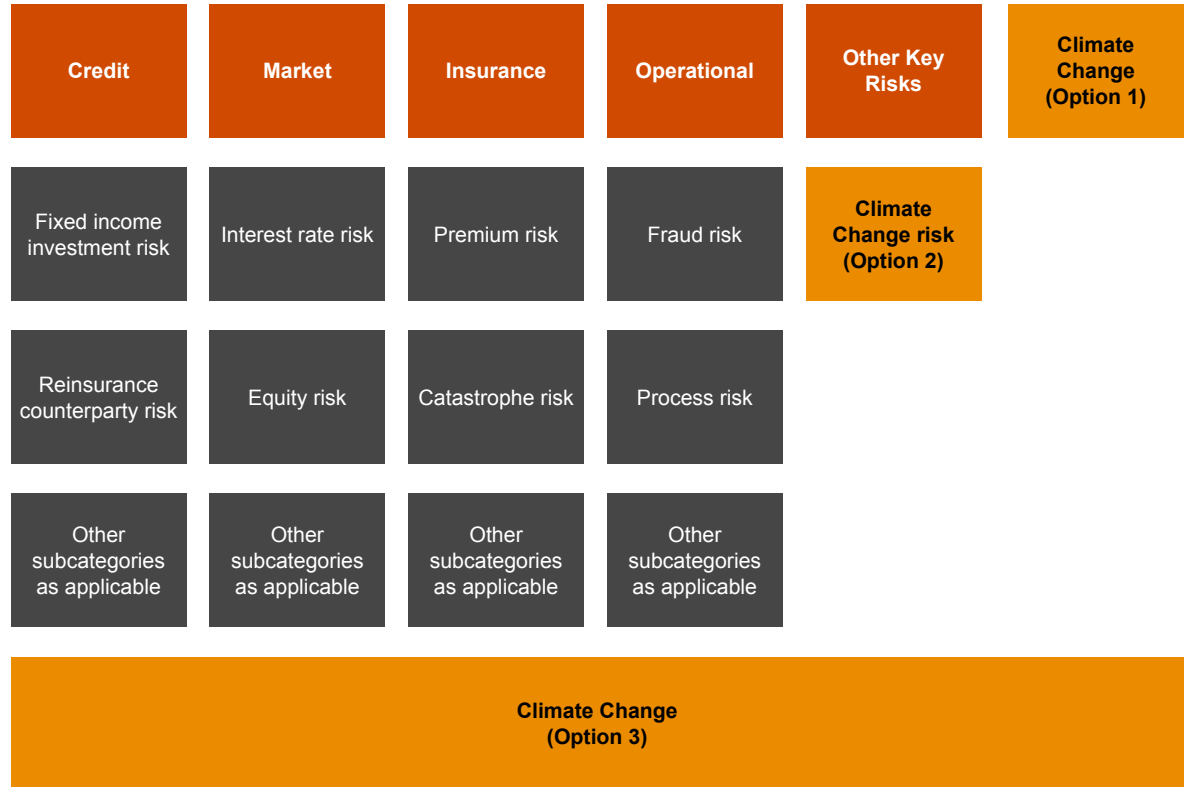
- a. Governance framework
- b. Risk management processes
- c. Business strategy
- d. Integration into ESG or other disclosures

Ways to implement the risks of climate change into ERM framework

Option 1: Recognize climate change risk is a key risk similar to insurance, market and credit risks

Option 2: Recognize climate change could fit into a company's risk management framework as a new sub-risk category under an existing key risk category

Option 3: Recognize climate change affects financial risks as well as non financial risks such as operational risk





Climate change scenario testing



Case Study: Operation Risk Climate Scenario Analysis

Predict current and future risks from different weather perils at a GPS-coordinate level to determine potential financial impacts from future extreme weather events on assets.

Physical risk modeling approach

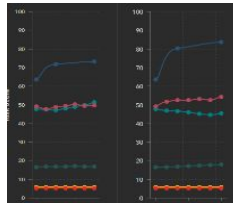
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Calculate **current risk score** by property or location for each individual climate peril



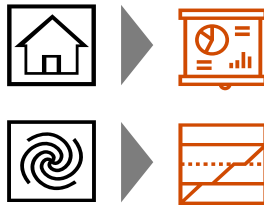
2

Project risk scores for future time horizons using the **changes in climatological variables** under different climate scenarios and models.



3

Develop functions which **link severity of weather events to business impacts** to facilitate assessment of business loss metrics



Covered changes in the physical risk intensity for six major perils



Flood



Hail



Hurricane



Drought

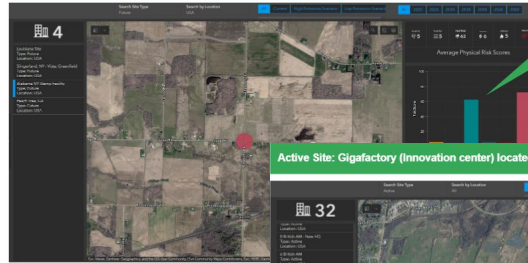


Wildfire



Wind Gust

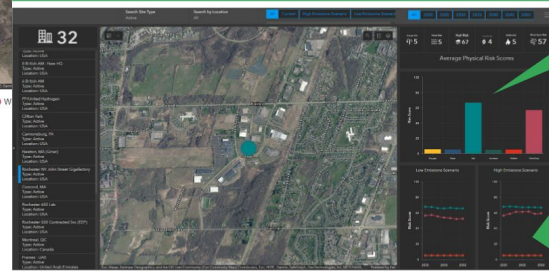
Future Sites: Gateway site located in Alabama, NY



This site has a high Hail and Wind Gust risk across both scenarios and all time horizons.

Wind Gust risk increases gradually till 2050 within high emissions scenario.

Active Site: Gigafactory (Innovation center) located in Rochester, NY



Gigafactory (Innovation center) has a moderate Hail risks. Hail could damage facilities or renewable energy sources.

Hail scores decrease slightly in the low emissions scenario but remains fairly constant in the high emissions scenario. Wind Gust risk also becomes more prominent in a high emissions scenario. Plug should consider possible power outages from heavy winds destroying power lines, along with any structural damage from hail that could jeopardize electrolyzers.

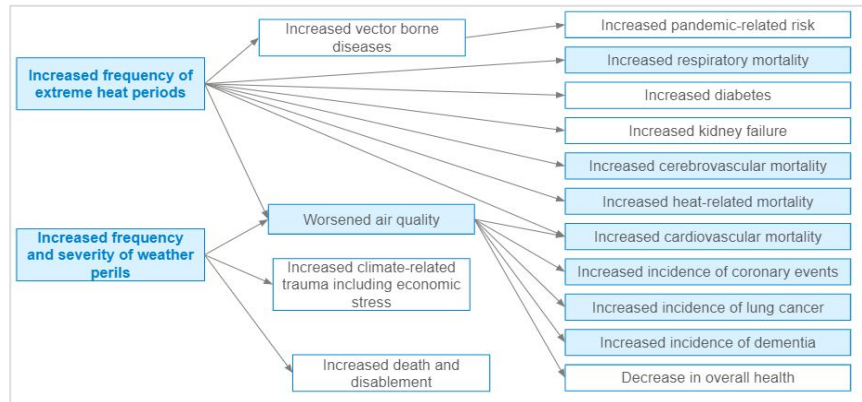
Case study - Liability scenario analysis on liabilities for life & health carrier

A targeted, science-based scenario analysis helps to understand how long-term insurance risk might be impacted by different climate scenarios

Linking Climate to Human Health

Climate change manifests itself as an impact on human health through both **heat stress** and cumulative **air quality** impacts from wildfires and other GHG emitters. Other impact pathways qualitatively considered centered around water quality/water scarcity and contamination, mental stress, as well as acute physical risk impacts such as difficulty in **evacuating nursing homes** in a hurricane or flood (pathways flowchart below for reference).

Age considerations were given to our projected impacts to mortality and morbidity, where the client's portfolio consisted of both high attained ages in LTC and a younger life block. We also developed separate assumptions based on studies targeted towards disabled lives for disabled mortality assumptions.

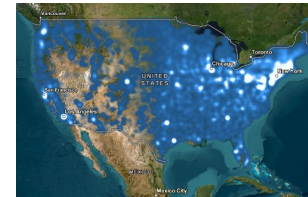


Using Climate Models for Precise Results

A quantitative approach to stress-testing morbidity assumptions through **IPCC-SSP scenarios** was used. We focused on **impact pathways with established epidemiological and scientific evidence**, and quantified morbidity impacts based on our research in combination with our understanding and the client's knowledge of their portfolio characteristics and cohort behavior.

We analyzed the **geographic locations (down to the zip code level) of policyholders** to consider both concentration risk and how climate perils will impact policyholders in certain locations. We layered the polygon location information into our proprietary **Geospatial Climate Intelligence** tool for localized risk predictions of heat stress and air quality to finetune climate stress assumptions. For example, heat stress is anticipated to be more severe in the South, and higher heat stress has been shown to lead to higher morbidity and mortality rates. By using a weighted average of impacts across zip codes, academic studies on mortality and morbidity impacts can be closer tied to the insurer's portfolio.

Upon creating vectors to stress the assumptions, a quantitative analysis was performed, **leveraging client's existing cash flow testing models** within AXIS, to include stresses on assumptions impacting **premiums, benefits, and expenses**. These results were then compared to baselines results to Understand the potential implications to the liability portfolio from climate change.

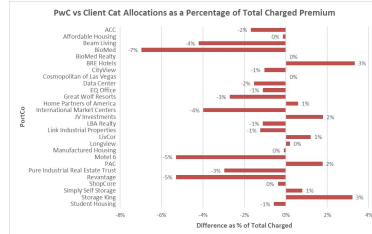
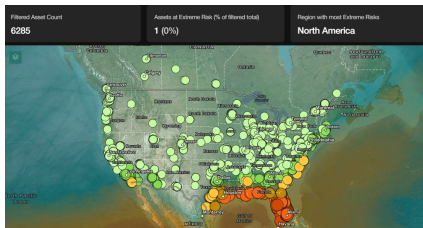


Case study: Catastrophe premium allocation for property captive insurer

PwC utilized Geospatial Climate Intelligence to derive high level property damage estimates from select climate perils across our client's (a Captive insurer) portfolio. We then helped the client equitably distribute its Catastrophe-related premium charges across the client's corporate policyholders while also lending a view towards at-risk properties in 2030.

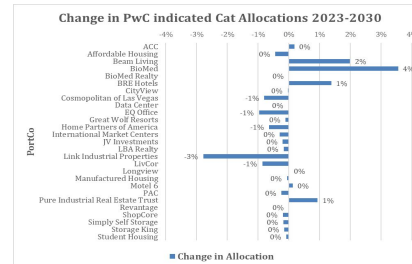
Current State Catastrophe Premium Validation

- Utilized **Geospatial Climate Intelligence** to estimate *current* frequency and intensity across **six perils** (Flood, Tropical Cyclone, Tornado, Hail, Storm Surge, Wind Gust) for over **34,000** client assets throughout North America.
- Translated frequency and severity indications into **building damage loss potential estimates** for each peril based on damage curves specific to certain building characteristics.
- For each of the Captive's insureds, **determined estimated share of Catastrophe exposure** for the in-scope perils based on building characteristics and asset locations. Compared estimate to Client's estimate to validate Client's internal Catastrophe premium charges.



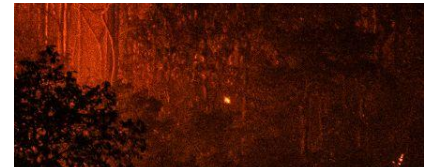
Future State Loss Exposure

- Utilized Geospatial Climate Intelligence to estimate *future (2030)* frequency and intensity of **seven perils** (including Sea Level Rise) for the Client's locations in a low and high warming scenario
- For the high warming scenario, determined **estimated change in Catastrophe loss exposure** for each of the Captive's insureds between 2023 and 2030 based on building characteristics and peril frequency / intensity.
- Client was equipped to manage future loss exposure across its assets by: **informing future Cat premium allocations to each insured**, assisting insureds in **developing targeted loss mitigation plans**, and assisting insureds in future **strategic decision making related to asset acquisition or dispensation**





Net Zero in insurance - greenhouse gas quantification and business integration



What is Net Zero and why are we talking about it?

To avoid the most dangerous impacts of climate change, planetary warming must be limited to 1.5°C.

51
Billion
tons

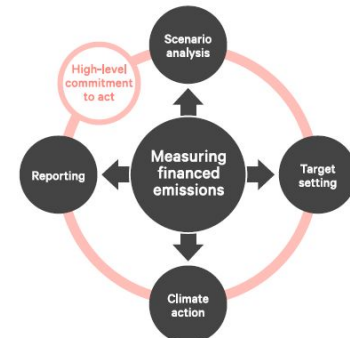
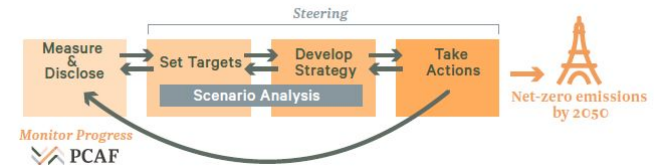
To do this, the amount of greenhouse gases added to the atmosphere each year must be reduced from **51 billion tons to zero, no later than 2050.**

Net Zero is the balance between emissions produced by and emissions taken out of the atmosphere. Reaching net zero means a company is no longer contributing to planetary warming.

For an insurance company, achieving this means tackling emissions from a company's **entire value chain** including not only operations, but also emissions of investee companies and from the use of sold insurance policies.

Insurers will need to manage emissions from these activities embedded in their investment and underwriting portfolios. By doing so, they can better identify and manage risks, navigate emissions reduction goals, act to reduce their portfolio climate impact, and disclose progress.

Illustrative process for embedding financed emissions quantification and management within organizational strategy



Source: (PCAF, 2020)

What are financed emissions?

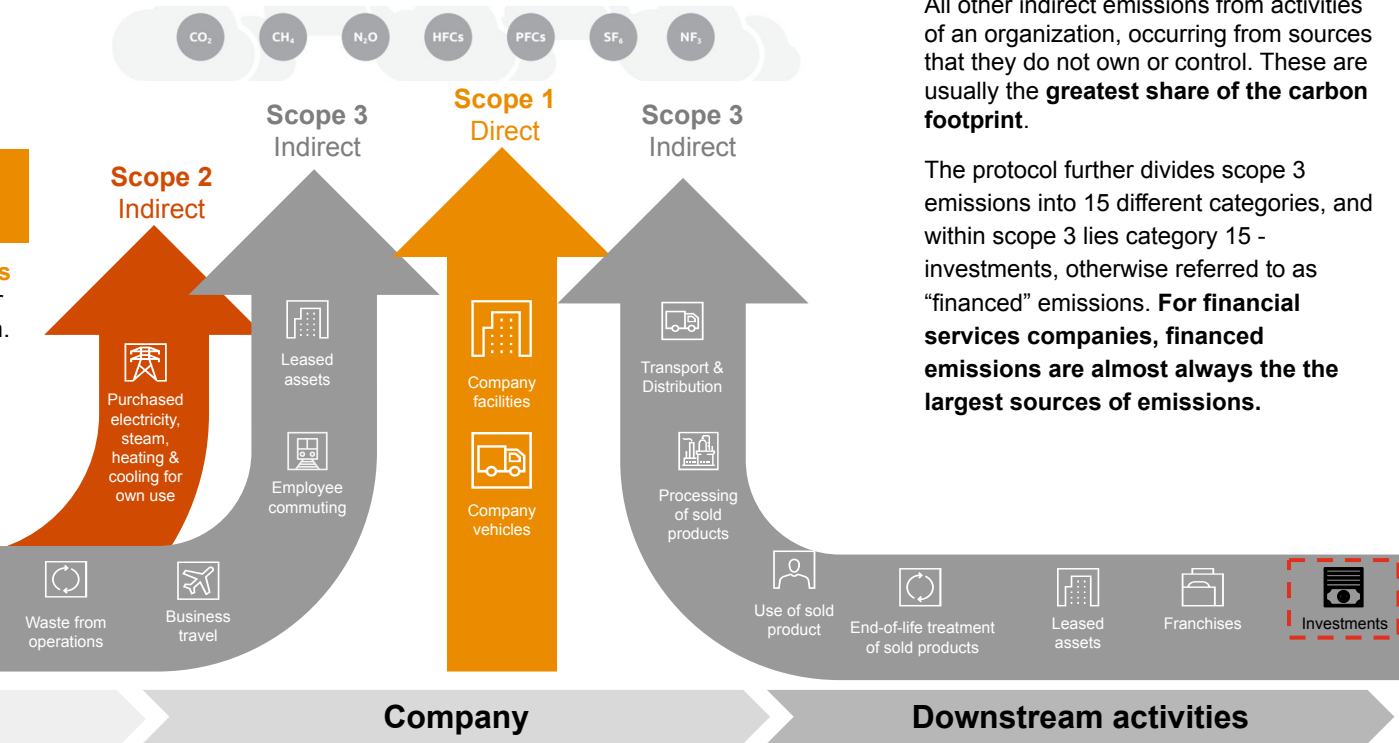
GHG Protocol

Carbon accounting is rooted in the fundamentals set forth in the Greenhouse Gas Protocol (GHG protocol), which divides emissions from all activities into Scope 1, 2, and 3 activities

Scope 1 & Scope 2

Scope 1 emissions are all direct emissions from the activities of an organization or under their control including on-site fuel combustion.

Scope 2 emissions are all indirect emissions from electricity purchased and used by the organization. Emissions are created during the production of the energy and eventually used by the organization.

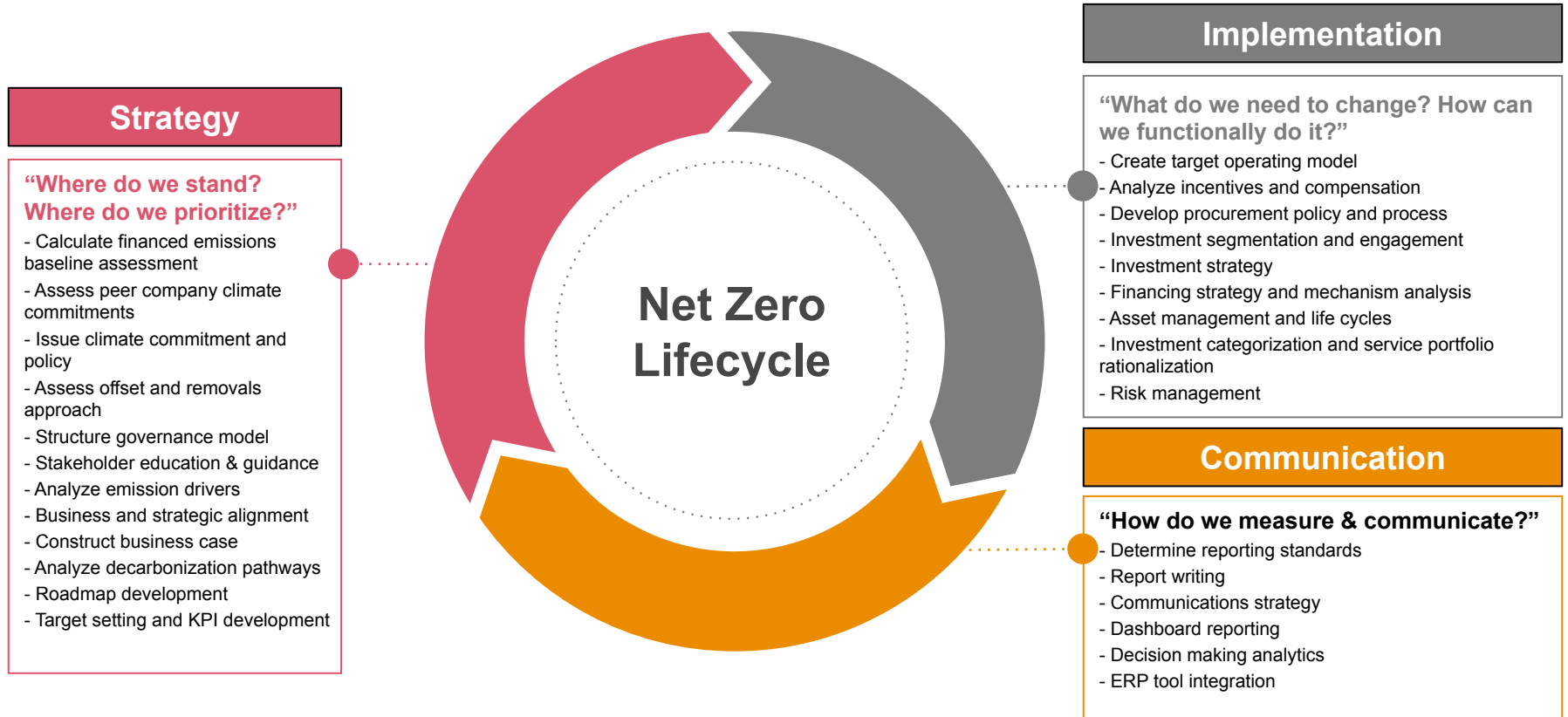


Scope 3

All other indirect emissions from activities of an organization, occurring from sources that they do not own or control. These are usually the **greatest share of the carbon footprint**.

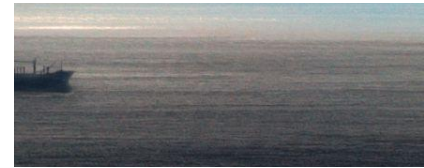
The protocol further divides scope 3 emissions into 15 different categories, and within scope 3 lies category 15 - investments, otherwise referred to as “financed” emissions. **For financial services companies, financed emissions are almost always the the largest sources of emissions.**

The journey to Net Zero financed emissions





The actuary's role in climate risk management and strategies for future climate uncertainties



What is the Actuary's role in Climate Risk Management?

As actuaries, we possess strong modeling, quantification, and risk assessment skills, while also understanding the ins and outs of the insurance business. This makes us uniquely positioned to take ownership of many different aspects of climate risk to an organization. These new challenges present an exciting opportunity for all actuaries to put our analytical mindsets to work and broaden traditional actuarial horizons. Some examples of how actuaries can be involved are included below. How are you helping your organization address its climate-related challenges and risks?

Updating Cat Models

**Physical Risk
Quantification**

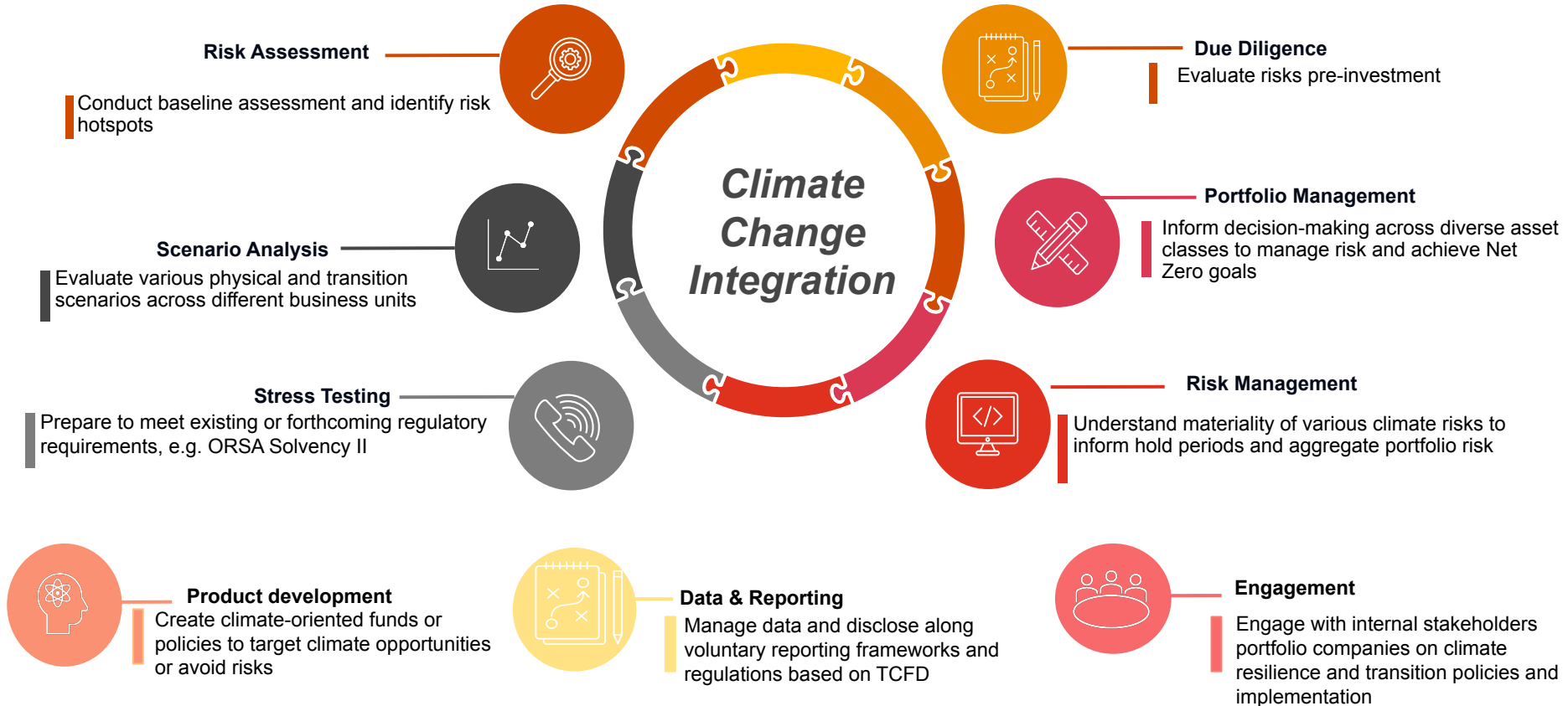
Net Zero Modeling

Climate Risk Integration

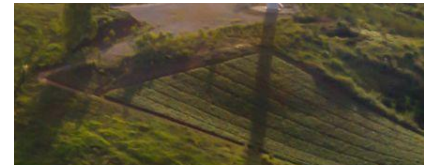
**Transition Risk
Assessment**

Scenario Testing

Climate risk and impact into different components of business models



Thank you



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