CFRF CLIMATE FINANCIAL RISK FORUM

CLIMATE FINANCIAL RISK FORUM GUIDE 2020

RISK MANAGEMENT CHAPTER

June 2020

Contents

This chapter represents the output from the cross-industry Risk Management Working Group of the Prudential Regulation Authority and Financial Conduct Authority's Climate Financial Risk Forum. The document contains information on approaches to managing the risks associated with climate change, and views on good practices at the time of production.

This CFRF guide has been written by industry, for industry. The recommendations in this guide do not constitute financial or other professional advice and should not be relied upon as such. The PRA and FCA have convened and facilitated CFRF discussions but do not accept liability for the views expressed in this guide which do not necessarily represent the view of the regulators and in any case do not constitute regulatory guidance.

1 Overview

Purpose

This chapter on Risk Management provides practical guidance on how to address climate risks within financial institutions. It describes good practices but is also designed to act as a guide for those who have yet to fully consider the topic, where case studies are included they are consistent with this approach. It has been produced by the Risk Management Working Group of the Climate Financial Risk Forum.

The guide is aimed at banks, asset managers and insurers of all sizes. Some of the information in this guide may be more or less relevant for different firms depending on the scale and nature of their business and their risk profile. In deciding what elements of the guidance to adopt it is recognised that firms' capabilities will vary greatly, however we encourage firms to start work with urgency to develop understanding of the risks. A common approach is to perform a materiality assessment and initially focus on a small set of risks with scope and sophistication increasing over time. It is for individual firms to determine the best approach based on the information in this guide and other sources of information.

The expectations and practices around climate risk are quickly evolving and hence the information and examples in the document, should be considered alongside current developments. This guide should be read in conjunction with the PRA's Supervisory Statement 3/19 on the financial risks from climate change, and with the outputs from other working groups of the Climate Financial Risk Forum (in particular the Scenario Analysis and Disclosures working groups). Whilst the Risk Management chapter aligns well to regulation (including PRA Supervisory Statement 3/19) it should not in any way be viewed as either setting regulatory expectations or providing a set of standards that can be audited against.

It is anticipated that the information in the guide will be developed over time based on feedback and the resultant priorities of the Climate Financial Risk Forum.

Scope

The guide is split into the following topics which were considered the most relevant for climate risk management:

- Section 2: Risk governance
- Section 3: Risk management frameworks
- Section 4: Risk appetite

- Section 5: Risk assessment for insurance underwriting, credit, financial market, and operational risks
- Section 6: Data and tools
- Section 7: Training and culture
- Section 8: Challenges, barriers and gaps

Supplementary information is also provided in the annex.

2 Risk governance

Effective governance should ensure that there is understanding, oversight and accountability for financial risks arising from climate change (collectively termed as "climate risk") at all levels of an institution. The board has ultimate accountability for the long-term health and resilience of a firm. Therefore, as is the case with established financial and non-financial risks, the board's understanding and oversight of the firm's approach to management of climate risks is key to embedding effective governance. There is a need for the board-level governance to be cascaded down into the organisation through governance committees and designated individuals, subject to the firm's legal and corporate governance structure. Governance arrangements should promote strong understanding of the risks at origination; colleagues in the relevant businesses and functions require strong understanding of the firm's approach, tools and approval authorities to ensure climate risks are identified, assessed and accepted at the right levels – consistently throughout the organisation.

Good practice

The ultimate goal for firms is to design and implement the governance approach for climate risks akin to established financial risks, while addressing the climate risk-specific nuances where necessary.

As such, one potential indicator of the firm's quality of climate risk governance could be based on the extent to which climate risk management is integrated effectively into established risk management. Good practice on climate risk governance includes the following elements:

1. Effective management and oversight from the board
2. Appropriate allocation of Senior Management Responsibility
3. Clear roles, responsibilities and accountability across all three lines of defence
4. Updated risk frameworks and policies for relevant risk types through which climate risks manifest (see section 3)
5. Board approved Risk Appetite and management reporting metrics (see section 4)
6. Clear risk authorities, reflecting the materiality of risks, which are implemented effectively
7. Controls embedded into relevant processes covering risk identification, assessment, acceptance or approval, monitoring and reporting (see sections 5 and 6)
8. Education and awareness building to develop climate risk understanding at all levels in an organisation (see section 7)

The World Economic Forum paper "How to Set Up Effective Climate Governance on Corporate Boards: Guiding principles and questions" provides further practical and useful guidance.

The differentiation between climate risk as a financial risk type, and broader sustainability / ESG risks should be clear. There is variation within industry as to where these wider risks fit within a firm's structure (e.g. second line, first line, or functions such as Corporate Social Responsibility teams).

Implementation steps

Steps for setting-up board governance

1. Deliver a tailored training programme to the board on climate risk; consider using external experts where necessary.
2. Update board committee terms of reference to include climate risk.
3. Provide periodic regular updates to relevant board committee(s) on:

    a. The firm's progress in preparing for and implementing climate risk management
    b. Risk reporting metrics (Risk Appetite and metrics developed)

4. The board to provide review and challenge on:

    a. Undue or unexpected climate risk concentrations
    b. The firm's strategy / corporate plan, considering the climate risk profile, through a short (e.g. 3-5 year), medium (e.g. 10 year) and long-term (e.g. 30 years) lens
    c. Materiality assessments and scenario analysis by climate outcomes and time horizons e.g. are the frequency and reporting of climate scenarios aligned to the firm's climate risk exposure?
    d. Emerging regulatory, reputational and legal obligations

Assigning senior management responsibility

When assigning senior management responsibility for climate risk, consider where responsibility for other financial risks is managed and align with that responsibility. This will depend on the firm, but examples include the Chief Risk Officer and/or the Chief Financial Officer/ Chief Investment Officer. Senior Management Function ("SMF") responsibility for climate risk should be assigned to an existing SMF; and the responsibility should not be shared between 'too many' individuals. As a guiding principle, not assigning SMF responsibility to more than 2 people is a good starting point, subject to the firm's legal and corporate governance structure.

Ensure the dissemination of responsibility is allocated appropriately and documented. Update the relevant committee terms of reference and set-up a committee or working group, chaired by the SMF holder, with representation from across the three lines of defence, to oversee operational delivery.

Senior management responsibility for climate risk management, alone, does not allocate responsibility across the firm. It's important to clarify roles and responsibilities across all three lines of defence, so that the ownership and accountability are clear and coordinated.

Example 2.1: Allocating roles and responsibilities across three lines of defence

	Example activities
First line	• Carry out initial climate risk assessment when onboarding clients or during periodic review of existing clients • Engage with clients to understand carbon intensities and their business plans for mitigating climate risk • Understand, assess and consider uncertainties and developments around timing and channels of climate risk
Second line	• Set-up and own central risk frameworks • Develop the tools for identifying and assessing climate risks • Deliver climate risk training • Develop scenarios and undertake stress testing • Support first line activity to understand, assess and consider uncertainties and developments around timing and channels of climate risk
Third line	• Review control design and execution

"The important thing is to act now, get started and iterate your approach. Climate change will not wait for us. The longer we wait, the bigger the challenge we will face."

Daniel Klier (Chief of Staff to the CEO of Global Banking & Markets and Global Head of Sustainable Finance, HSBC and CFRF Risk Management Working Group Chair)

3 Risk management frameworks

Risk management frameworks are a key means by which risk governance more broadly, and climate risk governance in particular, can be operationalised.

Good practice

Good practice for a climate risk framework includes the following elements:

1. Good practice is to treat climate risk as a cross-cutting risk type that manifests through most of the established principal / standalone risk types. Whether treated as a principal risk or a cross-cutting risk type, linkages of climate risks with established risk types (particularly the more material risks such as underwriting, credit, operational and financial market) should be established and understood in the firm.
2. There should be tools to identify and assess physical and transition risks. It may be necessary to collaborate with external experts to fill the internal knowledge and expertise gaps.
3. Central risk frameworks and relevant policies should be updated (see implementation steps below).
4. A uniform risk taxonomy and risk categories should be developed (see section 5) – both for individual clients and transactions (particularly for material transactions), and at an aggregate portfolio level so risk concentrations may be assessed.
5. Climate risk Management Information ("MI") should be included in established risk reporting (e.g. to governance committees).

In defining the firm's appetite for adopting good practice (or the extent to which the firm chooses to adopt good practice), consideration should be given to the cost and resourcing needs.

Implementation steps

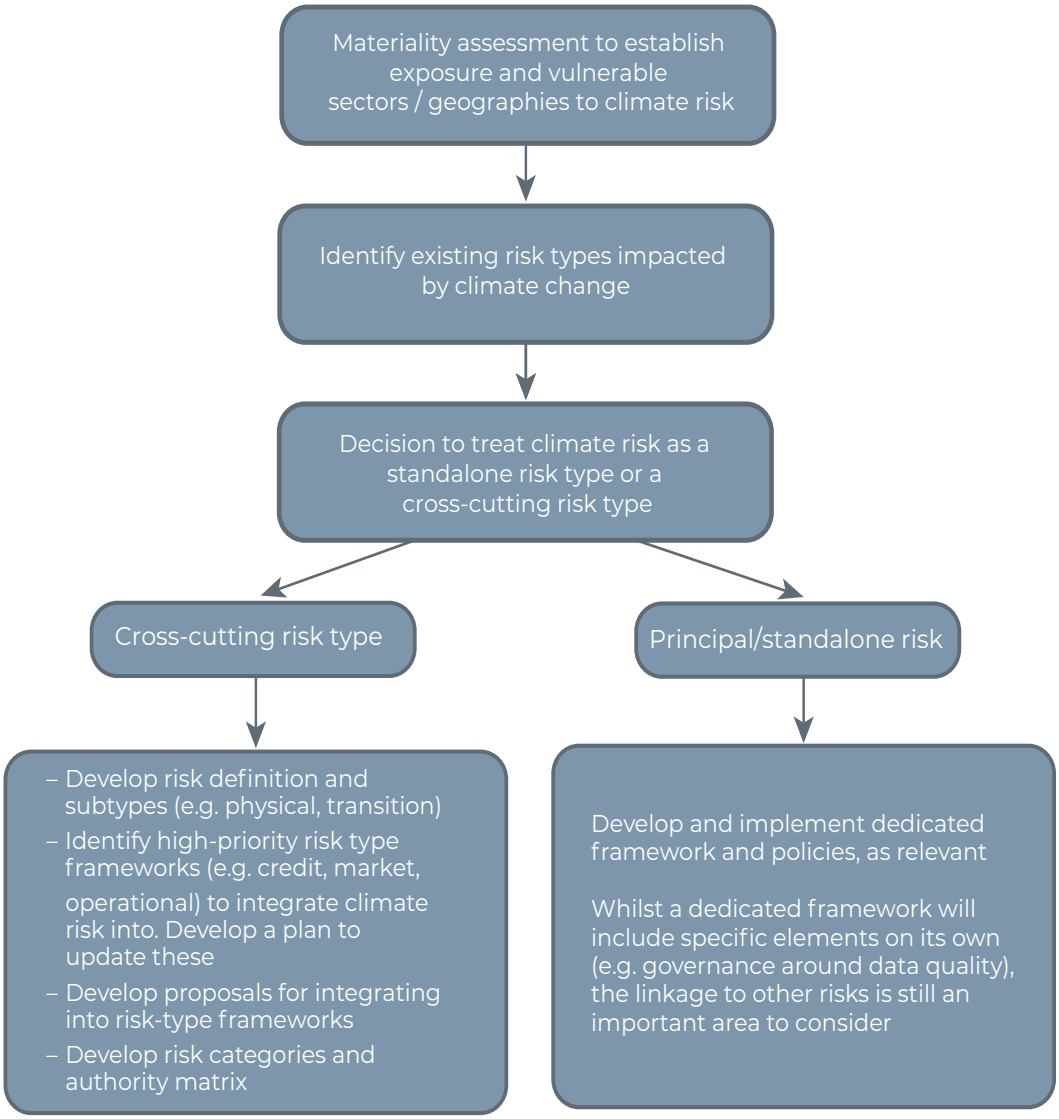
Climate risk should be integrated into existing enterprise risk management frameworks, strategically and in line with board level risk appetite (see section 4). There are three ways to approach climate risk and develop risk management frameworks, treat climate risk as (a) a standalone, principal, risk type using the firms' established practice in deciding and managing principal risk types; (b) a risk within other existing risk types (i.e. a "cross-cutting" risk) (see Figure 1 a summary approach set-up), or (c) both within existing risk types and as a principal risk.

Undertaking a materiality assessment of climate risks will help the firms to decide which is the best approach. Factors to consider in the materiality assessment include the firm's exposure to physical and transition risks. Exposure could be associated with both the firm's own property and its business model, including concentrations of risk at portfolio and transaction level, and by geographical

footprint. For an initial high-level assessment on physical climate risk vulnerability by geography consider using external independent data sources, e.g. the ND-GAIN Country Index, as well as internal assessments where possible.

If climate risk is deemed a standalone risk type, then the necessary frameworks and policies need to be developed as such. Alternatively, as a cross-cutting risk type, consider implementing a work plan to progressively update the relevant risk type frameworks and policies, prioritising as necessary based on relevance, materiality and resourcing. Figure 1 provides an example set-up approach for frameworks.

Figure 1: Example – initial set-up of frameworks



4 Risk appetite

Good practice

The risk appetite should reflect and communicate the level of climate financial risk that an institution is willing to take, tailored to the business model, and may incorporate broader considerations based on Environmental, Social and Governance (ESG), reputational risk or corporate responsibility, (e.g. following a no-harm approach) which may already be in place within the firm.

As climate risk may be a standalone risk category or considered within other existing risk categories, the approach to developing a risk appetite will differ. It may be appropriate to incorporate both standalone and cross-cutting risks within the risk appetite, where the latter materialises within various established risk categories.

If climate risk is a standalone risk category, the risk appetite should consist of two components:

- "statement" – a clear, 'plain English' articulation of the acceptable risk level; and
- "metrics" – quantitative or qualitative measures which allow the institution to assess adherence to the statement. Each statement may have a number of metrics associated with it which allow the business and risk committees to monitor the risk profile.

If climate risk is considered within other existing risk categories, the risk appetite may not have a 'statement' specific to climate risk, but there should still be 'metrics' that can be clearly linked to climate risk.

Risk appetite statements tend towards a 3- to 5-year time horizon, i.e. in line with strategic planning, but the financial risks from climate change may not materialise within such a short time frame. A mature appetite should therefore consider the impacts over a longer period, e.g. a 30-year timeframe with interim milestones that will evolve as more knowledge is gained. A mature appetite should also include scenario analysis and impact assessments (e.g. the impact of a 3^{o}C temperature rise on the 'as at' portfolio), or trend analysis (e.g. weather-related catastrophe losses over the years).

There is no common view of leading practice for factoring long-term climate risk scenario analysis into risk appetite as yet. Options include using a long-term qualitative statement (e.g. 'being aligned with the Paris Agreement') or Example 4.2 below provide examples of metrics for firms to consider. Having a climate risk appetite can enable institutions to initiate pre-emptive risk monitoring and mitigation (e.g. business model decisions to avoid concentration of exposure in sectors likely to be affected by climate risk).

A risk appetite that articulates, and gains buy-in to, the complex trade-offs that the board is willing to accept – e.g. risk vs return vs reputation – and balances the

conflicting asks of stakeholders will be critical in operationalising the risk appetite for climate change. The appetite should be translated into risk limits for each operational team, either through Key Performance Indicators or Key Risk Indicators, and linked to objectives. For example, lenders/ underwriters/ investment managers will need to consider whether their customers' climate risk profile is aligned with the institution's climate risk appetite, and, if it isn't aligned, whether customers are taking action to reduce their climate risk so it will align in the future.

Example 4.1: Options for considering a 30 year timeframe in the risk appetite statement

1. **Long term scenario analysis to project existing metrics**
   Use scenario analysis to understand the projection of metrics that are used to measure and monitor risk appetite under set scenarios. The projected metrics can guide pre-emptive actions.

Metric	Appetite	Tolerance	Current RAG	Scenario 1 – 2050	Scenario 2 – 2050	Scenario 3 – 2050
	X%	Y%	Z%	A%	B%	C%

2. **Defining new metrics and thresholds under a specific scenario**
   The scenario analysis could identify that new, additional, metrics with defined appetite and tolerance may need to be added under a specific scenario.

Metric	Appetite	Tolerance	RAG
	X%	Y%	Z%
XXXX under disorderly 2 degrees scenario	D%	E%	F%

3. **Using metrics which incorporate longer term view**
   For climate risk, metrics may need to be altered to incorporate the longer term risks. For example, a transition risk rating which incorporates the customer's expected credit risk under longer term scenarios may need to be defined.

Metric	Appetite	Tolerance	RAG
% High Transition Risk Ratings in portfolio	X%	Y%	Z%
QoQ leverage of high transition risk industries/ customers	X%	Y%	Z%

Case Study 4.1: Insurer A – Pathway Approach to Manage Coal Exit Strategy

The risk appetite is centred on a plan to limit exposure to companies that generate 25% or more of their turnover from coal by 2022, and 0% by 2040.

From an insurance perspective, this involves exclusions for single site coal-fired power plants and individual coal mines. This is complemented by scaling-up issuance of low-carbon technology insurance. For investments, there will be a gradual divestment from utilities and mining companies that generate a material amount of revenue from coal, and/or are not in line with the 2°C threshold set out under the Paris Agreement.

Example 4.2: Using quantitative metrics

As the ability to monitor climate risk becomes more sophisticated, institutions should begin to develop a series of metrics covering the below:

Metric	Overview	Examples
Bounding Metrics	A single or small number of metrics that set bounds around the amount of climate risk that an institution is willing to take. The metric represents the key elements that drive the risk appetite.	• Carbon asset risk of portfolio. Incorporating carbon intensity as a proxy for transition risk, lifespan of physical assets and EBIT for individual customer names. • "Climate Value at Risk" (VaR) – present value of climate costs or profits divided by market value
Delivery	Forward looking limits that have been set as early warning indicators to ensure that the risks are kept within the agreed thresholds. If climate risk is considered within existing risk types, then there should be a clear link between climate related delivery metrics and the relevant risk type.	• Sovereign exposure to climate related risks, e.g. Notre-Dame University's Notre Dame-Global Adaptation Index (ND-GAIN). • Expected loss or RWA of portfolio if the temperature rises by 3ºC • Leverage trends / tolerance of specific industries
Monitoring	Metrics that will alert management to a potential change which could mean that risk appetite may be breached.	• % limit on exposures or investments in high transition risk industries. • % mortgage portfolio exposure to high physical risk locations under scenario X • Performance within underwriting limits which restrict the writing of new primary insurance or reinsurance contracts for thermal coal or other fossil fuel projects • Concentration metrics – mortgages and mortgage-backed securities at risk
Wider CSR/ Rep Risk / ESG Lens / Portfolio Steering	Metrics which focus on alignment of the portfolio to the strategic priorities or ESG / CSR commitments, rather than measuring the financial exposure to climate risk.	• Carbon footprint including supply chain • Weighted average carbon intensity, based on relative investment share or lending provided • Carbon/Revenue (can also provide a proxy for exposure to transition risk) • Carbon Delta's (an environmental FinTech) warming potential metric to assess corporate credit and equities shareholder funds' alignment with the Paris Agreement 2°C target.

Implementation steps

The initial steps in defining a climate risk appetite are:

1. Consider business strategies, the existing portfolio and the type of climate risks faced. For example, the banking sector may be more vulnerable to transition risks if they are providing long term loans to clients that may be affected by climate policy. General insurers may be more susceptible to the physical risks, if their underwriting exposures are particularly concentrated and their risk appetite should reflect this.
2. Engage the board to probe specific aspects of risk appetite (see example questions for boards in example 4.3).
3. Develop and approve a qualitative statement.
4. Identify metrics which can be used to track climate risks to the firm and work with business and risk to determine appropriate appetite or tolerance thresholds. These metrics have an associated set of thresholds, proposed by the business and set by the institution's board, which allow clear monitoring through a 'RAG' status (or similar) and provide an early warning system which can prompt action as required.
5. Longer-term, assess how metrics can best include the results from scenario analysis and impact assessments (e.g. the impact of a 3^{0}C temperature rise on the 'as at' portfolio), or trend analysis (e.g. weather-related catastrophe losses over the years).

Example 4.3: Questions to ask boards

A board may find it helpful to work through a subset of questions to gauge their tolerance for climate risk. Examples of potential board questions are shown below.

Defining the brand, ambition and targets

- How do we want our brand to be perceived around climate change, carbon emissions, sustainable financing and broader sustainability topics?
- If we wish to be carbon neutral, what do we mean by carbon neutral (absolute vs net)? Does it cover our financed emissions? By when will the firm commit to being carbon neutral?
- What global frameworks do we want to commit to? E.g. Paris Agreement, TCFD, Principles for Responsible Banking. What does this mean practically?
- What reputational risks are we willing to accept and not accept in supporting our customers in the transition to a low carbon economy? What reputational risks will we accept in emerging economies where economic and humanitarian needs may be reliant on high carbon energy sources?
- What targets can be tracked to monitor progress against our transition? How will these targets be perceived by investors?
- Do we have the right data and systems in place to report against these targets? What additional data do we need? How do we validate the quality of the data on which we base decisions?
- What would we do if several of our competitors/ peer group had a more ambitious approach to climate risk?
- What would we do if governments mandate a quicker transition to a carbon neutral economy, e.g. within 5, 10, or 20 years?

Aligning the business model

- What does aligning with the Paris Agreement mean in terms of the structure of our portfolio and the companies that we finance? Which sectors and companies will we have to reduce exposure to? What does it mean for our own operations and people?
- Which approach should be taken to evaluate whether current/future business might have significant adverse impacts on the environment/ sustainability?
- How will we assess companies across Environmental, Social and Governance criteria? Is an equal weighting applied to each criterion?
- What are our criteria for deciding whether to engage with environmentally harmful companies or divest?
- Will we continue to finance environmentally harmful companies who do not show willingness to transition? Over what timeframe would we continue to finance them? What are the risks to our business?
- Are we willing to exit profitable customers or sectors? What timeframe is our exit strategy over? Which exit / reduce strategies could be implemented?
- Which business activities could be seen as opportunities for growth because they are considered as environmentally sustainable?
- Are climate considerations incorporated into the strategic planning, business models, financial planning and other decision-making processes?
- How do plans factor in the uncertain and variable nature of how climate change could affect the business over different timeframes?
- Which approach should be taken to evaluate whether current business might have significant adverse impacts on the environment/sustainability?

Measuring and embedding risk management

- What are the financial and reputational risks of our current exposure? Are we comfortable with this level of exposure and concentrations? What mechanisms do we have to de-risking said exposure?
- How is climate risk materiality assessed and reported in the short-, medium-, and long-term? How can the board ensure that responses to climate change are in proportion to the stated materiality?
- What is the agreed methodology by which we define high transition risk and high physical risk elements across the portfolio?
- What scenarios for climate change are being used to assess the impact on the business and financial performance of the company? How do we stress over such a long period – qualitative/quantitative, capital/liquidity or strategy focus? What countries, businesses, sectors, companies are most impacted in these scenarios? Are we comfortable with this exposure? Is our underlying collateral positively linked with climate related probability of default?
- For high transition risk customers/sectors: what level of exposure or RWA are we comfortable with, what potential is there for trapped capital, and what is the average maturity of the exposure?
- How do we plan to manage the crystallisation of climate transition and physical risks over time?
- How will we prioritise risk assessments of the portfolio? E.g. by country, business, product, sectors, perceived impact from climate change.
- Under which risk categories do we expect climate change risks to materialise primarily, e.g. financial, reputational?

- Do we invest sufficient resource in climate reporting/ risk management? What are the benefits from adding more dedicated resource in this area? What are the risks of not doing so?
- Do we see climate change risk appetite driven by corporate responsibility, transparency requirements, financial threat, or opportunities?

Enabling through people, clear accountability and training

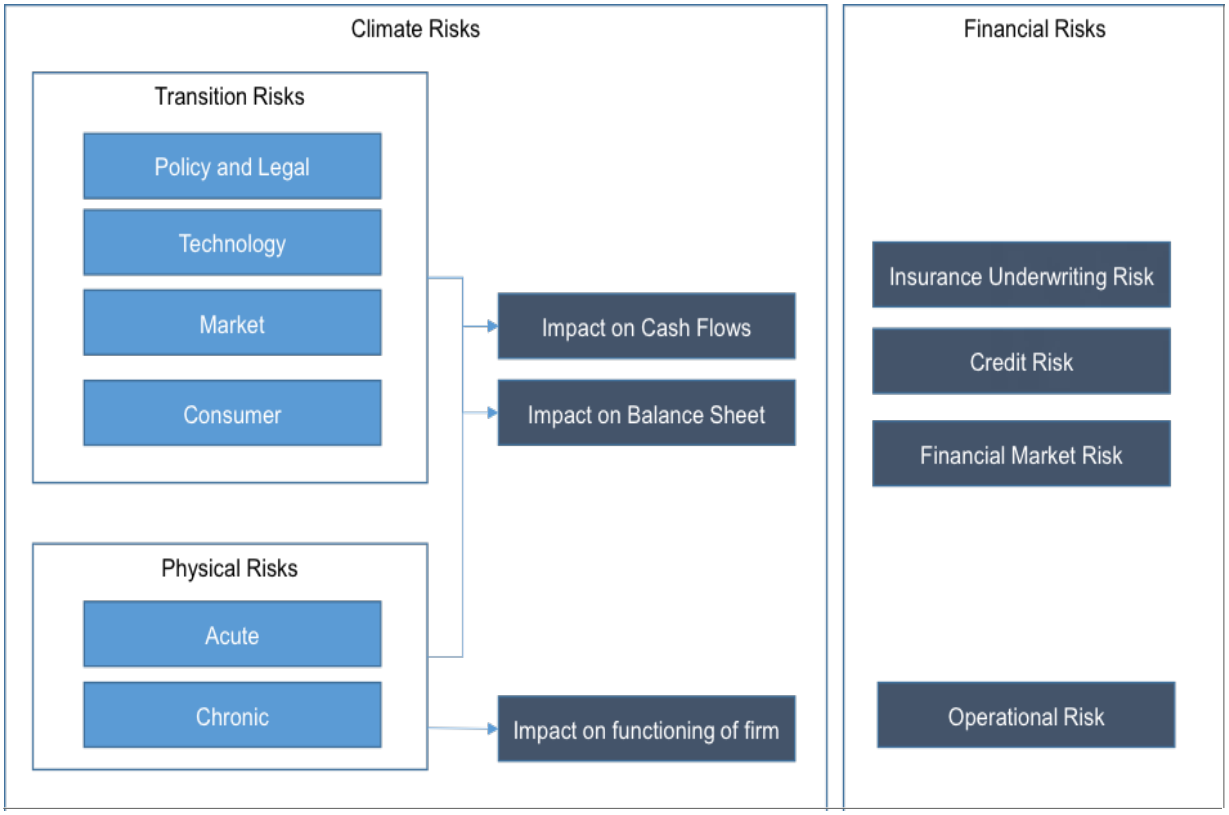
- To what extent are climate risks and opportunities incorporated into the board's understanding of directors' duties? Who is responsible for climate change at board level?
- Is accountability for climate risks and opportunities considered during internal and independent evaluations of the board and management?
- Are incentives designed to promote and reward sustainable value creation over time?
- Has the board considered appointing a climate expert, or creating an informal or ad-hoc climate advisory committee of internal and external experts?
- Does the composition of the board allow for informed and differentiated debate and objective decision-making on climate issues?
- What steps is the board taking to ensure it remains sufficiently educated about the relevant climate-related risks and opportunities for its business?
- Is climate integrated into the "three lines of defence", the Enterprise Risk Framework for the company and limits and thresholds?

5 Risk assessment

Climate-related risks, manifesting through transition and physical channels, are considered as systemic risks which could impact the stability of the financial system. Risk assessment of the financial risks as well as the non-financial risks is essential to measure, monitor and mitigate the risk within a firm's appetite. Scenario analysis is a key risk and business analysis tool to assess the impact of climate change, especially given the underlying uncertainties in how and when risks will manifest. This section should be read in conjunction with the Scenario Analysis guide.

This section provides guidance on risk assessment for four risk categories, which were considered by the Risk Management Working Group to be the most material and applicable across the financial sector: insurance underwriting risk, credit risk, financial market risk and operational risk. There are other risk categories, in particular litigation risk and model risk, which firms should consider as well as undertaking a mapping exercise to understand the potential second and third order risks facing their organization.

Figure 2: Financial risks impacted by climate risk



Insurance underwriting risk

Physical risks will impact insurance losses due to higher frequency and severity of weather-related events with impacts on reserving and pricing, particularly affecting property insurance and agriculture. Specifically:

- **Acute physical risks:** Higher frequency or severity of weather-related natural catastrophe events including primary perils like tropical cyclones and winter storms in Europe, and secondary peril events like storm surge floods, hail, and wildfires.
- **Chronic physical risks:** Climate changes such as global warming and changed weather patterns (for example, rising sea-levels and associated floods, shifts in regional weather-related events, extreme weather conditions such as heat or cold waves and droughts) will impact human health (for example increasing mortality rates, and increasing spread of vector borne diseases).

Transition risks can manifest through technological and market shifts. For example, the extensive policy, legal, technology and market changes that are required to make the transition to a low-carbon economy could give rise to increased litigation activity against fossil fuel companies and other greenhouse gas (GHG) emitters. Insurance losses can also be associated with valuation of the liabilities (reserving) and pricing, particularly affecting: (i) General Liability and Directors and Officers (D&O) cover due to climate related litigations; and (ii) Credit & Surety cover related to stranded assets.

Credit risk

Credit risk reflects the potential financial loss that may arise due to diminished creditworthiness or default of counterparties. The client could be exposed to severe climate risk – either physical risks to its operations and assets (breakdown of supply chains due to weather events and subsequent financial losses), or transition risk to its sector of operation (e.g. an automotive company focussed on manufacturing diesel cars). If the climate risks manifest, the client's probability of default (PD) could increase and/or its loss given default (LGD) could increase. It is natural, therefore, to incorporate climate-change into business as usual (BAU) credit risk assessment.

Counterparty risk, i.e. the risk associated with a derivatives client defaulting at the same time that the bank is in the money, has been less of a concern to date in terms of climate change. However, this risk is likely to increase over time. For example, more bank counterparties will be dependent upon the carbon credit markets (either as sellers or buyers) and, in the shipping sector, the need to hedge fuel transition risk may become more pronounced with the implementation of the International Maritime Organisation (IMO) regulation IMO 2020 (a new regulation for a 0.5% global sulphur cap for marine fuels which becomes effective in January 2020).

Particular attention should be paid to risk concentrations (Concentration risk) as climate risk may aggregate over time across portfolios, e.g. autos combines wholesale exposure to manufacturers, distributors, captive finance companies, and retail business exposure to fleet leasing, car loans, etc. Second order risk is also important, for example, auto exposure plus upstream exposure to oil producers, refiners, marketers.

Financial market risk

Financial market risk can manifest through transition risk channels through market value (MV) loss / asset and liability management (ALM) impact due to societal, legal and technological response to climate change, particularly affecting bonds and loans, commodities and equities.

Physical risk channels can also result in MV loss / ALM impact due to weather impacts, particularly affecting property / real estate and commodities.

Operational risk

Operational risk represents the potential economic, reputational or compliance impact of inadequate or failed internal processes, people and systems or from external events, including legal risk and the risk of a material misstatement in financial reporting. The major climate change impacts will likely be due to physical risks affecting the operations of financial institutions (business continuity events) as a result of increasing frequency and severity of weather events. There might also be compliance and reputational impacts due to failures in producing climate related disclosures as required / expected by the market. There may also be supplier/ third-party operational risk due to climate events, e.g. heat or flood related outages at third party cloud / data centre providers, or sourcing of supplies from entities with poor GHG disclosure or strategy.

Firms should consider impacts of climate change for each Operational Risk level 2 category for their firm, for example, in respect of: People and Culture; Third Party Management; Business Continuity; Technology; Security; and Regulatory, Legislative and Tax Compliance.

Insurance underwriting risk

Good practice

(Re)insurance firms leverage existing processes and tools for assessing underwriting risks related to climate change. Depending on materiality, a proportionate approach may be chosen. However, challenges exist because of the uncertainty about the impact of environmental changes over the long run, depending on the development of other factors. Climate change scenarios and new risk mitigations are expected to develop over the coming years in line with advances in climate change research. There are also opportunities, e.g. related to new underwriting products.

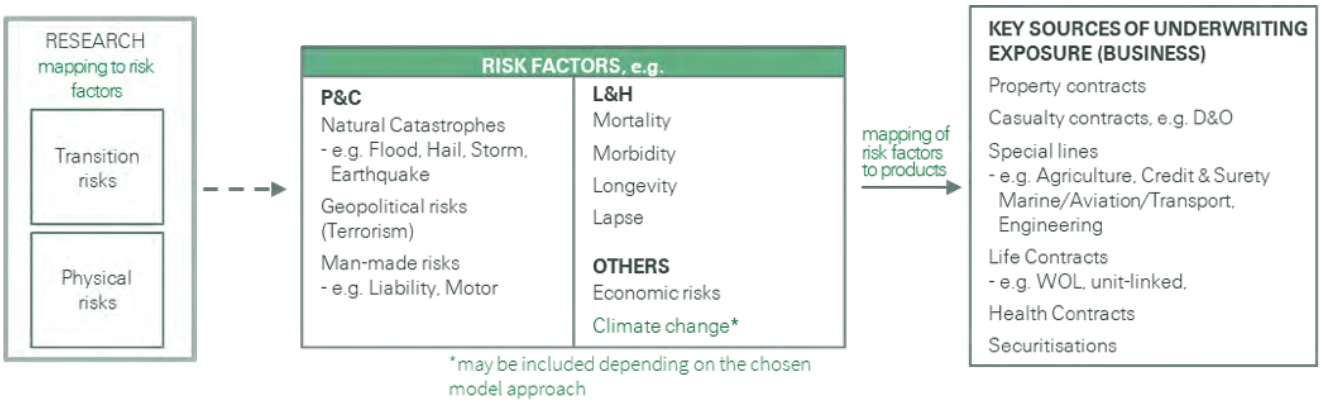
Risk identification

Climate change will impact both sides of the balance sheet of (re)insurance firms. Liabilities across all major lines of business will be affected, e.g. by more severe or frequent weather events, climate-related litigations, changing policyholder savings behaviours, etc. As (re)insurers' assets are often long-dated to match the duration of the liabilities or related to insurance savings products, they are exposed to credit risk and in particular real estate may be exposed to weather events.

Mapping of physical and transition risks within the risk landscape of (re)insurers

Climate change impacts the magnitude and frequency of existing risks types. To assess the risk, environmental change factors may be mapped to the holistic set of risk factors. For example, where climate change would lead to increasing frequency or severity of certain perils, this would inform the view of an existing risk factor rather than creating a new one. This supports the ability to assess the materiality of exposures, e.g. by mapping insurance contracts (e.g. volumes) to the relevant risk factors covered under these policies (see Figure 3).

Figure 3: Risk factor mapping to climate change factors



Such an approach can inform users of standard approaches but is more often utilised by companies using an internal model where, for example, footprint and hazard maps are commonly employed tools. Climate change related risks need to be considered in the context of socioeconomic factors to explain the increasing losses.

Longer-term risks

(Re)insurance firms apply a forward-looking approach through active monitoring/ research, e.g. by using emerging risk and Own Risk and Solvency Assessment (ORSA) processes.

- **Emerging risk** tools support the review of early signals. It involves external and internal sources, e.g. databases and literature, and subject matter experts from different business areas. For example, greater threat of pandemics due to warming temperatures and air pollution caused by wildfires are identified emerging risks.
- The **ORSA** time-horizon is typically shorter than the timespan over which climate risks will evolve. However, firms could also assess their longer-term strategy as part of their ORSA, i.e. the impact of climate change for certain (re)insurance products.

Measurement

The level of granularity and approach for risk assessment may vary. The Solvency II standard formula provides a minimum framework based on high level risk categories, but does not explicitly consider climate change risk. In contrast, internal models are based on a comprehensive set of risk factors which may cover environmental factors more appropriately. This is an area of development.

Heatmaps

Heatmaps can give an indication of the potential impact from climate change factors for certain lines of business. Possible dimensions of the heatmap are the

probability and potential impact of certain risks materialising. Firms may develop their own maps or refer to industry wide assessments. For example, the UNEP Principles for Sustainable Insurance project has developed a heat map that provides an indication of potential ESG (Environmental, Social and Governance) risks for non-life business (see UN PSI, Underwriting environmental, social and governance risks in non-life insurance business).

Metrics
Firms use established metrics to track the potential impact from climate change at portfolio or segment level, e.g. Annual expected losses (AEL), Average annual losses (AAL), or to assess tail losses, e.g. Aggregate exceedance probabilities (AEP) or Occurrence exceedance probabilities (OEP). However, the impact of climate change may be only indirectly measured by these metrics and it is difficult to isolate from other factors. For example, while increasing natural catastrophe (Nat Cat) losses might trend upwards, a large portion of the increased loss may be attributed to variability of extreme weather events while in fact the higher losses are actually mainly driven by socioeconomic factors.

Information on carbon intensity may be obtained from TCFD disclosures, ESG reporting or third party providers, where these are available. The following relevant indicators and frameworks are being developed:

- **EC initiatives on sustainable finance:** The EU classification system – the so-called EU taxonomy – to determine whether an economic activity is environmentally sustainable and EU climate benchmarks including disclosure requirements are expected to be generally operationalised by firms in the financial sector (as TCFD based standards).
- **Underwriting specific carbon footprinting:** The CRO Forum is working on a carbon footprinting methodology to quantify carbon emissions in (re) insurance portfolios. The idea is to use average carbon intensity (tonnes CO2e per $M revenue) of a portfolio of (re)insurance transactions which would be most consistent with TCFD metrics.

Risk mitigation
Risk mitigation is relevant for (re)insurers under two perspectives: 1) to mitigate risks affecting the firm's balance sheet, and 2) to offer appropriate risk mitigation products to policyholders. Various (possible) measures exist, e.g. related to portfolio steering, development of new products, risk transfers, and policy measures.

Portfolio steering
Firms may use the following measures to steer their portfolios according to their risk appetite:

- **Climate risk limits:** For example, limits related to carbon intensity of counterparties.
- **Enhancements:** Increase share of products with an attractive risk return profile under climate change assumptions.
- **Target green/brown ratio:** Steering towards a target contribution from "green" and "brown" activities. Taxonomies defining "green" and "brown" are being developed, e.g. by the European Commission, but may need to be adapted for underwriting exposures.

New products / impact underwriting
Impact underwriting means explicitly considering risk mitigation and adaption strategies in the product design, e.g. terms and conditions supporting environmental goals. Examples are innovative solutions for ex-ante risk financing and parametric insurance solutions. A generalisation of "impact underwriting" would provide incentives for the transition to a low-carbon economy by promoting adequate adaptation measures that limit the impact of climate change. However, there are also limitations for insurance, e.g. insurance would not be available for the most hazardous areas or large economic losses because of deficient land use planning.

Risk transfers
Nat Cat reinsurance is common practice to mitigate property losses due to natural hazards. Most covers are renewed annually which allows regular re-assessment of the risks related to a changing climate. Multi-year contracts providing incentives to invest in more mitigation during the contract period could be further developed (see also impact underwriting).

Policy measures
Risk transfer and risk reduction need to go hand in hand. Insurability of climate risks is highly dependent on preventive measures and other actions such as socioeconomic policies, zoning laws and geographic planning. Climate adaptation should therefore be aligned and integrated into a broader strategy of economic growth, national development policies and local planning. (Re) insurers can work with the public sector to systematically identify Nat Cat risks and design mitigation scenarios. Raising awareness through disclosures and the incorporation of climate risk in sovereign and company credit ratings by rating agencies will be useful in promoting greater transparency.

Implementation guidance

While climate change will affect (re)insurance firms differently, there are some steps that are relevant for all firms for the implementation of effective climate change risk management under a proportionate approach. These are:

- Research climate change
- Define and operationalise risk appetite
- Assess processes, data and tools
- Establish risk mitigation plan

1. *Research climate change*

Understanding the impact of climate change on insurance liabilities is still in the early stages. Firms need to define which information is relevant for them based on their exposures and access the relevant research channels, including e.g. academics, private and governmental organisations, working groups (see Appendix, section 9 for relevant sources).

2. *Define and operationalise risk appetite*

Clarity around materiality of climate change factors and relevant time horizons is important for defining an adequate risk appetite. Corresponding limits need to be operationalized through underwriting standards for governing controlled risk

taking. Depending on the materiality of the risk, different layers of escalation and requirements for risk assessment may be defined.

- **Assessing Materiality:** Risk factor mapping can be used to identify such lines of business with high exposures, i.e. by identifying dependencies between environmental change factors and risk factors (qualitatively or quantitatively).
- **Embed risk appetite into underwriting standards:** The integration of climate risk assessment with the established transaction process is recommended as being more effective than using a separate process. For example, some (re)insurers maintain exclusions on certain counterparties to limit their exposure to coal business. This may be further advanced by steering the portfolio towards a certain carbon intensity target.
- **Considering climate change risks for the valuation of the reserves:** So far, there is no commonly accepted evidence about a material impact on the technical provisions for life insurance. However, this is an area to be monitored, because climate risks may affect life exposures in the long-term through impacts on mortality rates due to future climatic events, including droughts, heatwaves or periods of extreme cold as well as vector-borne disease spread.

3. *Assess processes, data and tools*

Firms may leverage existing risk management processes and tools for the assessment of climate change risks. Section 6 provides an overview of the relevant tools.

4. *Risk mitigation plan*

The business model should consider short- and long-term risks. Some relevant risk mitigation techniques are described further above. The risk mitigation plan will enable firms to stay within risk appetite under a forward-looking perspective.

- **Time horizon:** Depending on the business model a long-term perspective may be adopted, e.g. up to 10-30 years.
- **Use of scenarios to test the risk mitigation plan:** Scenarios are useful to test the effectiveness of the risk mitigation plan. Risk mitigation plans that are effective under a wide range of possible outcomes will make firms more resilient.

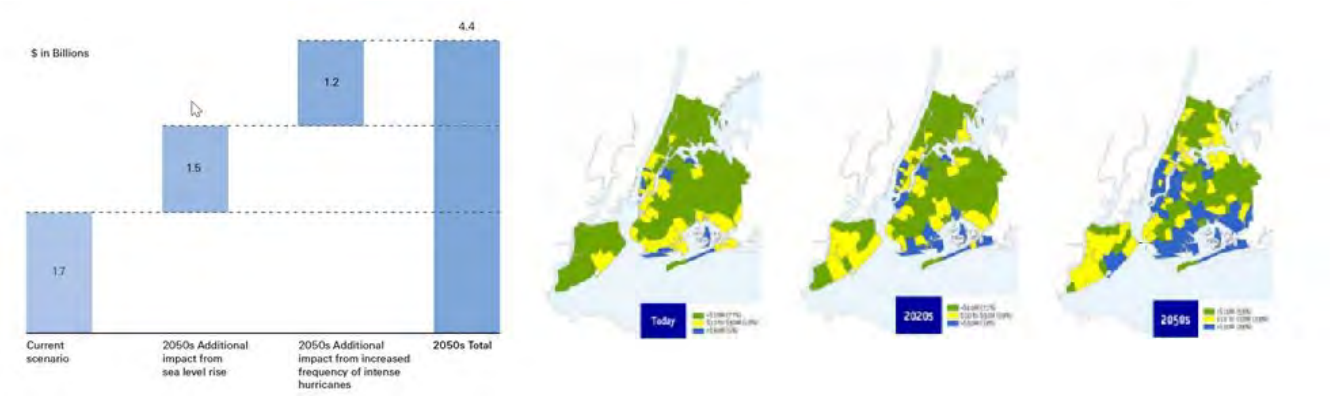
Case Study 5.1: Economics of Climate Adaptation (ECA) methodology – Example: New York

Hurricane Sandy (2012) was the costliest natural disaster to ever hit New York City. Economic losses for the city were close to USD 20 billion. Rising sea levels mean a similar storm in the future could cause far greater losses. It triggered a discussion about resilience like in many other events. The Economics of Climate Adaptation (ECA) methodology was used in a 400-page report titled 'A stronger, more resilient New York' which contained over 250 recommendations which could be implemented to increase the resilience of the city. The ECA methodology enables decision makers to understand the potential impact of climate change on their economies – and identify actions to minimize that impact at the lowest cost to society.

Data and tools

In a first step, for a given location, economic sector and affected population, the method identifies the most relevant hazards and analyses historic events. Using state-of-the-art probabilistic modelling, the expected economic loss today and further incremental increase due to economic development paths and climate change is estimated. Scenario analysis is used as the main tool to help decision-makers deal with uncertainty, constructing three potential climate risk scenarios: today's climate, moderate climate change and high (or extreme) climate change. The figure below on the left side shows the potential increase in losses that may be caused by similar events by 2050, i.e. driven by sea level rise and increasing frequency of events. The panels on the right show the AEL per post code from tropical cyclones for present day, the 2020s and the 2050s.

Figure 4: (i) Growth in Expected Annual Losses from storm surge and wind, (ii) Flood exposure by post code

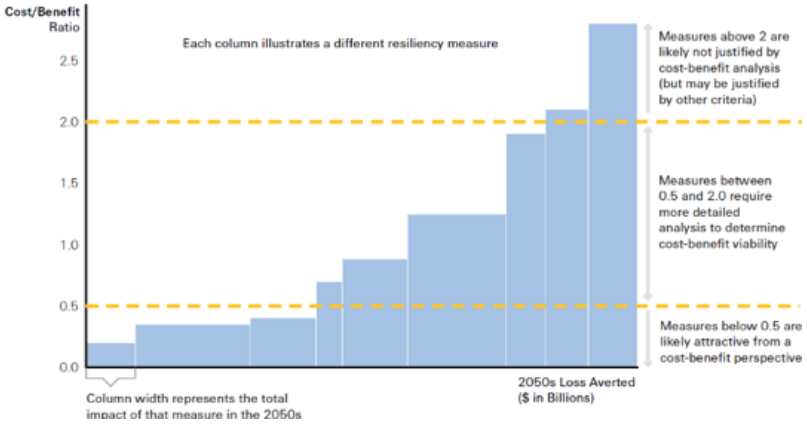


Today expected losses are concentrated in many of the same neighborhoods of the city. However, in the future, expected losses will cover a significantly wider area. To arrive at these scenarios, global and regional circulation models are used to assess changes in precipitation and temperature, and leverage public academic research, e.g. to flesh out the complex interactions between climate change and potential impact, e.g. between increases in sea surface temperature and hurricane intensity.

Risk mitigation plan

The next step is to build a balanced portfolio of resilience building measures. This is achieved by calculating the cost/benefit ratio of each measure. The loss aversion potential (the benefit) is assessed by modeling the effect each specific measure has in reducing the loss. The cost is calculated by assessing the capital and operating expenses necessary to implement the measure.

Figure 5: Evaluation of risk mitigating measures



ECA studies show that a balanced portfolio of prevention, intervention and insurance measures are available to pro-actively manage total climate risk. Insurance – or risk transfer – incentivises prevention initiatives by pricing the risk. ECA studies have shown that insurance is an effective adaptation measure particularly for low frequency/high severity weather events. Similar studies may be also useful to inform underwriting decisions going forward.

For further details see the "A Stronger, More Resilient New York" report produced by the City of New York.

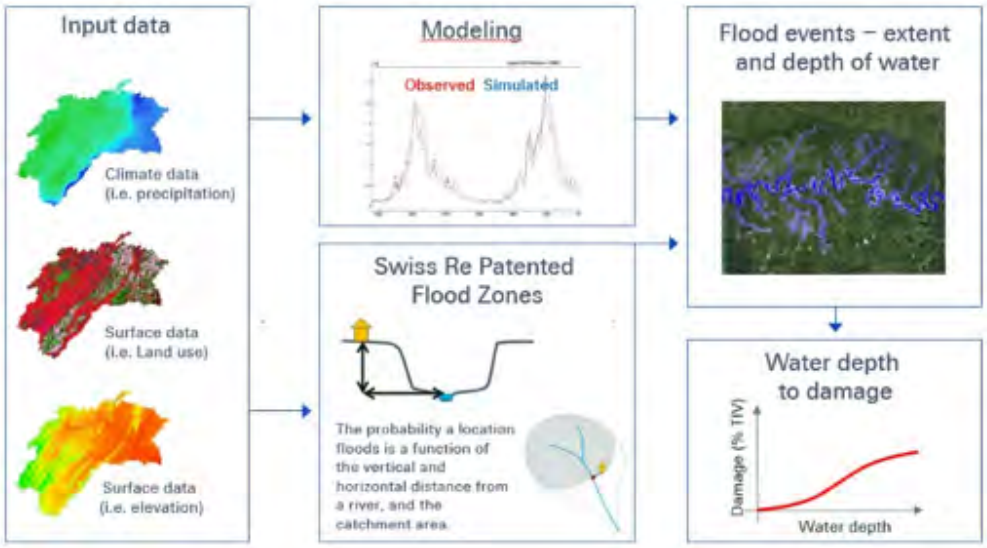
Case Study 5.2: US private flood insurance solution

Floods continue to affect more people worldwide than any other type of natural disaster. With USD 50 billion in annual global losses, the damage caused by floods is staggering. These costs are set to rise even further, as more people and businesses move to densely populated urban areas. There is a risk protection gap because many properties are not insured against flood for various reasons. For example, in the US, an average years' worth of storms will currently produce uninsured losses of USD 10 billion due to flooding, compared to insured losses of USD 5 billion.

Data and tools

While granular flood risk information has been lacking in the past, today a fully probabilistic US flood model – combining detailed hazard, vulnerability, value distribution and insurance conditions – delivers detailed risk information that allows risks to be rated for individual exposures considering their unique characteristics (see Figure 6).

Figure 6: Use of highly granular flood zones



Risk mitigation solution
Flood data and modelling capabilities are shared with private insurance clients. Insurers can launch their new flood product faster and with greater confidence, providing coverage consistent with a traditional insurance policy, customised to homeowners on an individual basis.

The use of probabilistic models is also an important step towards performing climate-scenario analyses. For this example, regularly updated probabilistic models are essential for a risk view that remains adequate for the current / changing climate.

Credit risk

Good practice

At a minimum, a bank management is expected to have reached an internal agreement on bottom-line issues such as whether there are sectors that should no longer be supported, when to exit a relationship, when to hedge, how long to hedge for. This agreement may be based upon a judgmental/qualitative assessment with some external data points. The bank should also be thinking about climate change as a financial risk in addition to being an ESG/CSR risk.

Credit risk analysis would consider climate impact upon all P&L, cash flow, and Balance Sheet metrics: Revenues, Costs, Assets, Liabilities, and Capital/ financing needs.

Risk due diligence increasingly incorporates a qualitative assessment of client's board's understanding, commitment, and communication on the issue. For example, whether or not they have verifiable/credible transition plans.

More progressed banks demonstrate a strong awareness of the issues and have started client engagement on the topic. Strategic discussions regarding climate risk would be a part of senior risk committees.

In the medium-term, good practice would be banks that have either built or acquired tools to analyse physical and transition risk, and have incorporated these into BAU. Client due diligence would therefore include a more granular assessment of the level of exposure, e.g. carbon intensity, physical locations, suppliers and customers, etc. and the degree to which the client is tracking a 2^{o}C scenario or better.

This would also imply an understanding of concentrations, and the beginning of incorporating climate scenarios into risk reporting. Banks generally support the use of (qualitative) stress tests and scenarios that consider a wide range of risk factors across risk categories; however, this is still an area of development.

Risk identification

Climate considerations would be expected to be mapped to existing processes, e.g. the Emerging Risks in the bank's Risk Identification and, where appropriate, in the Risk Appetite Statement, the Know Your Customer (KYC) process, credit due diligence, Credit and Rating Policies (global and sectorial), Collateral Monitoring policies, Head Office portfolio reporting.

Risk assessment – assessing Impacts on clients and counterparties

Banks should start to build historical data sets with a long-term goal of quantifying these risks in terms of Probability of Default (PD) and Loss Given Default (LGD). In the meantime, most banks have adopted a qualitative approach – either using risk categories (e.g. high, medium, low) or in financial loss terms (dollar/absolute loss thresholds or percentage loss thresholds).

Current good practice combines qualitative assessment using due diligence questionnaires and a thorough review of public disclosure, with a more quantitative analysis using internal and external data. Some banks have already deployed desktop delivery to enable portfolio and counterparty level monitoring and benchmarking.

Good practice also requires a focused and comprehensive development and training program to ensure that all internal stakeholders (senior management, Board of Directors, relationship managers, Business delegation holders, risk officer, credit analysts, etc.) share a consistent and up-to-date understanding.

Although there are some absolutes when identifying high climate risk exposures (e.g. an exclusively coal-powered generation company with no plans to transition to a low-carbon economy), materiality is usually difficult to assess in isolation. It is, therefore, important to be able to benchmark counterparties, portfolios, and countries against their peers. In this respect, a key decision is whether to rely upon internal resources, or to purchase external data. External providers can provide useful trend and benchmark data, including climate risk and ESG scores. However, there are limitations to this approach, such as the sometimes low percentage coverage of names in a portfolio, and the cost. Many banks, therefore, have chosen internal options for the moment, including:

- **Top 10 lists:** Materiality of climate change on customers (carbon footprint or potential financial loss), being assigned High, Medium, Low or on a numerical scale. This may then be incorporated into a matrix assessment including the impact of customer on the bank, e.g. level of exposure and RWA, relationship, etc.

- **Heat maps:** Qualitative assessments lend themselves to a "heat map" type approach covering risks such as direct and indirect emissions, regulatory risk, capacity to adapt, and exposure to stranded assets, etc. Carbon, as well as other environmental concerns such as water supply, emissions, waste management, packaging, biodiversity, and labour practices, will remain important. (See Case Study 5.4)
- **Peer comparison:** Within each sector, identify whether the counterparty is ahead, in line with, or behind on their consideration of the risks from climate change. Whether a counterparty adapts to the transition is influenced by factors such as its level of climate change related Research & Development spend, reducing fossil fuel inputs, and degree of physical risk. Noting that, in some sectors, the whole sector may be impacted.

Given the current evolving state of climate change risk management, it is understood by all stakeholders that banks may have a "knowledge gap". This can be filled with external expertise in many cases. However, the bank must develop its ability to analyse external data.

For example, there are several sources of Sovereign and Country macro risk data such as vulnerability and transition readiness. These include the University of Notre Dame Global Adaptation Index, Beyond Ratings, The World Bank, The UN's Food and Agriculture Organization country profiles.

For portfolios of high carbon industry names (fossil energy extraction, electricity generation, transportation, steel and cement) data can be acquired from vendors.

Physical risk is often challenged by a lack of detailed disclosure and, given its sensitivity, can often prove difficult in due diligence. Some organisations are developing tools for top down assessment of the most sensitive sectors to physical risk.

Lastly, the analysis of the P&L, cash flow, and balance sheet implications for individual counterparties is often dependent upon assumptions regarding sales volume and margins, the cost of transition and "stranded asset" risk. External providers are able to provide some input, sometimes including scenario analysis assuming a global uniform carbon price. This can be combined with qualitative assessment to produce a more holistic risk view.

Case Study 5.3: Impact of a global carbon price

A bank decides to implement, where possible, a new cash flow forecast requirement to reflect the theoretical impact of a global carbon price. This is in addition to the normal Base Case and Downside Case considerations. To allow for future price increases, a flat price of USD40 is used per metric ton of carbon dioxide equivalent emitted by each subject counterparty. The bank acknowledges that there are several layers of scope: (1) emissions from sources directly owned by the company, (2) emissions from purchased power, heat, etc., and (3) emissions related to the company such as business travel. Initially, the bank decided to focus on (1) given limited disclosure.

Case Study 5.4: Holistic assessment of acute and chronic climate change

During the onboarding of a new regulated electricity transmission and distribution company, the credit analyst took a holistic view of the potential impact of acute and chronic climate change upon many aspects of the company's chart of accounts. The analyst was then able to qualitatively assess the BAU balance sheet, profitability, and cash flow ratios from a more stressed/future state perspective.

Figure 7 Utility company financial analysis

BALANCE SHEET

Assets		Liabilities	
Current	(+) A/Rs increase from demand (–) Greater bad debt / past due from fires / floods	Current	(+) Payables increase for energy / staff (+) Short-term debt spikes
Long Term	(–) Goodwill impairments, brand damage (+) Chronic – expanded / strengthened T&D assets – Ability to load balance renewable sources – Underground hardware – Heat resistant materials – Increased cooling of transformers (–) Increased depreciation as load increases – Shorter depreciation life	Long Term	(+) Increased debt balances for capex (+) Loss of credit rating
		Equity	(–) Short and long-term reduced profitability
TOTAL ASSETS		TOTAL LIABILITIES & EQUITY	

PROFIT & LOSS

Revenues	(+) Increased peak and total demand (-) Acute – Heat degrades carrying capacity of transmission (-) Acute – Heat causing California-style wildfires (-) Acute – Weather causing storm damage / outages (-) Chronic heat rise weakening operating efficiency (-) Political block to including fire costs in rate base
Expenses	(+) Chronic – Increased operating expenses (+) Increased energy costs (+) Increased repair & maintenance expenses (+) Increased depreciation (+) Chronic – Increased capex for storm / weather resilience (+) Increased insurance premiums (+) Acute – Unplanned repair and right of way maintenance costs
Interest	(+) Interest on increased debt burden and higher rates demanded
NET INCOME	(-) Lower Profitability impacting Market Capitalisation
Dividends	(-) Reduced cash availability for distribution
NET CHANGE IN RETAINED EARNING	

The challenge of timeframe

Timeframe is a critical challenge in the assessment of climate change risk. If the timeframe is too long the results are too intangible to be of use, particularly for banks where the lending horizon is normally 1 to 5 years (although the bank's physical assets, some derivatives, and project financings may need a longer outlook). However, if the timeframe is too short the results will not inform strategic decision-making. As a general principle, therefore, it is important to have clarity at the beginning of any assessment what timeframe is applicable.

As a general guideline, transition risk issues are more likely to be short-term, with technology, country and regulatory dependencies. Conversely, physical risk is more long-term, and requires a better understanding of physical coordinates, e.g. productive assets and mortgage portfolios concentrated near water. The severity and manifestation of both these risks will very much depend of the climate pathway.

Managing and mitigating exposure

Several banks have publicly committed to cease financing of carbon intensive or environmentally sensitive sectors, e.g. shale gas, oil sands, coal mining/coal fired power generation (sometimes with materiality thresholds and/or assessment of management's sincerity regarding a steady transition). Some banks have announced strengthened measures to combat deforestation and protect biodiversity, e.g. palm oil sector requirements for clients to protect high carbon stock forests.

Some banks have stopped providing certain products, e.g. derivatives coal-based trading, physical inventory management transactions in coal and crude oil. Others have moved to prioritize mortgage and Buy-To-Let transactions to properties with high-energy efficiency ("EPC") ratings, or enhanced their market making of emissions credits to assist transition risk.

In terms of hedging, short-term credit risks, for example those that may become elevated due to transition risk exposure, can be partly hedged with traditional credit default swaps (CDS). As usual, however, the market depth of name specific CDS is quite limited. Credit risk insurance may also be an option, particularly where physical risk is a concern. However, the availability and/or cost of such coverage may prove challenging.

Options are also emerging for portfolio-level risk mitigation techniques. Some corporates have issued "Transition Bonds", explicitly intended to help fund the transition to more sustainable agricultural activities. As identified transition financing assets accumulate, banks could consider whether this concept could be expanded to the securitisation and covered bond markets. However, currently "green bonds" struggle with the question: "what is green?" and that green bonds make up only a very small component (<2%) of total bond issuance.

Key tools and data requirements

One tool currently used to address climate change risk is the questionnaire. These are often compiled from publicly disclosed data and supplemented, where possible, through direct interaction with the client during the due diligence process. The questionnaire path for emerging risks is well established, having been previously used by many institutions, for example, to assess major sanctioned country exposures.

Given the difficulty and expense of building internal models and sourcing data – particularly for incorporating risk into EBITDA – many banks are currently using external providers. The challenge remains of limited geographic and counterparty coverage. A non-exhaustive inventory of third-party providers is provided in section 6.

In the future state, it is hoped that indicators such as Transition Risk and Physical Risk Scores can be developed and quantified into PD and LGD.

Implementation guidance

As a matter of principle, climate change risk assessment needs to be anchored in the same place as other risk decisions. This means that it should be explicitly incorporated into the risk identification process and risk appetite statement and cascaded down to lines of business. As with all risk, primary responsibility should lie with the first line of defence with risk being second line.

Formal training is needed to educate both lines of defence regarding terminology, metrics, and bank policy. Similar to previous group-wide exercises for sanctions, anti-money laundering (AML), etc., consideration should be made to making such training mandatory. First line of defence should also be responsible for engagement with clients that appear to be lagging.

Sustainability needs to be built into all client discussions and be used to inform consideration of both risks and opportunities. The bank should maintain a monitoring/exclusion list for non-compliant corporates.

Banks should closely monitor developments in sustainability-linked loans, such as the measurement of sustainability performance targets (SPTs), such as external ESG ratings, which track improvements in a borrower's sustainability profile and are directly linked to pricing incentives. Where possible, affirmative and negative covenants to be progressively introduced into loan documentation, e.g. disclosure (per TCFD), level of carbon footprint with reductions linked to business plan (similar to leverage covenants in current agreements). It is, however, acknowledged that for this to be successful there is a need for global regulatory alignment, perhaps through the auspices of Network for Greening the Financial System (NGFS).

For the ultimate PD and LGD assessment, a two-step approach is more practical in the current state:

1. Traditional model-driven credit rating PD/LGD assessment;
2. Macro climate overlay by expert judgment "notching and denotching". Clear guidelines need to be developed and communicated to drive consistency and comparability across portfolios.

Case Study 5.5: Assessing transition credit risk for corporate customers

A bank has provided an example of an internal tool for the assessment of transition risk to corporate customers. below. Steps include:

- Assess impact of transition risk to sectors within portfolio (qualitative or quantitative);
- Assess impact of transition risk to countries within portfolio (qualitative or quantitative);
- Assess 'adaptability' of customers, most likely for a selection of customers based on size of exposure of other materiality basis (qualitative or quantitative);
- Assign transition risk rating to each customer (illustrative example below);
- Determine policies for management of customers based on transition risk rating;
- Determine wider use of transition risk ratings within firm, frequency of review, and incorporation of scenario analysis.

Figure 8: Transition risk ratings for corporate customers

Inputs

Impact on Sectors:
1. Policy risk
2. End demand risk
3. Technology risk
4. Legal & rept'nl risks

Impact on Countries:
1. COP 21 commitment
2. Willingness & capacity
3. Sovereign risk

Adaptability:
1. Comparison of emissions Vs gv't targets
2. Comparison of emissions Vs peers
3. Assessment of qualitative factors (governance, strategy, adaptability of business model, peer comparison)

Transition Risk Rating by Customer		Sector / Country Score			
		Immediate/ high	Medium term/high	Medium term/average	Low
Adaptability - Ability to manage impact of transition risk	Leading	2	3	3	3
	Good	2	3	3	3
	Average	1	2	3	3
	Below average	1	1	2	2

Further enhancements:
Quantitative adaptability score and sector/country score (weighting inputs)
Incorporation of scenario analysis either as overlay on inputs, ratings or uses

Uses

Risk Management decision making, including:
- **Counterparty risk assessment**
- Sector outlooks

Opportunity identification and tracking

Disclosures / financial reporting

Case Study 5.6: Assessing climate change related risks associated with residential property for mortgage lending

There is a gap in how and when lenders collect data regarding the mortgage security property. This often means that consideration of environmental risks on the property is limited and only takes place after the mortgage offer has been issued, through the conveyancing process. It is now recognised that this needs to change, to build a platform to collect data, for future decisioning and the ability to manage climate risk.

The approach of mortgage lenders to decide what is a suitable residential security for lending needs to evolve to consider how changing climate and environmental factors will impact properties over a typical mortgage term of 25 to 40 years. This is a far cry from the historic approach, based upon a surveyor visiting a property and confirming that the construction today is sound, but giving

no considering to the lifespan of the loan. This is also a change to valuation methodology, moving away from a pure present-day comparable basis to incorporate new longer-term environmental data sources and models of climate change impacts.

The key is to collect the data about every property at the start of the process so the decisioning can be up front and not impact the customer journey. Data needs to be specific at the property-level and is available from a number of expert specialist providers. Relevant data sources that should be considered are:

- Energy Performance Certificate rating
- Flood data (run-off, river and coastal)
- Coastal erosion data
- Ground stability data (subsidence, soil, sand, silt)
- Natural ground hazards (mining, sink holes, etc.)
- Insurability (consideration given to Flood Re)

(The list above is only a selection of data that is considered. Most of these are available as free open source data but the quality and granularity of these data sets should be tested to ensure they are robust enough to make decisions based upon when comparing to paid for cleansed data)

Creating a rules engine and defining risk appetite to assess these property-related risks when originating a new residential mortgage, allows different methods of valuation (automated valuation model (AVM), desktop, full physical) to be mandated, and informs the current valuation of each property – which in extreme cases can mean that the property is not suitable security for a mortgage or requires more expert consideration.

Visualisation tools can help understand and assess specific risk events, helping to share the impact and drive action – for instance they can be used to assess the impact of the flooding at the Whaley Bridge reservoir and the River Don in Sheffield. Building a hub of data on the mortgage portfolio allows for scenario analysis and stress testing for various environmental perils under climate change scenarios, for example an increase in temperatures. This will allow modelling of the impact of given long-term climate scenarios on the whole mortgage portfolio and estimation of the financial impact from (i) the degradation or (ii) to mitigate the physical impact.

The below is an example of how you can quickly visualise when events happen like the flooding from the River Don in Sheffield. The red markers are illustrative properties in the mortgage portfolio to understand exposure and assist these customers. This also means you can see, from the blue areas, properties which have been flooded and areas for future mortgage originations which aren't safe to lend on until flood defences are built.

Figure 9: Properties affected by flooding

Financial market risk

Financial market risk manifests itself differently between banks, insurers and asset managers. This section considers good practices for longer-term investments, which are most relevant for insurers and asset managers, as well as good practices for trading book short-term market risk, which is most relevant for a bank's trading book.

Good practices for longer-term investments

In the context of climate change, financial market risk is defined in the following contexts:

- the market value (MV) loss due to societal, legal and technological response to climate change, particularly affecting bonds and loans, commodities and equities (i.e. transition risk); or
- the MV loss due to concern over actual climate/weather events (i.e. physical risk). Physical risk will particularly affect property / real estate and commodities but can also impact corporates more broadly, such as the impact of rising temperatures or loss of water supply on production facilities.

The approach set out in this section will primarily relate to the longer-term investments which are at risk of losing value due to climate risk; principally those held by asset managers and pension funds or similar investment firms. An important consequence of falling asset prices, or 'fear of falling asset prices' can be illiquidity in the markets or the triggering of other erratic market behaviour. With regards to funds, this can lead to gating events and cash liquidity problems.

Potential market losses from climate risk could be more significant than losses from credit risk in loan books due to the relative subordination of equity and debt markets, the contagion effect and the potential for hedge underperformance.

Since market risk can be a precursor to a default event, this section should also be read in conjunction with section 5 on credit risk.

The following good practice comprises the risk identification through to ongoing portfolio monitoring stages of risk management.

Risk identification

1. Investment decision process

Investment decisions should factor in both current and forward-looking climate risk assessments.

2. Identification of climate risk as part of company, sectorial and underlying analysis

Climate risks can be relevant to a variety of sectors and can directly impact equity values, credit spreads, commodities, interest rates, foreign exchange, bond prices and all other associated market parameters. Portfolio sensitivity to climate-related risks should be used as part of a risk identification process.

Sensitivity to physical risk should be measurable on real assets but can also directly impact asset values. For example, catastrophe bonds/Insurance-linked securities[1], or sovereign bond prices can alter due to concerns about the cost of dealing with a disaster or disruption, and its impact on a country's economy. Similarly, where the return on an asset is directly linked to underlying assets or receivables, such as Asset Backed Securities (ABS), then the risk analysis requires a 'look through approach', where the analyst can identify the physical locations of the underlying mortgages / assets and overlay the areas that are sensitive to physical risk. Detection of such risk should typically be performed during core credit and sectorial analysis and review processes, and communicated to market risk managers. This can be performed in conjunction with qualitative analysis, carried out typically as part of first line investment operations in asset managers and insurers.

Risk assessment & monitoring – assessing the impacts on assets and markets

1. Climate metrics included as part of regular portfolio monitoring and increasingly scenario analysis

Climate metrics and evaluation are increasingly included as part of monitoring of a portfolio of assets or securities. This attempts to take a step away from asset level monitoring and provide a view on the portfolio as a whole. This evaluation tends to be quantitatively driven and raises flags for further qualitative analysis rather than assessing whether a portfolio is within a defined limit or set of parameters to invest within.

1 Insurance Linked Securities are bonds which transfer catastrophe risk from insurers, reinsurers or corporates to the capital markets (investors). The risk transfer mechanism operates through the loss of principal and coupons by investors in the event of a significant pre-defined insurance event.

Most practices today focus around point-in-time analysis. Quantitative metrics which are frequently used to evaluate a portfolio's carbon involvement and risk include:

- Scope 1, 2 and 3 emissions standards proposed by the Greenhouse Gas Protocol. Scope 1 includes all the direct GHG emissions produced by a company, while Scope 2 also includes indirect emissions through the production of electricity, heat or steam consumed during operations. Scope 3 emissions is the most comprehensive and includes the full upstream and downstream lifecycle of emissions, including production of raw materials and use of the product following sale.
- Portfolio carbon intensity measured as GHG emissions per $ of revenue earned.
- Climate scenario analysis and stress testing. This is where investors model possible future environments and project the financial condition of assets under these scenarios. Scenario analysis can help fund managers to understand the climate resilience of their portfolios and inform the decision-making process.
- A "value at risk" approach (which differs significantly from the bank traded book VaR calculations) can be used to estimate the risk of an investment. Certain methodologies apply climate scenarios to identify the potential loss a portfolio could face given the costs companies would incur to achieve a target of global warming of 2^{0}C. These methods generally calculate the present value of climate costs or profits divided by the market value of the investment.

2. Climate reporting

Asset owners and fund evaluators are increasingly interested in the carbon profiling of funds. Leading practices include these metrics in client reporting while fund rating providers evaluate carbon profiles of various funds.

Where voting and ownership rights exists in asset level equities, increasingly climate risk is incorporated into voting decision and policies. The value of stewardship and voting activities are maximised once investors have first identified red flags using portfolio climate monitoring and analysis tools.

Implementation guidance for longer-term investments

Implementation will vary depending on a firm's risk systems and organisation.

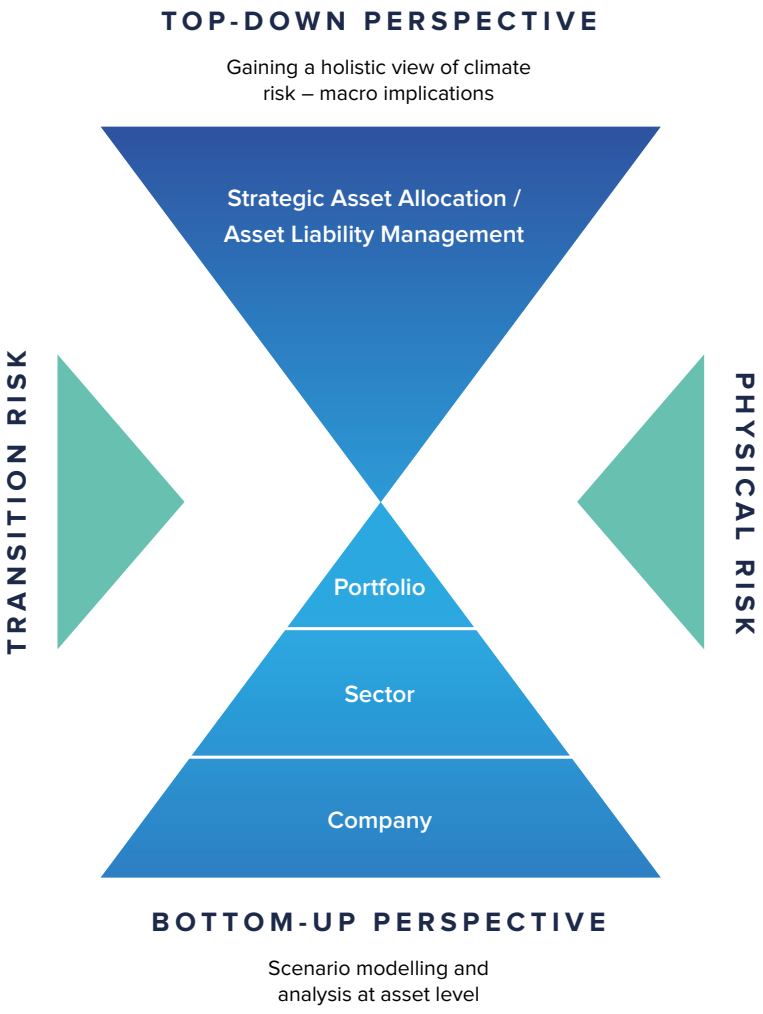
In the short-term, leading practice calls for the use of tools and systems to incorporate climate risks as part of qualitative sector and company analysis and physical real asset evaluation. Portfolio monitoring and climate reporting is prevalent, and in certain asset classes reinforcing climate risk with stewardship and voting practices is possible today.

Short-term leading practice is also likely to evolve to include climate financial risk, in a proportionate manner, as part of risk appetite statements. This is the logical next stage in the risk identification and risk monitoring cycle and requires significant organisational steps to be taken in order to be successfully adopted. With these changes comes the expectation for greater oversight of climate risk at board level. Limitations around tools and systems means that in the short-term such analysis is likely to focus on a point-in-time.

In the medium-term, scenarios will evolve to allow leading practice climate financial risk management to include risk appetite limits based on an expectation of the future.

Scenario analysis is an iterative process which can provide insight into risks, opportunities and drivers of change, as well as the potential impact on the fund and individual investments. The first step involves clearly setting out the objectives of the analysis and scope of assets under consideration. The second step involves selecting and modifying physical and transition climate risk scenarios, such as those published by the IPCC and IEA, based on the relevance of the model's assumptions. For the final step, current leading practice combines top-down holistic views of societal climate risk with bottom-up sector and asset level modelling, as shown in Figure 10. Using this approach fund managers can understand both the direct physical risk to their portfolio as well as the potential risks posed by a low-carbon transition. Refer to the Scenario Analysis Guide for more information.

Figure 10: Scenario analysis combines top down and bottom up views of physical and transition risk



Common questions to ask when selecting a climate scenario methodology include:

- What questions does this tool help my organization answer?
- Will my organisation be able to better identify relevant market signals in regard to climate change?
- How would this tool help in assessing the value at risk of investments in my portfolio?

Case Study 5.7: Assessing physical risk of assets under management

A global asset manager is currently exploring climate change scenario analysis on three assets. These are U.S municipal bonds, commercial mortgage-backed securities and electric utilities. The process used to gauge the risk of the assets is as follows:

1) Determine assets with identifiable physical locations

2) Overlay the physical asset locations against climate data

3) Link climate data to physical and socio-economic implications

4) Determine if climate risks are priced in or insured

5) Assess if the company has the resolve and financial capacity to adapt

Case Study 5.8: Climate risk assessment

The climate risk assessment first involves identifying the problem and risk factors, and then conducting stress-testing and risk management. This process involves 3 steps:

1) Identify risk factors

2) Consider their development in different climate scenarios (3 transition risk scenarios were used: a 1.5^{o}C scenario, a 2^{o}C scenario and a 3^{o}C scenario. These scenarios were tested for both bonds and equities).

3) Undertake high level assessment of the consequences.

Figure 11: Climate risk assessment

Good Practice for Trading Book Short Term Market Risk

As physical risk becomes more apparent around the globe and transition risk begins to materialise (via corporate, consumer or policy action) traders and market risk analysts following short term trading books should expect to experience more market shock events on specific sectors, individual names or regions. Such potential risks should be factored into existing management reporting and existing stress scenario frameworks, which are already designed to handle instantaneous shock events.

Good practice would call for the design of new macro scenarios where relevant, for micro scenario quantification, or for more enhanced risk reporting. Examples of macro scenarios could include significant wildfire or weather events or large scale policy announcements impacting broadly across markets. Micro scenarios would call for the analysis of specific names or sectors at risk of shock events. There is a vast range of events that could be used but they could include change in local/country policy, new carbon pricing, floods, physical asset repricing, the market reaction to an advanced corporate disclosure, or action impacting either directly or indirectly on the markets/supply chain. This analysis requires an approach to data similar to that set out in this guide under both the market and credit risk sections, which will result in enhancements to management information such that exposures having a degree of climate risk can be flagged, analysed and discussed with senior management.

Operational risk

Good practice

The management of operational risks arising from climate change, whether from physical or transition risks, should be fully incorporated and mapped into the Operational Risk Management Cycle, for example risk identification, measurement, management, monitoring and reporting.

Operational risk is a broad category, and its economic, reputational or compliance impacts can often be financially material. The below considers the breadth of operational risk with focus on material climate operational risks around: 1) business continuity arrangements and operational resilience; and 2) green washing and not meeting customers' expectations.

Risk assessment

Risk assessment should consider the following aspects:

Location Strategy, Business Continuity Arrangements and Operational Resilience, including for: Offices and Data Centres; Staff access to those Offices; and 3rd Party Suppliers. As well as the impact of the office locations for firms, their data centres and outsourcers, the ability of the workforce to travel to the office should be considered. One global bank is currently working with its property insurers to understand their property portfolio in areas most likely to be impacted by physical risks of climate change – further information on steps underway are set out in the case study below. In respect of 3rd party suppliers, companies should consider what preparations and assessments outsourcers have made themselves, and the mitigating actions they have in place.

Case Study 5.9: Geo-mapping of own property footprint

One global bank is working with its property insurers to understand their property portfolio in areas most likely to be impacted physical risks. Steps underway include:

- Defining the definition of climate change risks (e.g. flooding, high winds)
- Mapping given climate change risks to understand inherent risk
- Establishing criticality of building location
- Produce heat map for monitoring
- Align controls with geo-mapping
- Cross reference design resilience and operating controls
- Understand residual risk
- How does this map to risk appetite?

For the future, the aim is to assess the heat map and residual risk under different climate scenarios and compare this against risk appetite.

Not meeting customers' expectations or providing products that meet growing climate (and ESG) customer and policyholder demand. On the other hand, there is also the risk of companies 'Green Washing' to meet customer requirements, which may meet a short-term need but is unlikely to be a long-term solution. A recent example of the risks of green washing is the c$500m biofuel US tax credit fraud, where a company falsely claimed that it produced or blended biodiesel fuel to qualify for tax credits (as well as laundering more than $100m in fraud proceeds). Whilst an extreme case, companies should be aware of and manage the potential risks to meeting the growing demand (and incentives) for ESG products.

As set out in section 6 there is a lack of complete, accurate and timely data and management information on climate. This makes it difficult for management, executives and boards to make good decisions and creates an increased risk of decisions that cause bad outcomes for a company or indeed society. In addition, there is a heightened risk, given the lack of good quality data, of 'unknown unknowns'. Companies should remain conscious of the downsides, as well as upsides, of available data sources. Companies should also consider carefully what data is measuring and the consistency of data published.

Whilst regulators are taking a pragmatic approach to the implementation of climate risk management, as with other regulatory requirements, firms are at risk of not meeting regulatory requirements and standards – see further comments below.

Litigation risk may also increase for companies as climate risks crystallise over time.

Additionally, whilst not necessarily operational risks, other non-financial risks that may impact a business include:

- At a macro level, there is increasing policy recognition of the critical role financial services have in enabling the transition to a low carbon economy and building resilience. Put another way, if financial markets are unable to organise themselves to allocate capital in a way that supports society to achieve its goals on climate change, then policymakers may look to encourage or mandate them to do so. This recognition of the critical role of financial services extends beyond policymakers to many wider stakeholders including the general public, retail and institutional investors, financial regulators and NGOs, who are all increasingly conscious of this.
- The advent of TCFD disclosure means it will be easier for the public and the media to understand how different firms are approaching climate change. Companies that are perceived to be less supportive of climate action, or actively experience events that significantly harm the environment, may experience reputational risk events leading to loss of revenue, increased costs, the loss of key people or regulatory censure. This risk is increased if firms are perceived to not to deliver on their promises to stakeholders and their actions do not back up their words.
- Firms who fail to approach climate change strategically may also fail to position appropriately for fundamental changes that occur due to climate change, such as changes in the market for certain products, or market risk events, resulting in loss for the business or failure to maximise the opportunity relating to climate change.

Risk mitigation

When assessing risks and considering risk mitigation activities companies should be careful not to overstate the impact of mitigation (and therefore understate the net risk) as mitigating factors might not work as well as expected (especially if untested or not previously applied) in practice. Potential mitigation activities can include for example exclusion lists, proactive divestment, stewardship/investor activism and investing in solutions. In particular, the quality of a firm's operational resilience framework, including for example business continuity procedures and management of reputational risks, will be crucial in mitigating climate related operational risks in future.

Implementation guidance

As a starting point in implementing and embedding climate change one insurer is undertaking a mapping exercise to map the components of climate change risk to the risk taxonomy, including operational risks, to determine any gaps in how climate change risk is measured and monitored. As a result of this, targeted updates to existing risk management policies and risk appetite statements will then be made to explicitly include consideration of the risks related to climate change. Where appropriate, updates will then be made to current limits and triggers. Once the risk management framework is updated this will then be embedded into the regular risk management cycle, developing new risk MI as appropriate.

As part of this, specific near-term steps that can be taken to implement climate risk management into operational risk management include, for example:

- Mapping the components of climate change to the operational risk taxonomy;
- Considering and recognising climate change in the Operational Risk Policy, and whether a Climate category should be included in the Level 2 Operational Risk taxonomy;
- Developing and implementing, where appropriate, risk appetite statements, operational limits and triggers setting out the operational risk the company is willing to bear taking into account factors such as:
  - Long-term financial interests of the firm, and how decisions today affect future risks.
  - Results of stress and scenario testing, for shorter- and longer-time horizons.
  - Uncertainty around the timing and the channels through which the risks from climate change may materialise.
  - Sensitivity of the balance sheet to changes in key risk drivers and external conditions.
  - Ability to deliver on the company's climate change strategy and commitments.
- Exposures against these limits can then be monitored and reported to on an ongoing basis;
- Consider the operational impacts from climate scenarios and/ or consider climate risk within existing BAU operational risk scenarios – as with existing scenario approaches the risk of double counting the impacts (as well as correlations) should be considered. The number and nature of scenarios should reflect the materiality of the risk to the business. It should also be considered what different scenarios mean for your business and what the business will look like in that scenario;
- In assessing the impacts of climate risks, new approaches to risk identification may be required (e.g. Workshops to identify operational risks over a short and long term horizon). Existing operational risk and control heatmaps and scoring methodology can be utilized to support the assessment of risks;
- Green products should be included into existing product governance, including assessment (by first line) of the green credential of a product based on clear criteria, with second line independent compliance/risk review of the assessment – this may necessitate definition of a policy or framework for first and second line to base decisions on;

- As set out in the above case study, working with property insurers to understand the property portfolio in areas most at risk from physical risks of climate change;
- Considering any capital implications through existing operational risk modelling;
- Recording / categorising any climate-related operational losses or events, and include losses or events in BAU risk reporting. Incremental updates to Management Information are likely to be required as sophistication, capabilities and data increase.

6 Data and tools

Risk assessment, data and tools has been considered through four risk lenses – underwriting, credit, financial market and operational. Given the breadth of the topic and overlaps (both across risk types and with other CFRF Working Groups), a separate section is included to provide specific guidance.

Climate change and climate risks are a frontline research topic, and as such there are ongoing uncertainties and developments which may supersede the content of this section.

Good practice

To address limitations, firms can seek data from the following sources:

- External providers – dataset or tools, with an awareness and acceptance of the embedded assumptions/limitations.
- From customers through questionnaires or publicly available disclosures, e.g. annual report data mining.
- Through development of internal tools using own data, models and assumptions.

Implementation guidance

Tools are available along the below categories to support and inform risk assessments. The spreadsheet published alongside the CFRF guide provides an overview of example datasets and tools available in the market as at June 2020. The list is not exhaustive, and no endorsement is indicated by inclusion in the list.

An overview of key tool types is provided below:

Expert judgement
Expert judgment is a well-established Actuarial method and will be required to adapt findings from external sources which requires some level of expertise within the firm. Expert judgement is a widely used tool in risk management and recognized under regulatory frameworks subject to appropriate governance.

Hazard Maps
Hazard maps provide location-level information on the extent or severity of perils. They are typically based on historic events but can be also created for future states considering the impact from climate change which will result in different frequency and severity of events affecting certain locations. Therefore, updated hazard maps based on modified assumptions on the frequency, severity, and location parameters of primary events and dependencies with secondary perils may be considered. Third party service providers and some reinsures provide hazard maps, e.g. through web-based tools.

Footprints

Footprints show the impact of a single event on a geographical map, i.e. highlighting areas with major physical impact from this event. For example, a tropical hurricane footprint would show wind speeds and path of this event. Risk assessments may be done on event sets, including historic events, stochastic events, e.g. simulated events as variations of historic events, and specifically designed synthetic events. Specific event sets could be created which consider the impact from climate change. This would require further assumptions, e.g. on how climate change would impact key parameters of existing (historical) events if they would occur under the changed environment.

Catastrophe models

The use of probabilistic catastrophe models to assess the loss potential for various natural hazards is state of the art in (re)insurance. Typical perils covered include e.g. hurricanes, windstorms, floods, earthquakes, terrorism and pandemics (representing major risk factors in the risk landscape of (re)insurers).

Catastrophe models require deep understanding of the physical parameters that define a natural hazard, e.g. wind speeds and path of movement and characteristics of the exposures, e.g. location and vulnerabilities, which allow estimation of the potential loss. The outcome of the model is usually provided as the probability to exceed certain loss amounts, e.g. OEP or AEP. While larger (re)insurers often have developed their own internal models, e.g. as part of wider internal models used for Solvency II, several specialised service providers offer external Cat models or data on Cat events. While stochastic Cat models are mainly seen in the context of valuation of liabilities, they can also be applied for properties on the asset side, i.e. due to the modular concept which separates hazard and exposure modules.

Catastrophe modelling as a technology is well applicable to a future scenario state. However, we would caution that its parametrisation for multiple decades becomes highly assumption-dependent. First, the modelling of weather phenomena is complex by its nature. Such weather phenomena are not temperature-only driven, but also exposed to complex and sometimes counteracting atmospheric mechanisms.

While global mean temperatures and sea levels are clearly rising due to climate change and an increase in variability of temperature and humidity has been observed, the impact of climate change on the frequency and intensity of severe weather events such as tropical cyclones, tornados or hailstorms is uncertain at this point. Furthermore, the impact of climate change on the natural-hazard landscape is expected to exhibit strong regional characteristics with sometimes differential trends between regions. Global trends are not always consistent across regions. Assumptions for forward-looking modelling should therefore reflect such geographic differences to account for different levels of exposures to climate-change risks.

Economic scenario generators

Economic scenario generators are tools that simulate future possible states of economies and financial markets, based on risk factors driving financial variability (for further details see Society of Actuaries: Economic Scenario Generators – A Practical Guide). The analysis of economic scenarios is used to identify unexpected but plausible outcomes and is therefore critical for testing valuation

models under a broad range of possible economic and financial conditions. Generally, two common applications may be distinguished:

- Market-consistent valuation, e.g. using risk neutral scenarios for the valuation of stochastic cash flows, e. g. options and guarantees.
- Real-world models are forward-looking in the sense that they capture the market dynamics as they will impact the future economic balance sheet of the firm.

Economic Scenario Generators are used for the calculation of best-estimate (re)insurance technical provisions, based on clearly defined set of economic assumptions. These will capture the macroeconomic effects of climate change (including interest/discount rates) as they materialise over the longer term and eventually outweigh mortality / morbidity / demographic effects on technical provisions. Real-world Economic Scenario Generator models may be further developed to support long-term scenarios on climate change.

Scenario analysis
There is a separate CFRF working group considering climate scenario analysis and related tools which can support firms. See the separate Scenario Analysis chapter of the CFRF guide for further details.

Transition assessment tools and frameworks
Tools are available that consider transition readiness and/or adaptability of corporates and sovereign/countries. These tools consider the implications of policy, legal, technology and market changes likely to be associated with a transition to a lower-carbon economy. They are forward-looking, and incorporate the current positioning of businesses, the plans to mitigate risks and the implications of a longer term stress scenario.

ESG scoring
Environmental, Social and Governance (ESG) scores provide a rating across a wider lens that climate risk, but many tools will split out environmental scores and sub-section scores to assess climate impact.

Scenario analysis tools
See Scenario Analysis guide.

Own firm questionnaires
These are often compiled from publicly disclosed data and supplemented, where possible, through direct interaction with the client during the due diligence process. The Questionnaire path for emerging risks is well established, having been previously used by many institutions, for example, to assess major sanctioned country exposures.

Risk and control assessments
These can be used to assess and monitor climate risks as per normal firm practices. Firms can consider the addition of the below elements to their current risk assessment templates.

Example 6.1: Potential additions to a firm's risk assessment template

Risk Modifiers (Physical and Transition)	Consequence	Inherent Risk 2050			Mitigants and Controls	Residual Risk 2050		
		Likelihood	Impact	Risk Rating		Likelihood	Impact	Risk Rating
Increase in frequency and severity of flooding due to sea level rise, increased rainfall and storm surges associated with rising global temperatures	E.g. Impact to mortgage portfolio in defined locations. Will assets become uninsurable? Impact on underlying collateral? Any information from scenario analysis?	4	4	16	E.g. What can be done pre-emptively, versus at the time the risk materialises. What indicators will be monitored?	4	3	12

7 Training and culture

This section provides a principle-based set of guidelines that will be incumbent on individual firms to apply into their framework, in respect of the nature, size, and scale of each individual organisation's exposure to climate change financial risks.

Culture is the ethos and strategy of the firm; consideration should be given to how the importance and urgency of climate change financial risks are understood and embedded across the organisation. Each firm will have its unique business model and strategy, and hence differing approaches will be relevant to embed a strong culture that results in the effective management of climate change financial risks. Whilst recommended that the tone of the culture should be driven from the top, ownership and personal accountability should be encouraged across all staff.

The underlying facilitator of achieving alignment with a culture that is climate change risk-aware is to obtain the buy-in and engagement of all staff and stakeholders. Therefore, activities and initiatives are proposed in this section to encourage understanding both for general populations of staff, as well as more specific tools for those with direct exposure to identifying, managing, mitigating and reporting on climate financial risks.

Good practice

The guidance provided in this section is structured around four questions firms should consider to inform an approach to embedding and maintaining effective climate risk management frameworks:

- Why – establishing the link to strategy and organisation purpose. Providing the wider context to the importance and urgency of acting on climate financial risks.
- Who – identifying the populations of employees and stakeholders who will receive training, along with the reach and scope of broader cultural awareness initiatives.
- What – understand the varying topics and level of detail required to support staff in their roles, dependent on the degree of direct involvement in managing climate financial risks. Consider the timeline of activity to be undertaken; including immediate upskilling, as well as ongoing embedding.
- How – consider use of existing tools to deploy training and awareness to identified populations of colleagues, and to influence cultural and behaviour change. Tailor and agree the frequency activities.

Why

The organisation's strategy, and how that relates to managing climate financial risks, should form the basis to the approach for training and culture. Obtaining buy-in from staff and stakeholders on the importance and urgency with which this topic should be addressed is critical to the success of the risk management framework.

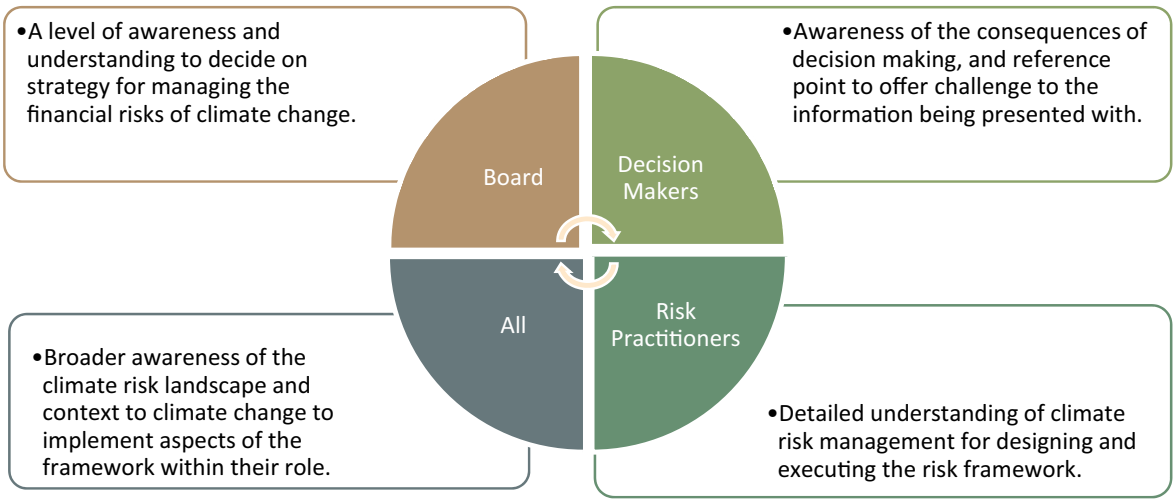
Firstly, setting the context to the subject of climate change, and linking to the organisation's strategy and purpose. Explaining why this topic is important now, both to the individual organisation, and to wider impacts. Such activities and approaches may include:

- Explanation of the wider context and scale of climate change as a crucial global issue.
- Setting an initial vision to inform the outcomes the organisation seeks to achieve with its climate risk management framework (see section 3) including links to broader ESG (Environmental, Social and Governance) principles.
- Articulation of risk appetite, and how it is measured (see section 4).
- Tone from the top, including clear guidance from senior management on the strategy for climate risk. For instance, what risks are the firm willing to take, what business is the company prepared to forego for sustainability reasons etc.
- Articulation of the risks, as well as the opportunities and benefits that can arise from managing risks effectively and efficiently. Including the loss avoidance from effectively managing and mitigating the impact and likelihood of climate change financial risks.
- The regulatory impetus is clear; there is a continuing emphasis from regulators of the potentially severe consequences of climate change, both on individual firms and structural adjustments to the global economy. Firms should be aware that they will be expected to be able to articulate the climate risks impacting their business and how strategies are managed to mitigate those risks.

Who

In order to drive an effective culture of climate financial risk management, clarity of respective roles and responsibilities should be established. Particularly given that the PRA expects that a firm's board and its sub-committees should have clear responsibilities for the management of the financial risks from climate change. To inform the appropriate training and culture activities, it is incumbent on firms to identify the relevant audiences, and corresponding level of information that is required to enable them to discharge their responsibilities. An example approach, with indicative audiences and training needs is outlined below and in Case Study 7.1: Example training approach.

Figure 12: Indicative training needs by audience



What

As outlined above, the nature of activities required to inform training and culture are dependent on individual roles, with varying degrees of subject matter tailored to direct / indirect exposure to managing climate financial risks. A clear understanding of what specific financial risks of climate change may affect your firm and its customers, will also in turn inform the relevant topics for training and awareness.

Having in place effective horizon scanning to identify changes coming down the line will also inform the impact on current business model and future plans. The frequency of activities should also be considered, and to ensure that the material is relevant to current regulatory expectations. Firms should also consider the time horizon over which activities should take place, as well as the frequency of ongoing refresh and embedding.

Example topics:

- Understanding climate change, effect on the business model and economic markets.
- Defining the importance of individual ownership, and how the impacts of climate change risk have broader ramifications.
- The climate financial risks, and how these manifest through economies and impact the company, customers, and staff;
- The impact on customers and how they can be supported;
- The firm's strategy in respect of managing climate financial risks, and key priorities;
- The regulatory requirements, including senior managers' regime and reporting;
- Precise processes relevant to roles directly involved with identifying, managing and reporting on climate financial risks.

Implementation guidance

The below provides an example of the types of tools firms may wish to employ, both in respect of training activities, and mechanisms to influence organisation culture and staff behaviours. This Climate Financial Risk Guide will also form a key resource to inform the risk management training undertaken. Firms should consider whether in the context of roles, responsibilities, and organisational structure, particular training aspects should be treated as mandatory, either on an annual basis or otherwise.

Training & awareness activities

- Use of specialist third parties to provide focused workshops with the board and key decision makers.
- Addition to existing function and role specific training curriculums.
- Intranet portal news channels (that can be customised to individual roles).
- Dedicated SharePoint sites, Lunch & Learn and Town halls.
- Online training programmes (personal development, and mandatory e-learning programmes).
- External parties could work with an accredited provider to develop training courses and professional qualifications.
- Establish working group with other key financial services firms to share good practice and understanding of key risks.
- Horizon scanning for changes relevant to regulatory and industry outlook.

Tools to influence culture & behaviours

- Embedding in strategy – internal / external reported commitments.
- Scorecards – embed sustainability into scorecards to drive behaviours (scorecards linked to compensation). Individual objectives linked to effective risk management / sustainability targets.
- Accountability for delivering effective culture & behaviour assigned to senior functions.
- Use of third parties to independently assess the effectiveness of embedded culture and behaviours.
- Inclusion of climate change topics in new joiner induction programmes.
- Establish cross department working groups to champion awareness and change.
- Use of customer surveys to understand customer expectation on ESG topics.
- Alliances with climate change organisations and charitable foundations.

Case Study 7.1: Example training approach

Nature of roles and responsibilities relevant to climate financial risks	**Scope / nature of training (suggested frequency)**					
	Contextual climate change training (onboarding / immediate)	Link to ESG strategy, refresh of context (annual)	Technical role specific training (regular)	Regulatory requirements (annual)	Strategic decision making, direction setting (annual)	Corporate governance responsibilities (annual)
Board-level / climate SMF	✓	✓			✓	✓
Decision maker relevant to climate risks	✓	✓	✓	✓	✓	
Day to day involvement in climate risks	✓	✓	✓	✓		
All other staff and contingent workers	✓	✓				

8 Challenges, barriers and gaps

Availability of data and tools

Data limitations can affect how quantitative risk appetites are developed and measured. Data gaps present a significant barrier which means that any risk limit has inherent uncertainty. Methodologies and systems are not defined and guidance has historically been lacking.

In addition to this:

- High quality and sufficiently granular hazard maps may not be readily available for all types of perils. Specialized service providers can provide hazard maps and footprints for major perils, e.g. flood, windstorm, and earthquakes.
- While advanced modelling technologies are generally capable for multi-year assessments, assumptions that may be used for such assessments are still pre-mature. Not all firms will have the resources to build sophisticated modelling capability but could use instead services provided in the market.
- Data gaps can be more prevalent for underwriting than for investment risk appetites, since insured loss dynamics can be difficult to quantify and ascribe to climate-related factors.
- Tools may not have sufficient coverage of a firm's business (e.g. customer base) to enable accurate risk assessments.

Standards

TCFD disclosures are not mandatory and different measures as calculated by customers, counterparties, and firms may not be comparable, due to lack of standards. There are also no clear standards about which activities may be considered as "green" or "brown". Further advancements of these standards are under way, e.g. by the EC Technical Expert Group and Insurers CRO Forum.

Proportionality

Climate risks have not been seen as traditional risk indicators and have not had the same level of priority by boards. This is clearly changing but there does need to be proportionality in the assessment. Firms should not unduly overweight climate concerns to the detriment of normal risk analysis, e.g. capitalization, cash flows, competencies, etc. Just as a guarantee does not make a bad deal good, a strong climate change strategy by a counterparty does not necessarily make for a creditworthy proposition.

Uncertainties over the longer time horizon

Climate change is a frontline research topic with still many uncertainties. For example, there are many uncertainties around how climate change will impact the environment, e.g. due to impact on weather-related events. The outcome

of climate change will also largely depend on socio-economic factors like urbanization and land use in sensitive areas as well as policy measures to mitigate these impacts. There are also consequences for financial markets and human health. These factors may lead to various outcomes which remains a major challenge for the development and use of scenarios for long-term risk assessment.

Aligning with strategic planning and risk management timeframes

Many chronic risks will not fully materialize for many years. This could lead to a temptation to avoid making potentially revenue-reducing decisions now with an undefined rationalization that the bank could always exit the sector/relationship later. Continued encouragement from all stakeholders is therefore required to encourage the longer-term view and engagement with serious long-term counterparties. In addition, consideration has to be allowed for the fact that countries will transition at different speeds. For example, it would be unreasonable to expect countries such as China and Indonesia to transition at the same rate as, say, Germany and Denmark.

In addition, time horizons for risk assessments (around 3-5 years) are generally not aligned with the typical timeframes expected to observe the manifestations of climate risks, which are often decades.

Unintended consequences

There is a real risk of unintended consequences. For example, external pressure could lead to banks not financing the transition thus precipitating defaults. At the same time, lenders need to be assured that by acting responsibly and participating in energy transition financing they will not find themselves subject to litigation in future.

Economic distortion can stem from incentives to finance green technologies and excluding the possibility of transition by entrenched players may lead to industry and economic disaster. Well-intentioned changes to internal liquidity costs and/or risk-adjusted return on capital (RAROC) hurdle rates could exacerbate such distortion.

There is limited incentivisation to invest in assets that are aligned with a low-carbon transition which may cause delays in business models adapting. At present, the Solvency II Directive in Europe does not afford reduced capital charges for sustainable assets.

Annex 1: Resources

CRO Forum – includes an initiative to recommend an industry methodology to quantify carbon emissions in (re)insurance portfolios

EIOPA "Opinion on sustainability within Solvency II"

European Commission Joint Research Centre (JRC) – promotion of disaster risk management tools and building of databases on disaster losses

European Commission Technical Expert Group (TEG) on Sustainable Finance – development of European standards for sustainability benchmarks and metrics

IAIS/SIF "Issues Paper on Climate Change Risks to the Insurance Sector"

PRA guidance "A framework for assessing financial impacts of physical climate change"

Taskforce on Climate-related Financial Disclosures (TCFD)

UNEP Principles for Sustainable Insurance (PSI) – initiative for new generation of risk assessment tools designed to enable the insurance industry to better understand the impacts of climate change on their business (e.g. by incorporating the latest scenario analysis)

UNEP/WMO Intergovernmental Panel on Climate Change (IPCC)'s Working Group – assessment reports on climate change (including standardised scenarios)

CFRF CLIMATE FINANCIAL RISK FORUM