

Managing physical climate-related risks in loan portfolios

Technical Supplement
to the 2024 Climate Risk
Landscape Report

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This project, a collaborative effort led by the United Nations Environment Programme Finance Initiative (UNEP FI) Risk Centre and run by technical expertise from Munich Re, has been pivotal in advancing the management of physical climate-related risks in loan portfolios.

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Contents

Executive summary	viii
1. Introduction: Setting the context	1
2. Adapting risk frameworks for climate risk considerations.....	5
2.1 Regulatory requirements.....	6
2.2 Risk appetite.....	10
2.2.1 Ownership and integration into governance.....	11
2.2.2 Key components of risk appetite.....	14
2.2.3 Existing climate risk categories	15
2.2.4 Learnings on risk appetite for climate risk from the (re) insurance sector	18
3. Strategies for managing physical climate risk	20
3.1 Physical climate risk exposure in lending portfolios	21
3.1.1 Residential mortgage.....	22
3.1.2 Business and agricultural lending.....	24
3.2 Banks' responses to natural catastrophe events	24
4. Proposed framework for managing physical climate risk in lending portfolios ...	27
4.1 Accept.....	29
4.2 Avoid.....	30
4.3 Adapt.....	31
4.4 Transfer	32
4.4.1 Loan payment deferrals.....	33
4.5 Overview of different risk management solutions	35
5. Conclusion.....	39
Appendix.....	41
Regulatory physical climate stress testing exercises	42
List of references	43

List of figures and tables

Figures

Figure 1:	Major weather-related loss events 2023 (Munich Re, 2023).....	3
Figure 2:	Core elements of recommended climate-related financial disclosures (TCFD, 2017).....	7
Figure 3:	2023 TCFD/ISSB-aligned regulations and actions in major economies (FSB, 2023).....	8
Figure 4:	Comparison of main sustainability disclosure frameworks and standards (IFC, 2023).....	9
Figure 5:	Good practices for climate-related risks governance (CFRF 2020).....	12
Figure 6:	Integrating climate change into risk planning (BBVA, 2024).....	13
Figure 7:	Risk Appetite KRI development (ABN AMRO, 2023).....	15
Figure 8:	Material impacts across climate-related risks (BOI, 2023).....	17
Figure 9:	Risk retention and transfer strategy for insurance (Aon, 2021).....	19
Figure 10:	The total economic cost of natural catastrophes is the sum of the asset losses, plus the associated financial and social costs (Deloitte, 2021).....	22
Figure 11:	Hurricane Katrina—Delinquent loans as a percent of active unpaid principal balance in the region (Fanniema, 2017).....	23
Figure 12:	Strategies for Risk Management in Loan Portfolios (Munich Re, 2024).....	28
Figure 13:	Munich Re's Location Risk Intelligence (Munich Re, 2024).....	29
Figure 14:	Analytical editions for current and future natural and financial risks related to climate (Munich Re, 2024).....	30
Figure 15:	List of possible management actions (Munich Re, 2024).....	36
Figure 16:	Summary of risk management measures ratings: accept, avoid, adapt, and transfer (Munich Re, 2024).....	37

Tables

Table 1:	Categories of climate risk drivers and their potential effects (BIS, 2021).....	16
Table 2:	Key factors amplifying the impact of natural catastrophes on banking sector risk profiles (Munich Re, 2024).....	22

List of abbreviations and acronyms

APCR	Autorité de Contrôle Prudentiel et de Résolution (French Prudential Regulation Authority)
APRA	Australian Prudential Regulation Authority
BIS	Bank for International Settlements
BNM	Bank Negara Malaysia (Central Bank of Malaysia)
BoE	Bank of England (Central Bank of the UK)
BoF	Bank of France (Central Bank of France)
BoJ	Bank of Japan (Central Bank of Japan)
CD	Certificate of Deposit
CFRF	Climate Financial Risk Forum
CSDDD	Corporate Sustainability Due Diligence Directive
DNB	DeNederlandscheBank (Central Bank of the Netherlands)
EAD	Exposure at Default
EBA	European Banking Authority
ECB	European Central Bank
ECL	Expected Credit Loss
ESG	Environment Social Governance
Fed	Federal Reserve (United States)
FSA	Financial Service Agency (Japan)
FSB	Financial Stability Board
G20	Group of 20
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HKMA	Hong Kong Monetary Authority
IFRS	International Financial Reporting Standards
IPCC	Intergovernmental Panel on Climate Change
ISSB	International Sustainability Standards Board
KRI	Key Risk Indicator
LGD	Loss Given Default
MAS	Monetary Authority of Singapore
NACE classification	Nomenclature of Economic Activities classification
OECD	Organisation for Economic Co-operation and Development
PD	Probability of Default
RAF	Risk Appetite Framework
RAS	Risk Appetite Statement
RCP	Representative Concentration Pathways
SARB	South African Reserve Bank
SEC	Securities and Exchange Commission
TCFD	Task Force on Climate-related Financial Disclosures
UNEP FI	United Nations Environment Programme Finance Initiative
WEF	World Economic Forum
WTW	Willis Towers Watson



Executive summary

To equip retail banks with tools and knowledge to effectively assess, manage, and minimise physical climate risks in their lending activities, this report offers an in-depth analysis of physical climate risk management. It moves beyond generalities to provide concrete, actionable insights for financial institutions (for the purpose of this report, the term “banks” will be used as a generic reference to these types of institutions). It serves as a practical guide, presenting a comprehensive overview of current practices, emerging trends, and innovative approaches in managing these risks.

Key to the guidance provided are strategies such as Accumulation Monitoring and Resilience Loans that are highlighted for their fundamental role in risk management. These strategies are notable for their effectiveness.

The key findings from the analysis are summarised below:

- **Progress modelling & solution design in parallel:** While it is critical for banks to continue to enhance their risk models so as to better incorporate consideration of climate risk, they should also start focusing on possible solutions to manage this new type of risk;
 - **Set clear risk appetite for climate risk:** Bank management needs to be clear on how much risk and capital they are willing to dedicate to this new risk category, preferably with pre-defined measures and associated thresholds that should trigger formal responses;
 - **Exploring new solutions:** There are several ways banks can deal with their exposure to climate risks, all of which come with both advantages and drawbacks. In many cases, their implementation will take time and raise complex matters. In anticipation of these challenges, therefore, it is critical for banks to kick off discussions now with the relevant functions about possible solutions. While progressing on their discovery journey, banks should seek insights from other industries, such as the (re)insurance sector, which has been dealing with these types of solutions for a longer period.
-

Following the introduction, the report is segmented into distinct sections, each addressing a critical aspect of physical climate risk management in loan portfolios. The report unfolds as follows:



Chapter 2, “Adapting Risk Frameworks for Climate Risk Considerations”, delves into the integration of climate risks in existing risk frameworks. It examines regulatory requirements and risk appetite, drawing parallels with approaches in the insurance sector for natural catastrophe and physical climate risk considerations.



Chapter 3, “Strategies for Managing Physical Climate Risk”, proposes a comprehensive framework for managing climate risks in loan portfolios, centred around accepting, avoiding, adapting, and transferring risks. This chapter provides a detailed analysis of each strategy, incorporating global case studies and evaluating their benefits and limitations.



Chapter 4, “Proposed framework for managing physical climate risk in lending portfolios”, outlines the strategic steps for designing and implementing the recommended actions, highlighting the roles of key internal and external stakeholders.



Chapter 5, “Conclusion & recommendations”, synthesises the findings and presents strategic recommendations for banks.



1. Introduction: Setting the context

The urgency to address climate change has never been more critical, as recent findings illuminate the severe consequences of inaction. According to the Intergovernmental Panel on Climate Change ([IPCC, 2022](#)), surpassing global warming of 1.5°C could lead to unavoidable increases in climate hazards, exposing ecosystems and humans to unprecedented risks. Even a temporary exceedance of this threshold may result in irreversible damage, emphasising the narrow window for effective intervention. The economic ramifications are equally stark, with projected losses surpassing USD 178 trillion globally by 2070 due to unmitigated climate change ([Deloitte, 2022](#)). These insights underline the crucial role of the financial sector in urgently weaving physical climate risks into their risk management strategies. This involves moving beyond mere reduction of their own risks and becoming key players in driving solutions ([UNEP FI, 2024](#)).

Financial institutions (herein, referred to by the generic term, “banks”) typically categorise climate-related risks into two main types: physical and transition risks. Physical risks stem from direct environmental changes that affect bank operations, customer and investee assets and supply chains, and the broader economy, such as extreme weather events leading to asset damage and operational disruptions. Figure 1 illustrates some examples of extreme weather events. This paper specifically addresses the impacts on a bank’s portfolio rather than its operations, as the former represents the most material risk.



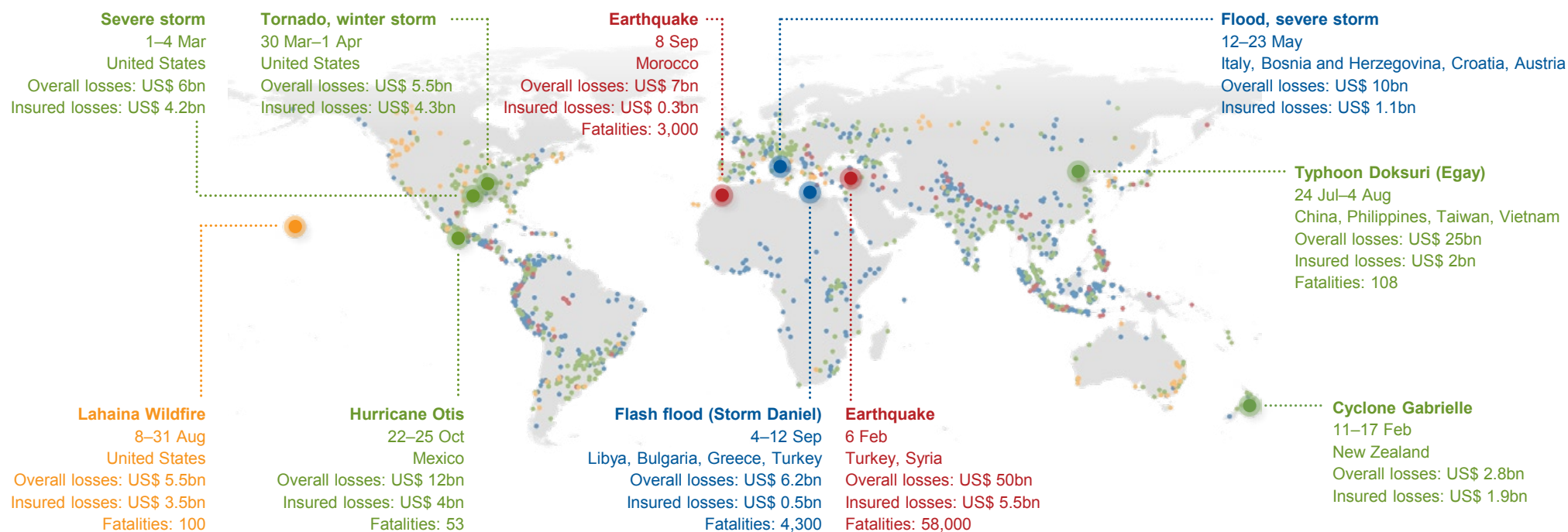


Figure 1: Major weather-related loss events 2023 ([Munich Re, 2023](#)).

On the other hand, transition risks are associated with the economic shift towards a low-carbon economy. This can also affect banks' customers and investments and their supply chains, as well as their compliance with evolving regulations and stakeholder expectations ([EY, 2021](#)).


In 2021, research by Ceres indicated that the annual value-at-risk from physical climate impacts on just the syndicated loan portfolios of major US banks could approach 10 per cent ([Ceres, 2021](#)). Physical risks pose a dual threat to banks. Firstly, these risks can jeopardise borrowers' operations, diminishing their revenue generation and debt-servicing capabilities. Such disruptions might ultimately provoke the insolvency of borrowers. Secondly, physical damages caused by extreme weather events can also lead to the depreciation of the value of collateral, such as real estate or industrial assets. Both of these threats exacerbate the bank's risk of credit losses. And if the losses are widespread, they could impact financial stability.

Adding to these concerns, macroeconomic and related risks further compound the challenges faced by banks. Economic downturns, changes in interest rates, and fluctuations in market conditions can magnify the impact of physical risks. For instance, a macroeconomic downturn following a natural catastrophe could further reduce the demand for real estate, leading to an even steeper decline in collateral values. Similarly, changes in regulatory and environmental policies in response to physical risks could introduce additional compliance costs and liabilities for borrowers, affecting their financial health and, by extension, the risk profile of the banks. These intertwined risks underscore the need for banks to adopt a comprehensive risk management strategy that considers both the immediate physical damages and the broader economic implications.

However, confronting these challenges also unveils opportunities for innovation in the banking industry. By proactively managing physical risks, banks can lead in crafting new financial products and services tailored to help the transition to a low-carbon economy, and thereby foster climate resilience and adaptation. These innovative solutions can provide crucial support to both businesses and individuals, aiding them in reducing climate change and counteracting its effects.

The strategic management of loan portfolios, which are central to banks' business models and their financial relationships across the economy, is key to leveraging these opportunities. Physical risk management within these portfolios not only minimise potential financial losses but also propels climate action forward. This report, therefore, emphasises the importance of banks addressing physical climate risks in their lending practices. Its goal is to enhance understanding of these risks, highlight effective management strategies, and showcase the latest trends in the field.

Combining insights and actionable advice, the document serves as a comprehensive guide for banks that are navigating the complexities of physical climate risks. It underscores the banking sector's crucial contribution to global climate goals and the pursuit of a sustainable, resilient future.



2. Adapting risk frameworks for climate risk considerations

2.1 Regulatory requirements

The regulatory landscape for climate risk management within the banking sector is rapidly evolving to meet the urgent challenges posed by climate change. Banks are now required to integrate climate risk into their risk frameworks more comprehensively, as evidenced by a slew of regulatory updates across the globe.

In recent years, financial sector authorities have become increasingly focused on climate change risks and their impact on financial institutions ([BIS, 2021a](#)). Accordingly, in 2022, the Basel Committee on Banking Supervision published a list of principles for the effective management and supervision of climate-related financial risks ([BIS, 2022](#)). Growing efforts have been made to quantify banks' and insurance companies' exposure to climate-related transition and physical risks ([BIS, 2021a](#)).

Considering that traditional risk management approaches may be unsuitable for measuring climate-related risks, authorities and the industry have turned to climate stress tests in order to provide a comprehensive assessment of the impacts of climate change on banks' balance sheets and operations ([BIS, 2021a](#)).

Financial supervisors have also started to look at the resilience of the financial system towards climate risks with requirements of climate stress tests. For example, in 2022, the European Central Bank (ECB) carried out a comprehensive climate risk stress test of systemic institutions as part of its annual stress test. The exercise aimed to foster climate stress testing capabilities for transition risks and acute physical risks ([ECB, 2022](#)). The United States Federal Reserve also conducted a pilot climate scenario analysis exercise in 2023, involving six of the nation's largest banks ([Reuters, 2022](#)).

Regulators are also increasingly explicitly requiring banks to incorporate climate change into their risk management framework, for example, in the context of the European regulatory landscape, the ECB requires banks to progressively meet all the supervisory expectations laid out in its guide on climate-related and environmental risks by the end of 2024 ([ECB, 2020](#)). In addition, the European Banking Authority (EBA) published binding standards on Pillar 3 disclosures on environmental, social, and governance (ESG) risks ([EBA, 2022a](#)). The EBA's standards require prudential information on these risks, which include transition and physical risks, to be disclosed by large institutions with securities traded on a regulated market of any Member State ([EBA, 2022b](#)).

As well as complying with regulations for the financial sector, banks also need to comply with regulations that are aimed at big companies, such as the European Commission's 2022 Directive on Corporate Sustainability Due Diligence ([CSDDD, 2022](#)). These regulations aim to foster sustainable and responsible corporate behaviour, while also anchoring human rights and environmental considerations into companies' operations and corporate governance.

In the United States, the Federal Reserve has outlined comprehensive principles for managing climate-related financial risks targeted at large banks with assets over \$100 billion. These principles aim to ensure the safety and soundness of banks and the broader financial stability of the United States. They do so by addressing physical risks from acute and chronic climate shifts, as well as transition risks from economic adjustments

towards a lower-carbon economy. According to these principles, banks must integrate climate risks into their risk management frameworks, enhancing their ability to comprehensively identify, measure, monitor, and control these risks ([Federal Reserve, 2023a](#)).

Recent years have also seen concerted efforts toward global standardisation and the alignment of climate-related disclosure frameworks. Until recently, the most recognised reporting standard for climate-related disclosures was the Task Force for Climate-related Financial Disclosures (TCFD) recommendations, which were [published in 2017](#). In June 2023, the International Sustainability Standards Board (ISSB) released its inaugural sustainability disclosure standards. These comprised the International Financial Reporting Standards (IFRS) [S1: General Requirements for Disclosure of Sustainability-related Financial Information](#) and [IFRS S2: Climate-related Disclosure Standard](#). The IFRS S2 integrates, and is consistent with, the four core recommendation categories published by the TCFD, as illustrated by Figure 2. That is to say, it requires entities to disclose information on their governance, strategies, and processes for managing climate-related risks and opportunities, as well as their performance and progress towards climate-related targets. The goal is to enhance the transparency and understanding of their climate risk management practices for financial report users.



Figure 2: Core elements of recommended climate-related financial disclosures ([TCFD, 2017](#)).

Worldwide, the mandate for climate-related disclosures is becoming increasingly common. In the United Kingdom, for example, the Financial Conduct Authority (FCA) has required TCFD/ISSB-aligned reports from large asset managers and owners since June 2023. This requirement expanded from premium-listed companies, which began their reporting in 2022, to include standard-listed companies in 2023. As of 1 June 2023, this obligation extended to a broad spectrum of financial institutions, including smaller managers and asset owners ([FCA, 2023](#)).

In January 2023, a new framework for ESG disclosures came into effect under the Corporate Sustainability Reporting Directive (CSRD). In October 2023, the European Commission adopted the first set of European Financial Reporting Standards (ESRS). Whilst the CSRD sets out reporting requirements and obligations, the ESRS provide the framework and methodology for reporting ([EFRAG, 2023](#)).

In the United States, the Securities and Exchange Commission (SEC) has adopted rules

to enhance and standardise climate-related disclosures by public companies and in public offerings. The final rules require larger public US companies to disclose risks that climate risks pose to their businesses, as well as greenhouse gas emissions (GHGs) from their own operations or energy use if this information is financially material to investors. Compliance dates for the rules will be phased in for all registrants, with the compliance date dependent on the registrant's filer status ([SEC, 2024](#)).

Figure 3 offers a non-exhaustive overview of the global regulatory landscape regarding climate-related disclosures and the adoption of TCFD recommendations in 2023, as compiled by the Financial Stability Board ([FSB, 2023](#)).

<p>Brazil: Financial institutions are already required to provide qualitative disclosures based on the TCFD Recommendations under a proportionality perspective according to the segmentation of the local financial system. Quantitative disclosures will adopt a similar approach.</p>	<p>Türkiye: In June 2023, the Public Oversight, Accounting and Auditing Standards Authority of Turkey decided to adopt the ISSB Standards. In January 2024, Türkiye Sustainability Reporting Standards were released, regulating the scope of application of Climate-related Disclosures.</p>	<p>Switzerland: The TCFD's climate-related financial disclosures have been made mandatory for larger companies across all sectors of the economy from 1 January 2024. Companies will be expected to implement the legislation starting in 2025 for the financial year 2024.</p>
<p>Japan: The Sustainability Standards Board of Japan (SSBJ) is developing standards for sustainability-related disclosures based on IFRS S1 and IFRS S2. The Financial Services Agency is considering to designate the SSBJ's standards within the regulatory framework.</p>	<p>Hong Kong: The Hong Kong Stock Exchange published in April 2023 a consultation paper proposing to mandate all listed companies in Hong Kong to provide climate-related disclosure in their ESG reports and announced that the implementation date will be 1 January 2025.</p>	<p>Saudi Arabia: Various ministries and government agencies, including SAMA, are currently coordinating their policy initiatives with a view to working towards a common sustainability disclosure requirement at the national level. A specific timeline is to be determined.</p>
<p>South Africa: In August 2023, following the Prudential Communication 10 on climate-related risks, South Africa's Prudential Authority has issued two proposed guidance notes on climate-related disclosures for banks and insurers.</p>	<p>Singapore: The Singapore Exchange introduced requirements for issuers to incorporate climate-related disclosures based on the recommendations of the TCFD. Climate reporting is mandatory for all issuers on a 'comply or explain' basis for the financial year of 2022.</p>	<p>New Zealand: Effective 1 January 2023, New Zealand's standards require mandatory climate-related disclosures for approximately 200 entities, including equity and debt issuers and large financial organisations such as banks and insurers.</p>

Figure 3: 2023 TCFD/ISSB-aligned regulations and actions in major economies ([FSB, 2023](#)).

The table below summarises the most important disclosure frameworks and standards.

	GRI	ESRS	ISSB	Consolidated into ISSB		
				Integrated Reporting Framework	SASB Standards	TCFD
Type of guidance	Standards	Standards	Standards	Framework	Standards	Guidelines
Application	Voluntary	Mandatory for large companies and listed smes	Subject to national jurisdiction adoption	Voluntary	Voluntary	Voluntary
Coverage	Global	European union (third countries in the future)	Global	Global	U.S., To be applicable globally	Global
Topics	Economic, environmental, and social activities and impacts	Environmental, social and governance	General Sustainability; climate, other topics to be added Sustainability: Climate, other topics to be added	Six capitals: financial, manufactured, intellectual, human, social, natural	Environment, social capital, human capital, business model & innovation, leadership & governance	Climate-related risks, opportunities, financial impacts, and scenario analysis
Sector specific	No	Yes (forthcoming)	Yes	No	Yes	Yes
Target audience	All stakeholders	All stakeholders	Investors	Providers of financial capital	Investors	Investors
Building blocks		TCFD, GRI, CDP	TCFD, SASB, CDSB			
Materiality type	Impact materiality	Double-materiality (financial + impact materiality)	Single materiality (financial materiality)	Single materiality (financial materiality)	Single materiality (financial materiality)	Single materiality (financial materiality)
Materiality definition	Aspects that reflect the organization's significant economic, environmental, and social impacts; or that substantively influence the assessments and decisions of stakeholders	Impact on people or the environment and financial effects on undertaking over the short-, medium- and long-term time horizons.	Information is material if omitting, misstating or obscuring that information could reasonably be expected to influence decisions that the primary users of general-purpose financial reporting.	Matter that could substantively affect the organization's ability to create value in the short, medium, or long term.	A fact is material if there is a substantial likelihood that a reasonable investor would view its omission or misstatement as having significantly altered the total mix of information.	Public companies' legal obligation to disclose information in their financial filings—including material climate-related information

Figure 4: Comparison of main sustainability disclosure frameworks and standards (IFC, 2023).

This regulatory update highlights the concerted efforts towards addressing climate risks, underscoring the pivotal role of banks in fostering a sustainable and resilient future. As regulations continue to evolve, banks are encouraged to stay abreast of these developments. In this way, they can ensure that their risk management practices are robust and forward-looking, and that they are capable of addressing the complexities of climate change.

2.2 Risk appetite

Drawing up a risk appetite framework comprises an essential part of companies' risk management strategy. Such a framework reflects the risk management philosophy that management wants its bank to adopt. For this reason, it exerts considerable influence on banks' culture towards risk,¹ as well as its operating style and approach to decision-making. Established by the board, this framework should align with the strategic objectives that the organisation aims to achieve. Additionally, it must be adaptable to the market environment in which the organisation operates, ensuring that strategic goals are pursued in a manner that remains sensitive to external conditions and industry dynamics. In most regulated markets, establishing a risk appetite framework represents a mandatory requirement for financial institutions, particularly within the insurance, banking, and asset management sectors.

Effectively managing physical risks within the loan portfolios of banks begins with defining the organisation's climate risk appetite. This appetite delineates the maximum probable loss a company is prepared to absorb within a specific time frame without causing unacceptable impacts on its business operations ([CFRE, 2022](#)). Specifically, a climate risk appetite outlines the degree of financial risk that an organisation is willing to accept in light of its business model ([CFRE, 2020](#)). This risk threshold varies across institutions based on several factors, including business strategy, regulatory requirements, and cost of capital, as well as the exposure to and materiality of climate-related risks ([BIS, 2021b](#)). This section introduces the concept of risk appetite, covering its essential components as well as the key risk categories, metrics, and frameworks that are prevalent among financial institutions. It lays the groundwork for subsequent chapters that will delve into detailed strategies and action plans for climate risk management. However, as highlighted by the ECB in its report on [good practices for climate stress testing](#), "more effort is needed regarding the transmission of transition risks to losses given default (LGDs) and the integration of physical risks into estimations of credit risk parameters". As risk models continue to improve, however, it is critical for lending institutions to already be paving the way for the integration of climate risk into their core business processes.

¹ Risk culture embodies the collective understanding and attitude towards risk-taking and management across all levels. It shapes how risks are identified, assessed, communicated, and addressed within the organisation, ensuring that risk management is integral to decision-making and aligns with a bank's risk appetite and strategic objectives.

In order to be truly effective, the risk appetite framework should have the following four characteristics:

<p>Be comprehensive</p> <p>Risk appetite frameworks must include all relevant risks for the organisation, both financial and non-financial ones. Furthermore, it is critical for management to consider internal risk drivers as well as those outside the organisation. Examples of the former include a failure of operational processes as this could significantly impair the organisation's risk profile.</p>	<p>Based on effective governance</p> <p>Setting a risk appetite framework and ensuring this is adhered to is one of the core responsibilities of the board of an organisation. The board must be provided with adequate management information on the core constituents of the framework and should regularly review its relevance in light of the risk environment.</p>
<p>Be consistently used</p> <p>The adoption of a risk appetite framework throughout the organisation is essential for the entire organisation to understand the appetite for risk and operate accordingly.</p>	<p>Be fully integrated</p> <p>As risk appetite frameworks are designed to help steer the risk profile of the organisation, they must be integrated into decision-making processes and adequately considered for all significant decisions.</p>

2.2.1 Ownership and integration into governance

Effective governance should ensure that financial risks arising from climate change are understood, accounted for, and integrated at all levels of an institution ([CFRE, 2020](#)). Firms should design and implement the governance approach for climate-related risks in the same way as other financial risks, while considering the specificities of this particular risk category ([CFRE, 2020](#)). Hence, the quality of climate risk governance relies heavily on the extent to which climate risk management is integrated effectively into established risk management frameworks ([CFRE, 2020](#)). Figure 5 provides an overview of elements that are particularly relevant in building governance structure for climate-related risks:

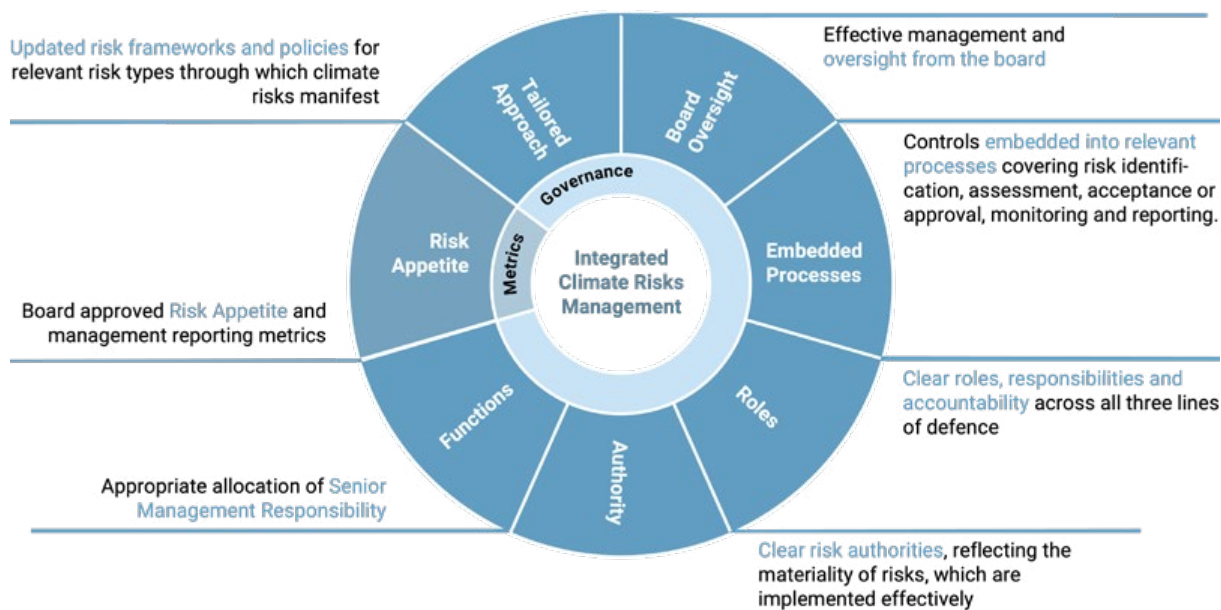


Figure 5: Good practices for climate-related risks governance ([CFRF, 2020](#)).

As climate risks get integrated into existing risk management frameworks, it is essential to consider these risks strategically and in line with a risk appetite ([CFRF, 2020](#)).

As illustrated in Figure 6 below (retrieved from BBVA's 2023 TCFD report), the risk appetite framework occupies a central position in BBVA's risk management strategy, thus demonstrating the importance of the bank's climate risk appetite.



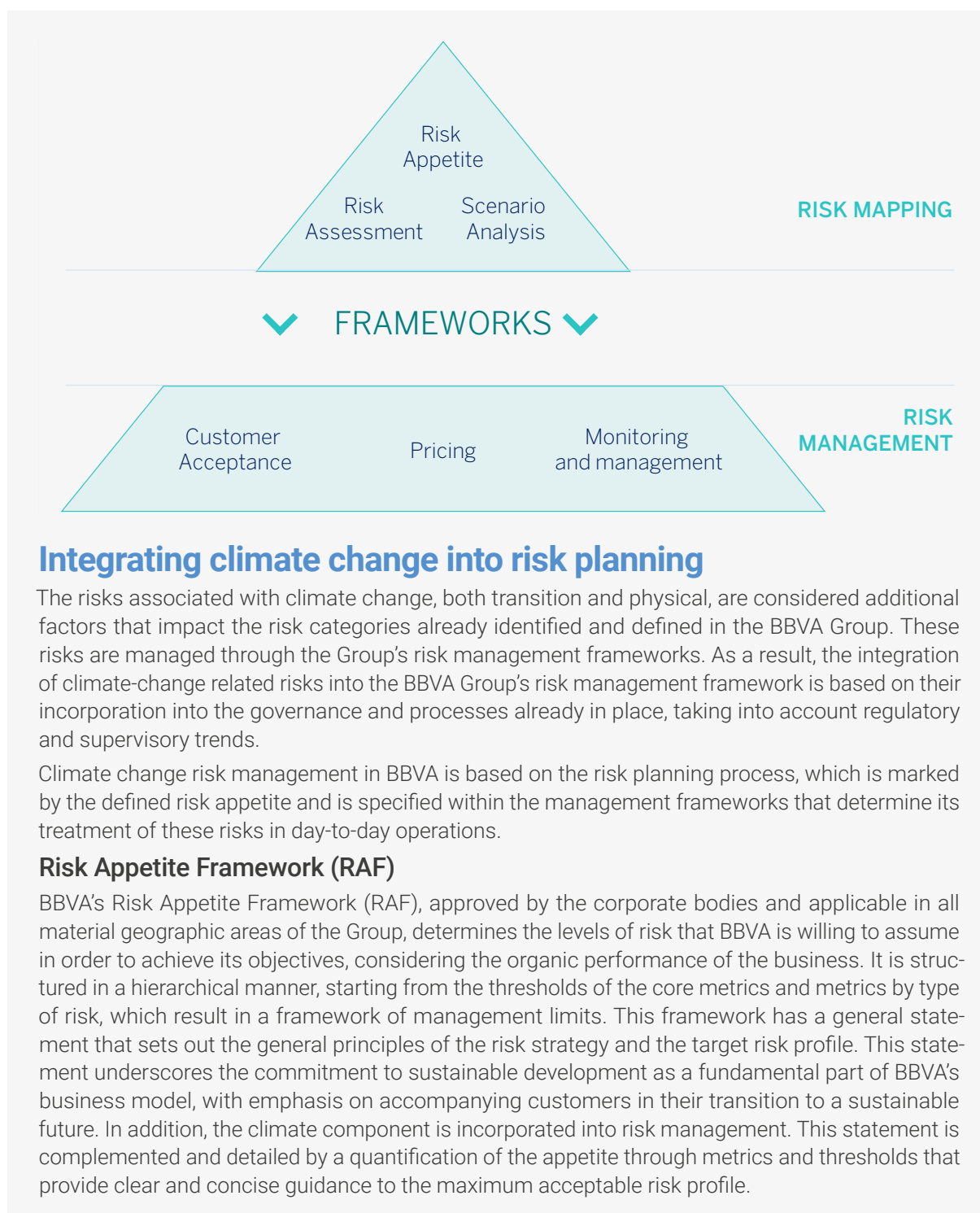


Figure 6: Integrating climate change into risk planning ([BBVA, 2024](#)).

2.2.2 Key components of risk appetite

As climate risk may be a stand-alone risk category or considered within other existing risk categories, the approach to developing a risk appetite will differ. According to the Climate Financial Risk Forum, if climate risk is considered as a stand-alone risk category,² the risk appetite should consist of the following two components ([CFRF, 2020](#)):

- i. **Risk appetite statement:** a clear articulation of the acceptable risk level. Risk appetite statements traditionally tend towards a time horizon of three to five years, in line with strategic planning; however, longer time horizons should be considered in the context of climate-related risks alongside short-term time horizons ([CFRF, 2020](#)).
- ii. **Metrics:** quantitative and qualitative measure allowing the assessment of the risk level faced by the institution in line with the risk appetite statement. Each risk appetite statement may be associated with several metrics, enabling risk profile monitoring.

A mature risk appetite statement should incorporate both broad assessments and specific metrics for climate risk. The unique nature of financial risks stemming from climate change often requires a forward-looking approach that extends beyond the strategic planning time frame of three to five years. This necessitates the inclusion of longer-term risk management tools, such as scenario analysis, impact assessments, and trend analysis, in order to ensure risks are managed over the duration they are likely to materialise over. Ensuring these assessments are tied to clear, climate-related risk levels is critical for a coherent strategy ([CFRF, 2020](#)).

The importance of defining clear metrics in a risk appetite statement cannot be overstated, with Key Risk Indicators (KRIs) playing a pivotal role in shaping a detailed and actionable framework (McKinsey, 2023). The ECB's 2022 Thematic Review underscores a shift towards developing both quantitative KRIs and qualitative KRIs that are detailed and predictive. The former should help management define its appetite towards climate risk and corresponding management strategy, ultimately enabling robust discussions on budget allocation and return on investment for each of the agreed actions. The latter should focus on tracking the implementation or adherence levels to climate-related risk management policies within institutions. These indicators monitor compliance with climate-related risk management policies, offering insights into an institution's effectiveness in integrating these practices throughout its operations. For KRIs to serve their purpose, they must be woven into the broader risk appetite framework, complete with clear escalation paths for any breaches. This ensures a systematic and proactive approach to managing climate-related risks, facilitating an institution's adherence to its defined risk boundaries ([ECB, 2022a](#)).

2 Further, analysing climate risk as a stand-alone risk category would enable banks to consolidate all financial losses (including credit, operational or market losses) stemming from single events affecting multiple business processes and portfolios.

Risk Appetite

	Indicator	Checkpoint/limits	Monitoring only
Sustainability risk	Percentage of clients requiring engagement on ESG	♥	
	Sustainable and Acceleration Standard volume change	♥	
Climate risk	Change in carbon footprint in lending and investment portfolio		♥
	Data quality of financed emissions		♥
Environmental risk	Relative exposure in sectors sensitive to physical environmental risks		♥
	Relative exposure in sectors sensitive to transition environmental risks		♥
Human rights risk	Strength of human rights risk management	♥	

Figure 7: Risk Appetite KRI development ([ABN AMRO, 2023](#)).

Figure 7 demonstrates ABN AMRO's approach to establishing key indicators for various risk types, including climate risk. The process begins with defining initial KRIs, followed by a phase of continuous monitoring. This monitoring collects data crucial for determining checkpoints and limits, while also enhancing visibility on how risks evolve over time ([ABN AMRO, 2023](#)).

2.2.3 Existing climate risk categories

Banks are exposed to climate change through macroeconomic and microeconomic transmission channels arising from the transition as well as physical climate risk drivers ([BIS, 2021b](#)). Systematic identification of the relevant risk drivers is a prerequisite for effective risk management ([ECB, 2022a](#)).

The influence of these risk drivers on the financial sector—and on banks, in particular—manifests across traditional risk categories. These impacts are detailed in an overview provided by the Bank for International Settlements, which outlines how climate-related risk drivers potentially affect each category of risk ([BIS, 2021b](#)).

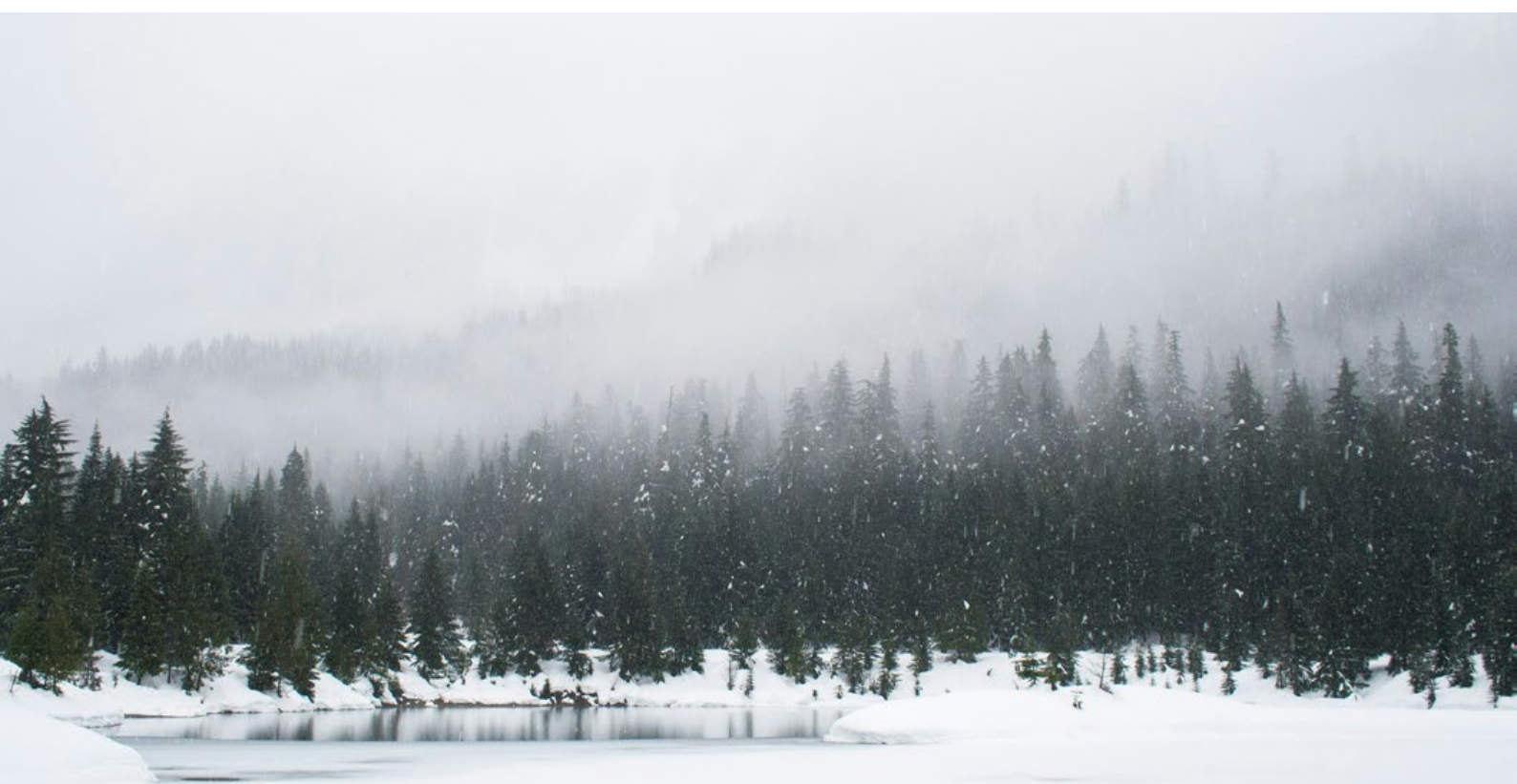


Table 1: Categories of climate risk drivers and their potential effects ([BIS, 2021](#)).

Risk	Primary drivers	Secondary drivers
Credit risk	<ul style="list-style-type: none">Reduction in borrowers' ability to repay and service debt due to decreased income from climate-related impacts.	<ul style="list-style-type: none">Decreased ability of banks to fully recover the value of a loan in the event of default, due to reduced asset values linked to climate risk.
Market risk	<ul style="list-style-type: none">Reduction in financial asset values due to immediate climate risk factors not yet incorporated into prices.	<ul style="list-style-type: none">Potential for large, sudden, and negative price adjustments.Breakdown in correlations between assets or changes in market liquidity for certain assets, undermining risk management assumptions.
Liquidity risk	<ul style="list-style-type: none">Climate risk drivers causing counterparties to draw down deposits and credit lines, impacting banks' liquidity.	<ul style="list-style-type: none">Reduced access to stable sources of funding as market conditions are affected by climate risk.
Operational risk	<ul style="list-style-type: none">Direct damages to infrastructures from extreme weather events.	<ul style="list-style-type: none">Secondary drivers are not distinctly separate for operational risk in this context, as the primary impact is the direct damage to infrastructure.

Banks often conduct materiality assessments to evaluate climate-related risks as a factor influencing other risk types. These assessments can occur at the bank, portfolio, and client levels.

It is important to distinguish between short-term, medium-term, and long-term materiality. Figure 8 from the Bank of Ireland showcases how various channels can lead to material financial impacts over different time frames ([BOI, 2023](#)).



Climate risk assessment: Material impacts across Principal risk types

Risk assessment	Transition risk impacts	Physical risk impacts (€m)	Quantified potential impacts ¹		
			Short	Medium	Long
Financial risks					
Credit risk	<ul style="list-style-type: none">Borrowers' ability to repay if operating in sensitive sectors.Changes in emission regulation or in user sentiment could affect asset value (Stranded Assets).	<ul style="list-style-type: none">Collateral depreciation leading to negative impacts on Loan To Value (LTV) (e.g. flooding, storms).Borrowers' ability to repay in sectors more sensitive to weather impacts like floods and storms (e.g. agriculture).	••	••	•••
Market risk	<ul style="list-style-type: none">The traded instruments held across the Group are subject to market risk as the underlying companies and sovereigns may be subject to value erosion due to climate change.	<ul style="list-style-type: none">The traded instruments held across the Group are subject to market risk as the underlying companies and sovereigns may be subject to value erosion due to climate change.	-	-	-
Funding & liquidity risk	<ul style="list-style-type: none">Based on scenario analysis, climate risks would have a negligible impact on the Group's current Funding & Liquidity risk profile.	<ul style="list-style-type: none">Based on scenario analysis, climate risks would have a negligible impact on the Group's current Funding & Liquidity risk profile.	-	-	-
Life insurance risk	<ul style="list-style-type: none">Risk of increased insurance costs (e.g. higher compliance costs for products and services, increased re-insurance premiums).	<ul style="list-style-type: none">Potential for extreme, erratic weather events in the Group's core home markets to drive sudden increases in morbidity and mortality risk.	-	-	-
Business & Strategic risk	<ul style="list-style-type: none">Long term franchise impacts if strategic commitments are not achieved and product offering does not adapt to changing market dynamics.	<ul style="list-style-type: none">Potential need to increase resilience of our network, supply chain and production process where off-shore operations are more exposed to increasing physical climate risks.	••	••	••
Operational risks					
Operational risk	<ul style="list-style-type: none">Climate driven impacts on operational processes include increasing levels of systems, data, model and sourcing risk to manage.	<ul style="list-style-type: none">Extreme floods or storms at multiple locations impacting our Business Continuity Plans (BCPs) with consequent impact to services we provide to clients (e.g. transaction processing).	••	••	••
Conduct risk	<ul style="list-style-type: none">Failures in ESG/green product design, market practice or customer engagement could lead to regulatory sanctions and brand damage, if there is a lack of transparency and misleading classification (greenwashing).	<ul style="list-style-type: none">Failures in ESG/green product design, market practice or customer engagement could lead to regulatory sanctions and brand damage, if clients suffer an unexpected loss due to climate risks.	•	•	•
Regulatory risk	<ul style="list-style-type: none">Failure to implement in a timely manner ongoing changes in climate regulation could affect the Bank's profitability through regulatory sanctions.	<ul style="list-style-type: none">Potential for regulatory sanctions if physical risks impact our Business Continuity Plans (BCPs) with consequent impact to services we provide to clients (e.g. transaction processing).	•	•	••
Capital adequacy risk	<ul style="list-style-type: none">Represents the risk of increased capital depletion from the impact of transition risks across the Group's other principal risks.	<ul style="list-style-type: none">Represents the risk of increased capital depletion from the impact of physical risks across the Group's other principal risks.	•••	•••	•••

¹ An estimation of the time horizon at which each risk is likely to materialise: short term within less than 3 years; medium term, between 3 and 5 years; or long term, more than 5 years. An estimation of the relative materiality of each risk negligible (-); Low (•); Moderate (••); Significant (•••).

Figure 8: Material impacts across climate-related risks (BOI, 2023).

Where climate risk factors impact existing risk measures that have defined limits, the thresholds may remain unchanged as long as these limits are aligned with the risk tolerance objectives. If this is not the case, targets and metrics may be adopted over time by initially rolling out “softer” targets. This should be done with the expectation that over time, as the understanding of the metric increases, the thresholds will become more restrictive. The time horizon for achieving limits/targets should also be considered to ensure the feasibility of the implementation of thresholds ([CFRF, 2021](#)).

2.2.4 Learnings on risk appetite for climate risk from the (re) insurance sector

Insurers have an established framework for determining when they retain risk on their own balance sheet or transfer it to others. This appetite usually clarifies two main considerations: (i) the level of volatility from natural catastrophes that management is comfortable with in the bottom line of the company; and (ii) the maximum event loss for which management is willing to buy protection. The latter consideration is often based on a value at risk corresponding to a 1 in 200 years event. As this framework could also be used for banks’ physical risk exposure, its key components are described in this section.

Climate risk appetite triggers changes in retention levels³ at insurance companies as costs resulting from climate change increase. In the current shifting environment, insurers must guarantee that risk capital is preserved where it is needed most when evaluating their incoming premium versus portfolio risk profiles. In some cases, higher risk retention can be a simple and effective means to alleviate premium increases and achieve some independence from the insurance market cycle ([Aon, 2021](#)).

[Figure 9](#) below, retrieved from Aon, illustrates the risk strategy adopted by insurers as a function of probability of losses and provides a helpful visual for discussing an appropriate level of risk. In the figure, the probability of loss is plotted versus loss-value. The strategies adopted are associated to a certain level of loss value. A risk retention strategy is used for relatively low loss values, while a risk transfer strategy is preferred for relatively high loss values. In addition, the level of insurable risk tolerance and risk confidence are defined in terms of loss value.

3 Retention levels may be understood as the maximum amount of risk retained by an insurer. Beyond that, the insurer cedes the excess risk to a reinsurer. The point beyond which the insurer cedes the risk to the reinsurer is called the ‘retention limit’. ([The Economic Times, 2024](#)).

Banks could use this approach to determine the risk they will retain on their own balance sheet and the risk they will transfer to others via securitisation, insurance, or other mechanisms. (See [Section 4.4](#) for more information about transferring risk).

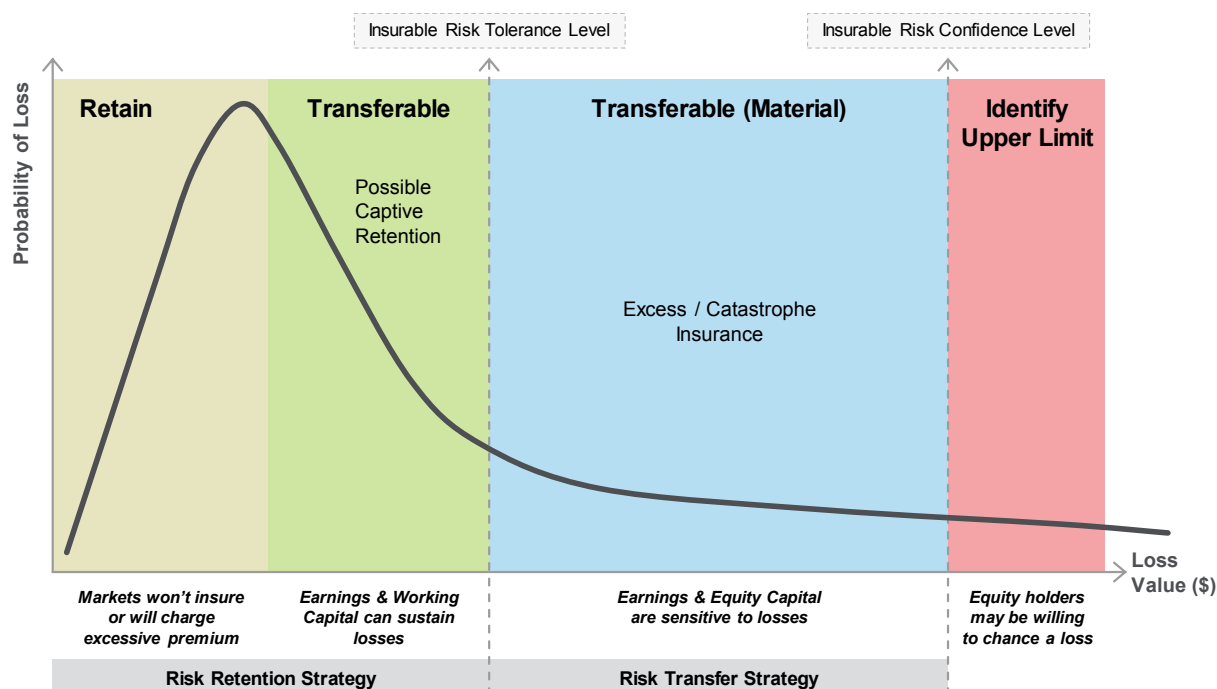


Figure 9: Risk retention and transfer strategy for insurance ([Aon, 2021](#)).



3. Strategies for managing physical climate risk

3.1 Physical climate risk exposure in lending portfolios

Banks’ assets are mostly composed of loans and advances to customers. Under IFRS 9, banks are required to measure their loans net of impairment which is measured using Expected Credit Loss (ECL), an unbiased and probability-weighted amount determined by evaluating a range of possible outcomes. This measure also influences banks’ capital requirements and by extension their capital adequacy ratio. In practice, this is done by leveraging risk models that measure both the probability of default (PD) of the borrower and the loss given default (LGD) representing the financial loss for the lender in case of default of the borrower ([IFRS, 2024](#)). The outcomes from these models are later combined into Expected Credit Loss using the following formula ([Moody’s Analytics, 2015](#); [Charles and Darwish Associates, 2020](#)):

ECL = Exposure at Default (EAD) x Probability of Default (PD) x Loss Given Default (LGD)

- **EAD** is taken as the current outstanding loan amount.
- **PD** measures the probability of a borrower defaulting on its lending obligations, defined as when a borrower is 90 days or more behind in making a repayment on their home loan. The probability of default is typically calculated over a one-year time horizon.
- **LGD** measures the amount the lender would lose in case of default of the borrower. It is equal to the outstanding loan amount at time of default less the value of the collateral net of all foreclosure costs, which typically represent about 20 per cent of collateral value.

In order to adequately capture climate risk into PD and LGD models, banks should first clearly identify their main transmission channels, including the ability for such risk to be captured by existing financial mitigants such as insurance protection or public funding. The following section details these transmission channels.

When assessing the impact that natural catastrophes have on society, the costs associated with such events can be assigned to one of three different categories, as captured in the Figure 10 below—namely, direct damage to the asset, financial costs from responding to the catastrophe, and associated social costs from impacts on mental and physical health.

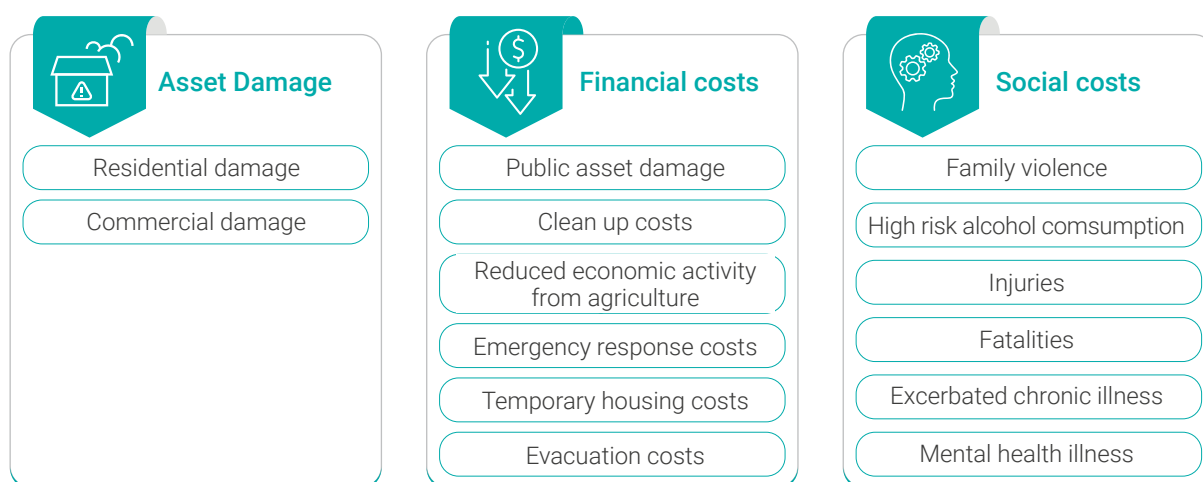


Figure 10: The total economic cost of natural catastrophes is the sum of the asset losses, plus the associated financial and social costs ([Deloitte, 2021](#)).

While natural catastrophes may harm banks' customers in very heterogeneous ways, the actual impact can be amplified under the various conditions listed in Table 2:

Table 2: Key factors amplifying the impact of natural catastrophes on banking sector risk profiles (Munich Re, 2024).

Conditions	Description
High exposure	Natural catastrophes can materially affect risk profiles of banks' customers either due to their extreme intensity or the high frequency of smaller events.
Risks accumulation	Diversification of earnings (and losses) is a highly effective risk management solution for natural catastrophes as they tend to be highly localised. Institutions like regional banks whose portfolio is concentrated in regions that can be affected simultaneously by a single severe event are particularly exposed to natural catastrophes.
Safety net absence	Lenders can have external safety nets such as the insurance sector or government support (e.g. NatCat ⁴ schemes or post catastrophe funding facilities), or facilitate risk wrappers for the potential delinquency or default by borrowers following major natural catastrophe events or a series of shocks. Where such safety net mechanisms are not present or (fully) effective, lenders' balance sheet ends up being exposed to natural catastrophe-related losses, often unknowingly.

3.1.1 Residential mortgage

With rising insurance affordability issues, particularly in high-risk areas, lenders are getting increasingly exposed to physical climate risk. This has been evidenced by an extensive inquiry conducted by Australian Competition and Consumer Commission, focusing on [insurance affordability in Northern Australia](#). This study found that homes' non-insurance rate is nearly twice the national average in Northern Australia, and as much as four times the national average in the country's North West (where tropical cyclones

⁴ NatCat, or 'natural catastrophe', refers to a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

are most prevalent). Further, even in those cases where home insurance is required under loan contract, banks often lack the resources and mandates to effectively monitor borrowers' insurance coverage over the course of multi-year loan life cycles. Banks may therefore inadvertently become exposed to more risk during the lifetime of a loan.

The most prevalent risk for banks is borrowers' impaired ability to repay their mortgage (default) due to major cash flow stress that arises from natural catastrophes damaging their non-insured (or inadequately insured) asset. Such a scenario can come about from major singular natural catastrophes as well as from repeated small or medium extreme weather events that jeopardise the financial cushion that borrowers might generally have to repair smaller or medium damages to their properties and to balance temporary financial stress.

Spikes in delinquency rates have been observed following major natural catastrophes. However, in most cases, these have only been short-lived (e.g. 12–24 months). This is because local governments or banks have stepped in with timely responses. Figure 11 shows such a spike of delinquencies in the United States after Hurricane Katrina in 2005. However, with the expected increase in frequency and/or severity of natural catastrophes, responses by external organisations such as banks may not always prove as effective.

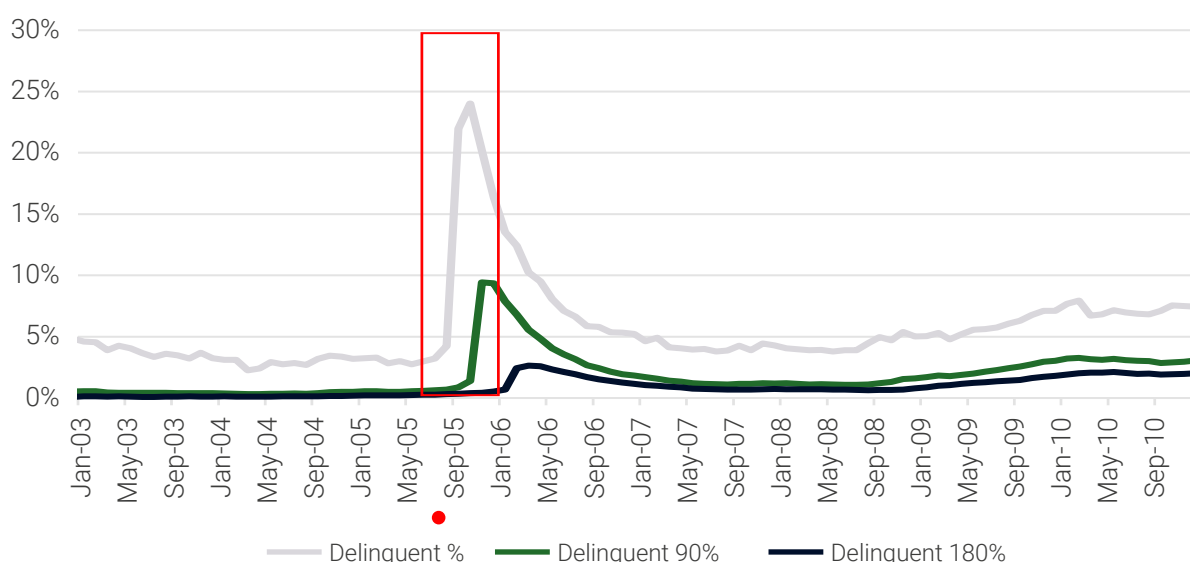


Figure 11: Hurricane Katrina—Delinquent loans as a percent of active unpaid principal balance in the region ([Fanniemae, 2017](#)).

The main climate-related risk in banks' loan portfolios stems from borrowers with high physical risk exposure and a high loan-to-value ratio (i.e., >80 per cent). As the loan is paid back by the borrower over time, this risk decreases. For example, with a 30-year Principal & Interest mortgage, a bank's exposure is particularly high in the initial seven years of the mortgage and decreases rapidly beyond that period. It can reduce even quicker when collateral values are increasing. However, depreciation in the value of the collateral (and the corresponding increase in loss given default) can increase the risk from a bank's perspective, especially in long-term loan arrangements. For this reason, banks need to monitor the value of collateral over the entire life of a loan. Such collateral depreciation can be the result of: (i) being uninsured and therefore having unrepaired damages to, or complete destruction of, an asset from a natural catastrophe; (ii) tempo-

rary land value depreciation after a catastrophe (e.g. major flooding); or (iii) long-term depreciation due to change in perceived exposure (e.g. the risk of sea level rise materialising in a few decades becoming factored into a company's present-day valuation).

3.1.2 Business and agricultural lending

Business loans tend to have shorter duration than home loans. This makes them less exposed to physical climate risk. However, a significant share of business loans are not backed by collaterals, which may lead to higher losses in case of nation catastrophes. In addition, transmission channels for physical climate risks are harder to assess due to the potential interruption losses for businesses and the possible impacts on their supply chain.

Agricultural lending is particularly vulnerable to physical climate risk and especially to chronic stresses (e.g. droughts and heatwaves). Agricultural portfolios are also often very concentrated in certain regions and thus can be simultaneously affected by single events. Where used, the value of collateral would also similarly be adversely impacted in light of the increasing frequency and severity of national catastrophe events.

3.2 Banks' responses to natural catastrophe events

Many banks, especially those with a regionally concentrated loan portfolio and a corporate identity tied to certain communities or regions (e.g. smaller regional banks), do respond to natural catastrophes that affect "their" communities. Examples can be found across different regions in the aftermath of different natural catastrophe perils, especially flood and storm events. The responses range from reducing the burden of existing loans through to providing additional funds and donations to relief services.

Examples include:

Australia and New Zealand Banking Group (ANZ) Catastrophe Relief Package (ANZ, 2024): ANZ offers personal and business customers affected by a natural catastrophe (wildfire, flood, storm, earthquake) a "Catastrophe Relief Package". This includes options such as:

- Short-term payment relief on home loans, credit cards, personal loans, and some business loans (interest payments might still apply).
- Waiving fees for restructuring business loans.
- Waiving fees for accessing term deposits early.
- Donations to municipal initiatives to build community resilience to natural catastrophes as part of ANZ's overall corporate citizenship strategy.

Banco Bilbao Vizcaya Argentaria (BBVA) Catastrophe Relief Fund (BBVA, 2017):

BBVA installed this fund in Florida to accelerate recovery after Hurricane Irma in 2017. It provides various support measures to communities in Florida, including:

- Deferred payments on existing consumer and small business loans and credit cards.
- Waived late fees.
- Discounted rates on home equity loans and lines of credit.
- Discounted rates on construction and renovation loans.
- Discounted rates on auto loans.
- Penalty-free withdrawals for withdrawals made from Certificate of Deposit accounts after the first seven days of account origination.
- Special rates and terms on consumer and small business loans.

Bank of Ireland post-flood support (Bank of Ireland, 2023): Bank of Ireland announced a variety of support measures to clients in the event of major flood events. The bank also cooperates with local insurance partners to provide repair services and loss assessments to affected customers. Support is facilitated via dedicated phone hotlines and through on-site visits by mobile teams of financial advisors, and includes measures such as:

- Payment flexibility on existing products, including mortgage breaks.
- Discounted loans or overdrafts.
- Extended contact centre hours during the weekend.

Desjardins Catastrophe Relief Fund (Desjardins, 2022): After flood events in Canada in 2019, Desjardins provided financial relief to affected customers and communities. Measures included:

- Deferred payments on mortgage or consumer loans (up to six months).
- Option of deferring credit card and financing plan payments (up to six months) and restructuring financing in specific cases.
- Option of deferring home and auto insurance payments (up to six months).
- Emergency loans to cover clean-up, security, and other costs.
- Donations to national relief organisations, such as Red Cross Canada.

National Australia Bank (NAB) Natural Catastrophe Support (NAB, 2022): In face of flood events across South Australia, New South Wales, Victoria and Tasmania in the autumn of 2022, NAB offered customers affected by these floodings different financial relief measures:

- Opened applications for AUD 1,000 grants up to a total amount of AUD 1,000,000.
- Donated AUD 100,000 to Catastrophe Relief Australia to fund recovery measures.
- Offered loan deferral or reduced payment arrangements.
- Waived some fees or charges relating to affected clients' accounts.

The focus of these measures was on business and agricultural borrowers. All inquiries that could be submitted online were subject to a case-by-case assessment, which required evidence showing significant property damage.

TD Bank catastrophe responses (TD Bank, 2023), (TD Bank, 2017): In the aftermath of Hurricane Irma in 2017, as well as following flood events in Vermont, United States in 2023, TD Bank responded in various ways to support clients affected by those events. Its actions included:

- Proactively waiving or refunding fees for use of non-TD ATMs, overdrafts, and monthly service charges
- Providing immediate Access to Certificates of Deposit without early withdrawal penalties
- Offering automatic fee and finance charge waivers for TD-branded credit card customers in areas affected by natural catastrophes, as defined by the Federal Emergency Management Agency
- Delivering debit and credit cards free of charge to impacted customers, wherever they are located, provided that delivery was possible under the flood impact.
- Automatically waiving fees for mortgage, home equity loans, small business loans, and personal loans for impacted customers in catastrophe areas.
- Donating cash in response to floods, such as a recent USD 150,000 gift to the Vermont Community Foundation in 2023 to support flood relief efforts in the state.

4. Proposed framework for managing physical climate risk in lending portfolios



Examples like those illustrated in the previous section are manifold and have been part of banks post-catastrophe responses long before climate change was increasingly recognised as a prevalent systemic risk inside and beyond the financial services industry.

Even so, most banks tend to react to such events in an ad-hoc way and few offer relief measures to their borrower base as part of a comprehensive and preplanned risk management strategy. Regarding financial support functions that are tailored to affected clients (such as loan payment deferral options), this ad-hoc approach can lead to insufficient budgets to attend to all affected borrowers evenly and effectively. Similarly, customer support is often insufficiently staffed and relies on case-by-case assessments, which leads to long waiting times for affected clients. Such delays can aggravate the financial and social costs of natural catastrophes, as discussed in the above sections.

To lay the basis for a comprehensive approach to managing climate risk and to define some concrete risk management measures, banks are advised to categorise their loan portfolio management into four main categories, as depicted in the chart below:

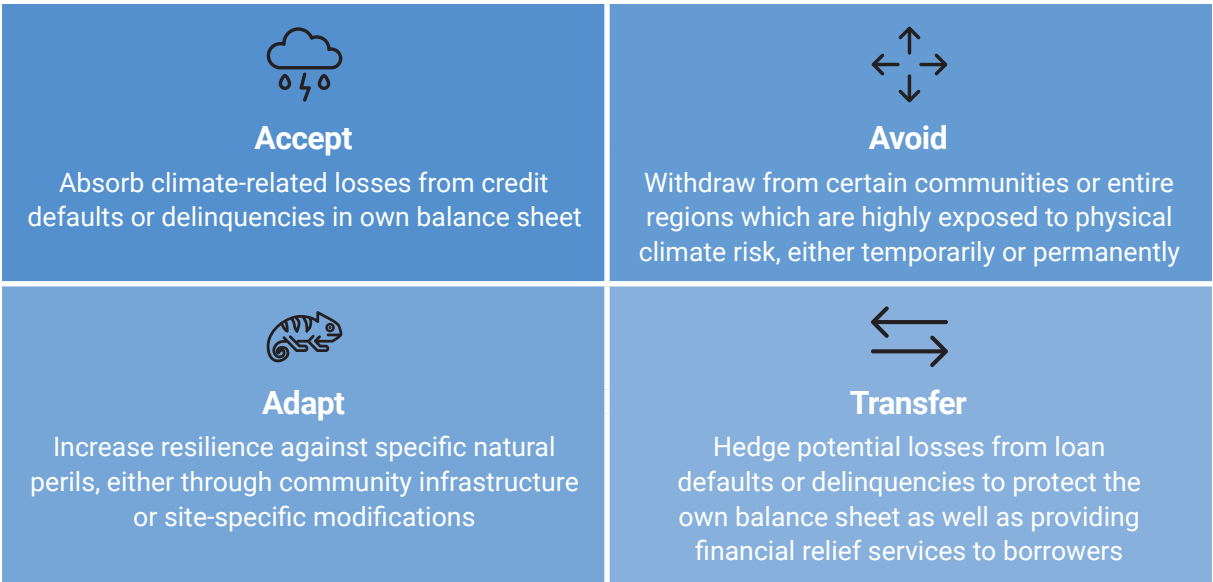
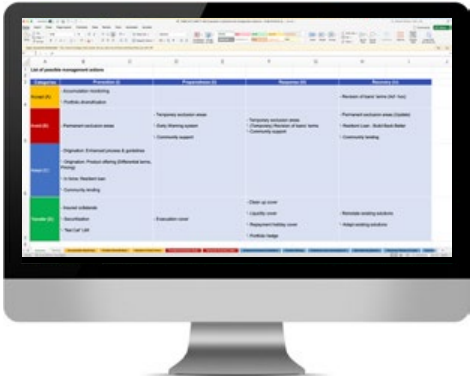


Figure 12: Strategies for Risk Management in Loan Portfolios (Munich Re, 2024).

Based on the feedback from the banks participating in the working group, some of the proposed risk management measures emerged as particularly promising solutions to integrate into banks’ risk management framework. These categories will be illustrated in more detail in the following sections before presenting an overview chart with different solutions for each category.

Note, the download version of this report contains a spreadsheet with a full overview of these solutions, together with detailed data and analysis; this information serves as an essential background material to enhance the understanding and participation in forthcoming strategic discussions.



4.1 Accept

Accepting physical climate risk exposure in a lending portfolio and absorbing the financial risks associated with increased natural catastrophe intensity and frequency is a valid approach in cases where portfolios are not overly exposed or where they are sufficiently diversified. However, the decision to accept such risks needs to be built on a comprehensive ex ante exposure analysis. Such an analysis should include current hazard exposure as well as scenario-based projections on future exposure. This is especially the case for potential collateral devaluations, as mentioned in the previous sections.

Example for risk management measure: Accumulation monitoring

With its geospatial software solution “Location Risk Intelligence”, Munich Re provides a solution for assessing and managing physical risks from natural hazards and climate change. The tool enables financial institutions of all kinds—be they lenders, investors, or insurance companies—to analyse the risk exposure of their assets, including the potential financial impact. It can be applied for single locations as well as entire portfolios.

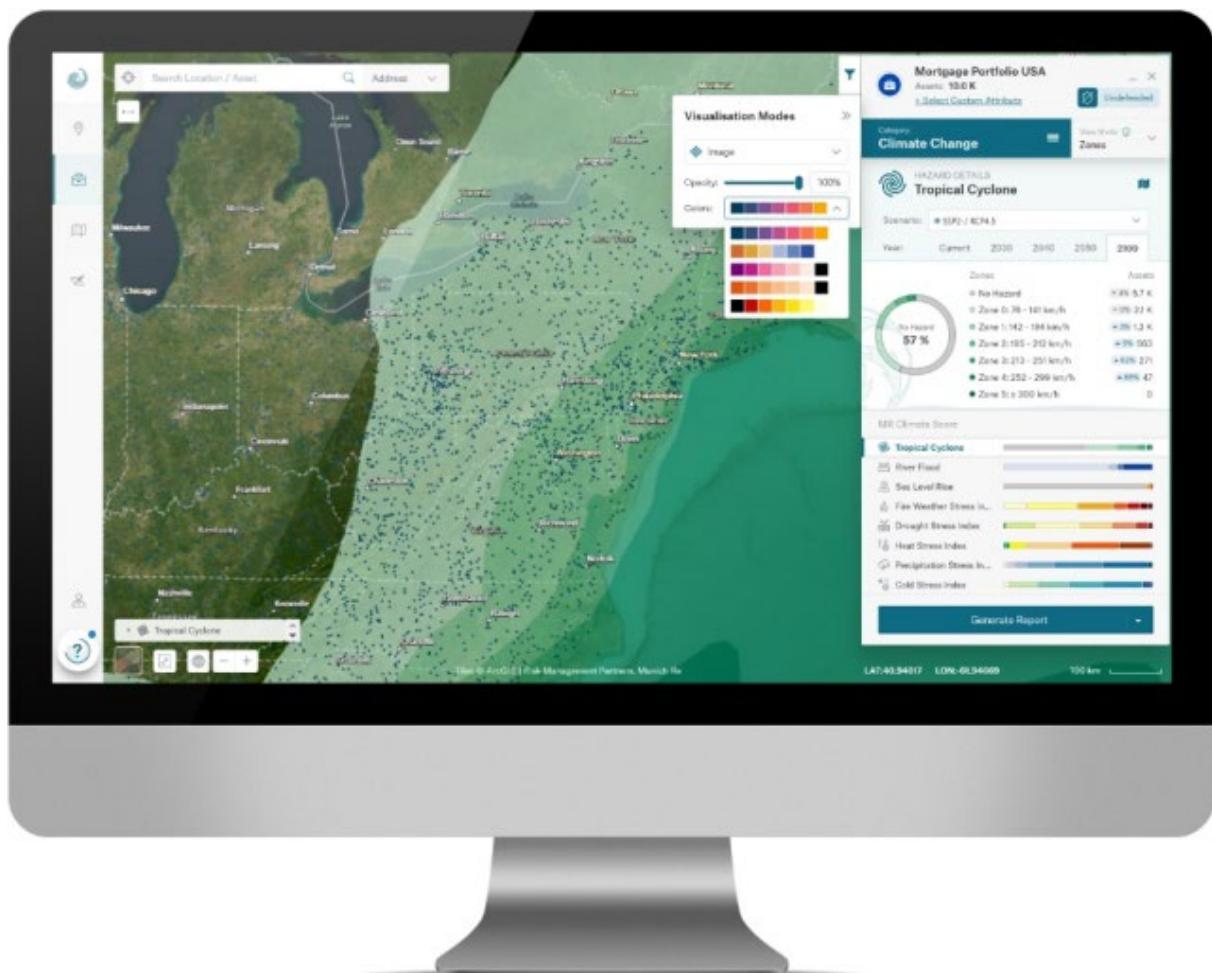
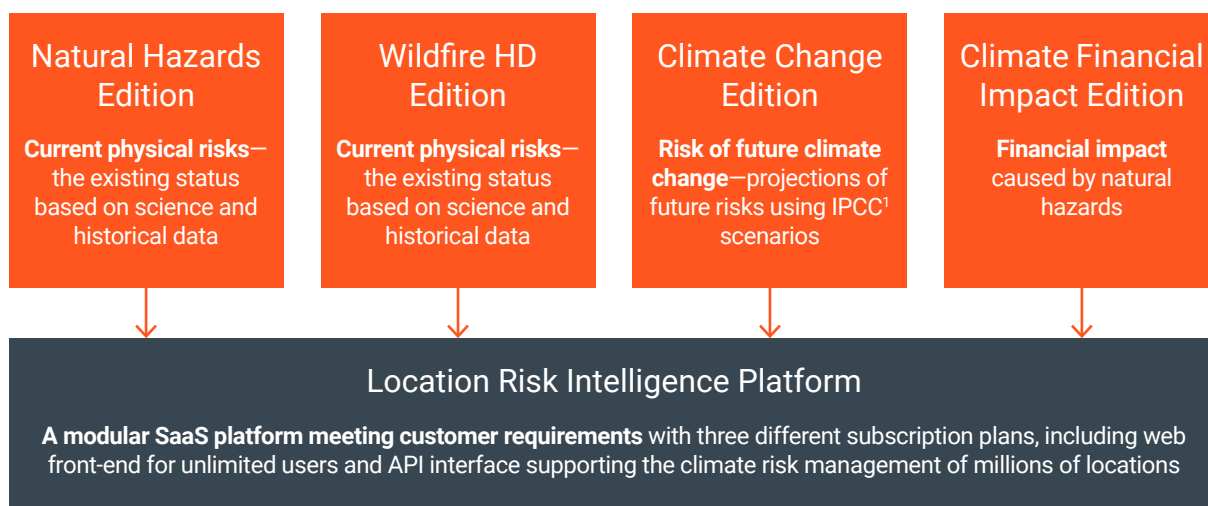


Figure 13: Munich Re's Location Risk Intelligence ([Munich Re, 2024](#)).



1 IPCC: Intergovernmental Panel on Climate Change

Figure 14: Analytical editions for current and future natural and financial risks related to climate ([Munich Re, 2024](#)).

The Natural Hazards Edition uses a series of map layers with hazard and risk ratings based on Munich Re's national catastrophe risk models to assess current exposure to such events. The Climate Change Edition, meanwhile, provides forward-looking perspectives on these hazards based on internationally agreed scenarios for GHGs up to 2100. By combining climate risk and lending data together directly into the geospatial platform, lenders can perform advanced analysis of the financial impacts under various scenarios, including estimating the impacts for single large events. More information can be found on [Munich Re's website](#).

4.2 Avoid

Withdrawing from business in high-risk zones is certainly an effective approach to avoid physical climate risk altogether, but it is questionable to what extent this is an effective long-term business strategy. Discussions with various banks have also revealed that withdrawal poses a significant reputational risk for banks in some cases, in addition to the loss in market share.

Before deciding to reduce exposure in certain high-risk communities or geographic regions, or to restrict or cease lending activities—whether temporarily or permanently—banks should conduct a comprehensive analysis of potential physical climate risks and their financial consequences. This analysis could help banks explore alternative strategies from other categories, aiming to minimise these restrictive actions as much as possible. Employing temporary measures from other strategic categories might provide sufficient time for a planned, strategic withdrawal, when necessary, thereby mitigating potential negative economic and social impacts.

4.3 Adapt

A more proactive approach to physical climate risk management lies in adapting to the anticipated increased frequency and intensity of extreme weather events, where those impacts have been revealed based on a thorough portfolio exposure analysis.

Adaptation can be implemented at different levels in society and in different ways. Physical infrastructure is particularly effective, such as flood levies, return flow basins along rivers, fire roads to protect against spreading wildfires, or agricultural drip irrigation systems to increase water efficiency and drought resilience. Similarly, nature-based barriers like wetlands, mangroves, and coral reefs can increase resilience against floods and hurricanes.

By way of example, Munich Re and Willis Towers Watson (WTW) have developed a parametric insurance solution that assists with adaptation to natural catastrophes. Launched in 2022, the product funded repairs to coral reefs in Hawaii following storm damages. As a first step, Munich Re underwrote the risk for a Hawaiian coral reef parametric insurance arrangement. Coral reefs not only are an important ecosystem and source of income for local communities, but they also function as a natural barrier against storms ([Artemis, 2024](#)). Under the policy term, payout of up to USD 1 million per storm (and USD 2 million total over the year-long policy period) can be triggered in cases where windspeeds in the core of the coverage area reach 50 knots. These payouts will aim to cover the costs of damages caused by storms and will maintain the reef's various ecosystem services.

Besides physical adaptation measures, early warning systems for natural catastrophes can contribute significantly to reducing damages and fatalities in the case of a natural catastrophe. The same is true for capacity building in highly exposed communities.

Since exposure to physical risk can depend on very site-specific characteristics and can vary greatly even within the same neighbourhood or even the same street, site-specific adaptation measures represent an important means to address the vulnerability of each individual asset.

One example of successful adaptation at individual asset level comes from Australian bank and insurance company, Suncorp. In Queensland, Australia, a region highly exposed to natural catastrophes like cyclones and floods, Suncorp's "Resilience Road" project seeks to enhance the resilience of communities to extreme weather and climate change ([Suncorp, 2024](#)). The solution focuses on providing financing for practical measures such as building resilient homes and infrastructure as well as educating homeowners on risk mitigation. As such, Suncorp contributed to installing concrete adaptation features in at-risk houses so as to increase their cyclone and flood resilience. Measures include enforcing roofs and windows, as well as elevating doorsteps and gas tanks. In addition, trees that were too close to the houses in question were removed so as to avoid damage to the property in the event of strong winds. Suncorp also supported capacity building efforts among borrowers. Not only do its borrowers benefit by having safer homes, but the bank also benefits from the decrease in the risk of financial distress and thereby the risk of delinquencies or even loan defaults in the aftermath of a cyclone or flood. In this

example, Suncorp supported the full cost of financing these improvements. However, a similar concept—called a ‘resilient loan’—could be adopted by lenders. This would see them offering borrowing capacity at preferential terms for asset owners who are willing to finance resilience measures for their collaterals, therefore benefiting both the owner and its lender.

The same mechanism also applies during the recovery from extreme weather events. In such cases, so-called “build-back-better” financing enables affected borrowers to integrate special resilience features when repairing their homes. As a consequence, they are less prone to experiencing similar damages should a natural catastrophe strike again.

4.4 Transfer

The motivation of banks for considering risk transfer solutions will vary greatly depending on their exposure to physical climate risk. The main drivers include:

- i. **Protection from existential threat:** In the few cases where exposure to natural catastrophes could materially affect lenders’ overall solvency, management must demonstrate to regulators and investors that comprehensive risk management is in place and that exposure is in line with risk appetite. In some cases, risk transfer solutions could be appealing where these are able to improve the financial strength or the solvency of the company.
- ii. **Optimise return on capital:** As physical climate risk increases, banks’ loan-related exposure will increase and find its way through to additional capital requirements. While it is expected that this risk will not increase to a level where risk transfer becomes an absolute necessity, any increase in capital requirements creates an opportunity for a bank to optimise its return on capital by arbitrating between holding more capital or paying for a risk transfer solution that reduces its capital requirements ([Bank of England, 2023](#)).
- iii. **Align with investors’ risk appetite:** Investors providing financing facilities to banks (either via capital or via debt such as Mortgage-Backed Securities) have certain expectations regarding the risk profile of their investment. In most cases, their appetite for losses stemming from natural catastrophes is very low. As transparency on banks’ exposure to (physical) climate increases through new climate risk reporting requirements, management will have to provide reassurance to investors that this risk is being adequately managed. One way of doing this is to set up adequate hedging for the most exposed or vulnerable securities.
- iv. **Support communities after a natural catastrophe:** Boosted by the increasing importance of ESG, lenders are taking an active role in helping communities recover from natural catastrophes, often at their own expense. Pre-paid risk transfer solutions could enable faster and potentially more significant contributions from lenders to communities’ recovery processes. Lenders’ recovery actions may include paying for clean-up costs for a community or individuals, temporary suspension of interest or principal repayments, or restructuring loans at preferred conditions.

4.4.1 Loan payment deferrals

One solution that proves impactful caters to a bank's client base who are exposed to physical climate risk in their house, in their business facility, or on their farmland. As shown in the section "Banks' responses to natural catastrophe events", many banks offer loan payment deferrals to borrowers who are significantly affected by a natural catastrophe, thus preventing increased financial distress. This can constitute an important differentiator to other lenders in the market, but it requires a bank to substitute the missing cashflow to maintain its own income. This solution is impactful even in the absence of an existential threat to a bank's own balance sheet. However, most banks offer such financial relief options in a rather ad-hoc fashion, without a clear internal budget and only after a lengthy case-by-case assessment.

A bank that systematically hedges the potentially missing cashflows through an insurance-based risk transfer mechanism can integrate a loan payment deferral as an add-on service to its loan product offering. In response, it can duly present itself as a trusted partner for mortgages, business financing, or agricultural lending.

While distributed as an optional add-on to the individual borrower, banks can decide (depending on the pre-assessed climate exposure) whether they only offer such an add-on just to highly exposed individual clients or instead to their entire client base. The underlying risk transfer mechanism can then either be applied only to the most exposed assets within a portfolio or as an entire portfolio hedge.

Most commonly, such risk transfer mechanisms are created via so-called 'parametric insurance covers'. See the box below for more details on this specific kind of coverage.

Parametric Insurance

The basic concept of parametric risk transfer solutions is quite simple: Parametric insurance pays out when a predefined event happens (e.g. a major hurricane or flood), according to a predefined scheme. This avoids a lengthy claim's adjustment process. Since the payout is based on independently verifiable and unambiguous parameters, the predetermined payment is made quickly, simply, and without lengthy adjustments.

Events may have an index-based trigger (e.g. a certain windspeed) or an area-based trigger (e.g. heavy precipitation or an earthquake in a defined area), which are often referred to as a 'cat-in-a-box'. These pre-defined triggers are based on data from a third party, such as a local or national weather station.

Exemplifying the cat-in-a-box concept, a policy might be structured to pay out 50 per cent, 75 per cent or 100 per cent of a predefined limit, depending on certain flood levels or wind speeds occurring within a 50-mile radius around the client's point of interest. The notion of 'point of interest' is an interesting feature of parametric solutions. The client defines a 'point on the map' (i.e. a latitude-longitude geographic coordinate) and, based on this point, the cover incorporates infrastructure that is critical for the client (and not just the client's own locations).

Similar to parametric covers against natural perils, Munich Re offers weather derivatives in the renewable energy space. Here, investors in renewable energy powerplants, like photovoltaic, wind, or hydro power stations, can protect themselves against unfortunate weather conditions that impact the respective energy output, such as lack of sunshine or wind, or low water levels that impact hydro-power performance. More information can be found in Munich Re's [webpage](#).

For example, depending on the current stage within the loan life cycle and the loan-to-value ratio, a pre-defined trigger could trigger a payout that would hedge the repayment obligations for two years for outstanding loans in a certain pre-defined area. An example of such a trigger could be a storm with windspeeds of up to 100 mph.

Munich Re has implemented several such solutions, mostly for banks whose borrowers do not have adequate financial savings to cope even with smaller events, such as for small business loan portfolios. However, the same mechanism would also apply where borrowers are not pushed into financial distress by one single event, but where a loan payment deferral provides a key advantage compared to other retail lenders' offerings.

Agricultural lending provides an illustrative initial use case. In 2022, Munich Re structured such a solution to protect Mexican farmers against the perils of drought and extreme precipitation ([PreventionWeb, 2022](#)).

4.5 Overview of different risk management solutions

After assessing different approaches and concrete activities around physical climate risk management, it can be summarised that ‘accept and avoid’ mainly applies as a means of risk management for a bank itself. However, a policy of ‘adapt and transfer’ represents a more proactive risk management approach that also extends to a bank’s borrowers and their communities. This second approach enables banks to employ ex ante measures to ensure their own resilience, as well as that of their clients, should a natural catastrophe or extreme weather event occur. The policies of adapting and transferring also address a bank’s role to provide ways for communities to recover efficiently in the aftermath of such events. By allowing for damage to asset (and the associated financial and social costs) to be reduced and for build-back-better measures to be implemented, resilience against future events can be increased. As such, adapt and transfer approaches not only enable a bank to maintain its presence in a market that is highly exposed to physical climate risk; they also provide a means to realise a competitive advantage compared to other institutions with less comprehensive climate risk management frameworks.

[Figure 15](#) below summarises various risk management measures along the four pillars (accept, avoid, adapt, and transfer), as well as the timing against a respective natural catastrophe or extreme weather event:

- **Loss prevention:** This consists of steps that can be taken at individual asset or community level to reduce the effects of natural catastrophes.
- **Event preparedness:** Preparedness plans establish arrangements in advance to enable timely, effective, and appropriate responses to specific potential hazardous events.
- **Event response:** This consists of all measures and actions taken during a natural catastrophe with the objective to protect affected populations and assets.
- **Recovery:** This process focuses on restoring, redeveloping, and revitalising communities impacted by a catastrophe.

Categories	Prevention (i)	Preparedness (ii)	Response (iii)	Recovery (iv)
Accept (A)	<ul style="list-style-type: none"> ▪ Accumulating monitoring ▪ Portfolio diversification 			<ul style="list-style-type: none"> ▪ Revision of loans' terms (Ad-hoc)
Avoid (B)	<ul style="list-style-type: none"> ▪ Permanent exclusion areas 	<ul style="list-style-type: none"> ▪ Temporary exclusion areas 	<ul style="list-style-type: none"> ▪ Temporary exclusion areas 	<ul style="list-style-type: none"> ▪ Permanent exclusion areas (update)
Adapt (C)	<ul style="list-style-type: none"> ▪ Origination: Enhanced process & guidelines ▪ Origination: Product offering (Differential terms, pricing) ▪ In force: Resilient loan ▪ Community lending 	<ul style="list-style-type: none"> ▪ Early warning system ▪ Community support 	<ul style="list-style-type: none"> ▪ (Temporary) Revising of loans' terms ▪ Community support 	<ul style="list-style-type: none"> ▪ Resilient loan—Build Back Better ▪ Community lending
Transfer (D)	<ul style="list-style-type: none"> ▪ Insured collaterals ▪ Securitisation ▪ "Nat Cat" LMi 	<ul style="list-style-type: none"> ▪ Evacuation cover 	<ul style="list-style-type: none"> ▪ Clean up cover ▪ Liquidity cover ▪ Repayment holiday cover ▪ Portfolio hedge 	<ul style="list-style-type: none"> ▪ Reinstate existing solutions ▪ Adapt existing solutions

Figure 15: List of possible management actions (Munich Re, 2024).

Approach/timing	Participants' feedback		Mean score				
	Action name	Overall score	Financial benefits for bank	Strategic benefits for bank	Borrower's benefit	Operational complexity	Compliance risk
Accept/prevention	Accumulation monitoring	2,10	3,00	1,25	0,25	3,00	3,00
Accept/prevention	Portfolio diversification	1,47	2,33	1,00	1,00	0,67	2,33
Accept/recovery	Revision of loans' terms	1,60	1,00	2,33	2,33	0,67	1,67
Avoid/prevention, recovery	Permanent exclusion areas	0,53	1,00	0,00	0,00	0,33	1,33
Avoid/preparedness, response	Temporary exclusion areas	0,60	1,00	0,00	0,00	1,00	1,00
Adapt/prevention	Origination: Enhanced process & guidelines	1,80	3,00	2,33	1,67	0,33	1,67
Adapt/prevention	Origination: Product offering	1,07	1,67	1,33	1,00	0,33	1,00
Adapt/prevention	In force: Resilient loan	2,33	2,33	3,00	3,00	1,00	2,33
Adapt/preparedness	Early Warning system	1,67	0,33	2,33	3,00	0,67	2,00
Adapt/response	Temporary Revision of loans' terms	1,80	0,67	3,00	3,00	0,67	1,67
Adapt/preparedness, response	Community support	1,73	1,33	2,33	1,67	1,67	1,67
Adapt/recovery	Resilient Loan–Build Back Better	2,33	2,33	3,00	3,00	1,00	2,33
Transfer/prevention	Insured collaterals	1,50	2,50	0,50	1,50	1,00	2,00
Transfer/prevention	securitisation	1,13	0,67	0,67	0,67	2,00	1,67
Transfer/prevention	Nat Cat LMI	1,13	1,67	1,33	1,33	0,33	1,00
Transfer/preparedness	Evacuation cover	1,45	1,00	2,00	2,50	0,50	1,25
Transfer/response	Clean up cover	1,70	0,50	3,00	3,00	0,75	1,25
Transfer, response	Repayment holiday cover	1,90	1,50	2,50	2,50	1,00	2,00
Transfer, response	Portfolio hedge	1,67	2,00	2,00	1,50	0,60	2,25
Control	Max possible score	3,00	3,00	3,00	3,00	3,00	3,00
Control	Min possible score	-	0,00	0,00	0,00	0,00	0,00

Figure 16: Summary of risk management measures ratings: accept, avoid, adapt, and transfer (Munich Re, 2024).

To construct [Figure 16](#), feedback was collected from the banks that contributed to the insights presented in this report. The feedback covers the following five categories:

Financial benefit for banks	How does this solution positively contribute to the bank's financial resilience in the face of natural catastrophes or extreme weather?
Strategic benefit for banks	Do other strategic benefits exist for the bank, such as increasing customer stickiness, achieving a more informed view on climate risks, obtaining learnings for future loan origination and portfolio steering, or another potential competitive advantage?
Borrower's benefit	How does a solution benefit the borrower, as the bank's central stakeholder group?
Operational complexity	Is it complex to implement this solution in the bank's current operational set-up?
Compliance risk	Are there any compliance risks associated with implementing this solution?

As depicted in [Figure 16](#), accumulation monitoring was most valued as a comprehensive approach to managing physical risk in their portfolio. With a low compliance risk and operational complexity, such analyses can potentially deliver significant financial impact as losses can be avoided or reduced.

Avoidance is the least preferred approach, as temporary or permanent avoidance of risks through withdrawal from certain markets can only go so far before a bank loses business.

Instead, banks put a clear focus on financing adaptation—namely, resilience loans to either prevent losses ahead of time or, in the form of build-back-better loans, to recover after a catastrophe strikes and to increase resilience against future events.

At present, most banks do not yet see the need to protect their own balance sheet from natural catastrophes and extreme weather. That said, when it comes to risk transfer solutions, it is important to point out that they see a potential competitive advantage in being able to provide financial relief to borrowers affected by a natural catastrophe. As such, repayment holiday insurance protection and clean-up covers received high scorings both for borrower's benefit and strategic benefits for banks.

Generally, it should be emphasised that a comprehensive framework to manage the exposure to natural catastrophes and extreme weather in lending portfolios should always be based on multiple approaches and a mix of different risk management measures. It should comprise thorough exposure analysis and accumulation control, as well as adaptation measures to decrease the impact once such events occur. In addition, risk transfer tools should be part of a bank's toolkit to ensure its own climate resilience as well as that of its clients.

5. Conclusion



In recent years, under the impetus of regulators and management, the financial sector—and banks in particular—have made great strides in their understanding of the consequences of climate change (physical risk). This progress is especially marked in portfolios where the transmission channels of this risk to existing categories of financial risk (e.g. credit risk), especially in retail lending, are best understood.

Access to climate risk models and solutions traditionally used by the insurance industry has enable management to define an appetite for this type of risk and thus contribute to the implementation of risk management actions. Also, the harmonisation of reporting standards in terms of the format to be used to communicate with investors allows for greater comparability between the risk profiles of different financial institutions, thereby speeding up the implementation of these actions.

In the course of this study, we had the opportunity to identify a number of actions that banks can take to manage climate risk. Some of these are already in place and being used to reduce the consequences of natural catastrophes. Others are newer and are based on knowledge traditionally more specific to the world of insurance. These have been tested on synthetic portfolios. Banks wishing to optimise their risk profile will be able to draw on this study to define innovative solutions. Exactly what solutions they deem most appropriate will depend on various factors, including their own exposure, their appetite for risk, and their development strategy,

UNEP FI recognises the value of dialogue between industry participants and will continue to provide ample opportunities both in small groups and in plenary sessions for banks to discuss their practices.



Appendix

Regulatory physical climate stress testing exercises

Noteworthy examples of such exercises include the following.

- **Australia:** Australian Prudential Regulation Authority (APRA), 2021 ([link](#), [link](#))—Banks
- **Europe:** European Central Bank (ECB), 2022 ([link](#))—Banks
- **Europe:** European Central Bank (ECB), 2021 ([link](#))—Banks
- **France:** Autorité de Contrôle Prudentiel et de Résolution (ACPR) & Banque de France (BoF), 2023 ([link](#))—Insurers
- **France:** Autorité de Contrôle Prudentiel et de Résolution (ACPR) & Banque de France (BoF), 2020 ([link](#), [link](#))—Banks and Insurers
- **Hong Kong:** Hong Kong Monetary Authority (HKMA), 2021 ([link](#))—Banks
- **Hong Kong:** Hong Kong Monetary Authority (HKMA), 2023 ([link](#))—Banks
- **Japan:** Financial Stability Agency (FSA) and Bank of Japan (BoJ), 2022 ([link](#))—Banks and insurers
- **Malaysia:** Bank Negara Malaysia (BNM), 2024 ([link](#))—Banks and Insurers
- **Netherlands:** De Nederlandsche Bank (DNB), 2021 ([link](#))—Banks
- **Singapore:** Monetary Authority of Singapore (MAS), 2022 ([link](#))—Banks and Insurers
- **South Africa:** South African Reserve Bank (SARB), 2021 ([link](#))—Banks
- **United Kingdom:** Bank of England (BoE), 2021 ([link](#))—Banks and Insurers
- **United States:** Federal Reserve (Fed), 2023 ([link](#))—Banks

The background of the slide is a close-up photograph of water droplets on a glass surface. The droplets are of various sizes and are scattered across the entire frame. In the background, there are out-of-focus, colorful bokeh lights in shades of orange, red, and yellow, creating a soft, glowing effect. The overall color palette is cool, with blues and purples dominating the background, contrasted by the warm colors of the bokeh.

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